KNIGHT'S

NEW

MECHANICAL DICTIONARY.

A DESCRIPTION OF

TOOLS, INSTRUMENTS, MACHINES, PROCESSES, AND ENGINEERING.

WITH

INDEXICAL REFERENCES TO TECHNICAL JOURNALS

(1876-1880.)

BY

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CHEVALIER DE LA LÉGION D'HONNEUR.
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Illustrated with more than three thousand engravings.

"How Index-learning turns no student pale,
Yet holds the eel of Science by the tail."
POPE.

First Steam Engine.
(Hero, 150 B. C.)

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PREFACE.

THE march of mechanical improvement, in the five years that have elapsed since the publication of the AMERICAN MECHANICAL DICTIONARY, renders it necessary to issue another volume, to keep the work abreast of the time.

The two great Exhibitions, at Philadelphia and Paris, — with each of which the author was officially connected as Delegate or Commissioner, and as a member of the respective juries, — have brought forward a world of new matter; and the records of our own Patent Office, as well as the testimony of our technical journals, bear witness to the fact that at no period has invention been more fertile, more brilliant, or more important.

The difficulty is not in filling a book, but in selecting the more important subjects to fill given bounds; and the lavish abundance of the material has been such that it has necessitated the introduction of a new feature into the work — that of copious references to the technical journals of the period 1876–1880, inclusive, — for fuller statement of the subject matters involved.

The author cherishes most confidently the belief that this feature will meet the approbation of readers and inquirers, and hopes that it may prove to the student in machinery, what William of Malmesbury said of a cognate subject, — the introduction of the Arabic [Indian] numerals into Europe by Gerbert of Auvergne, — "A great blessing to the sweating calculators."

EDWARD H. KNIGHT.

WASHINGTON, D. C., *June 1, 1881.*

POSTSCRIPT.

DR. KNIGHT, whose name is so honorably connected with the AMERICAN MECHANICAL DICTIONARY, did not live to see the final publication of this volume. He was engaged upon the final section when he was taken ill, and died January 22, 1883. It was found, after his death, that he had left the remainder of the work in such a forward state of preparation that the task of editing was confined chiefly to such arrangement of his material as would bring it into the order which Dr. Knight was following. While, therefore, the Publishers share with the patrons of the work the regret that its accomplished editor could not give the final touches to his Dictionary, they take satisfaction in knowing that the work was wholly his.

HOUGHTON, MIFFLIN AND COMPANY.

BOSTON, *November 1, 1883.*

LIST OF SPECIFIC INDEXES.

The Specific Indexes in the following List are to be found in their alphabetical places in the body of the work. Each Index embraces the technical appliances, etc., appertaining to its subject.

LIST OF FULL-PAGE PLATES.

KNIGHT'S NEW AMERICAN

MECHANICAL DICTIONARY.

[An asterisk (*) indicates that an article or description referred to is illustrated.]

A.

A-ba'ting. Properly, *bating*. A steeping process in tanning. See BATING.

A-bat-toir'. A city slaughter-house, where are assembled all the conveniences for butchering the animals and putting the offal into merchantable form. The plans usually involve humane, rapid operations and relatively cleanly and wholesome surroundings. See notices of the abattoirs of

Philadelphia . . . * "*Scientific American Sup.*," 1375.
Brighton. *Lawson* . . "*Scientific American Sup.*," 1939.

Ab'scess Knife. A pocket instrument with a curved blade, the edge on the concave, and contained in a tortoise-shell or ivory handle.

The abscess lancet is a pointed thumb lancet in tortoise-shell scales.

Ab-sor'bent Stra'ta Wa'ter-pow'er. An invention of M. G. Hanrian, of Meaux, France, for utilizing the descent of water in a tube leading from a water-bearing to an absorbent stratum as a source of power. The water passing downward in a vertical well-tube acts upon the buckets of an endless chain, which passes over a wheel above and rotates it.

The invention is described and illustrated in the "*Bulletin du Société d'Encouragement pour l'Industrie Nationale*," and is reproduced in "*Scientific American*," * xxxiv. 159.

Ab-sorb'ing Well. A well or deep pit sunk into an absorbent stratum, and used to carry off drainage.

These wells are used in certain localities in the United States where a retentive stratum of clay rests upon gravel or sand, as in Alexandria, Va., where the drainage of the town is mostly obtained in this way, by well or cesspools dug into the substratum.

Ab-sorp'ti-om'e-ter. An instrument invented by Bunsen for measuring the absorptive power of gases.

A-but'ment. (*Add.*) 7. (*Carpentry.*) The shoulder on a joiner's plane between which and the plane-bit the wedge is driven.

A-but'ment Crane. A crane mounted upon an abutment or pier, of a viaduct, for instance, and ascending with the elevation of the structure.

Figure 1 represents a small crane of this nature, used at the Viaduc de l'Indre. It was fixed on the piles, and then upon the masonry, being readily raised step by step as the structure advanced. In the instance cited two horses were attached to the rope by which the material was drawn up.

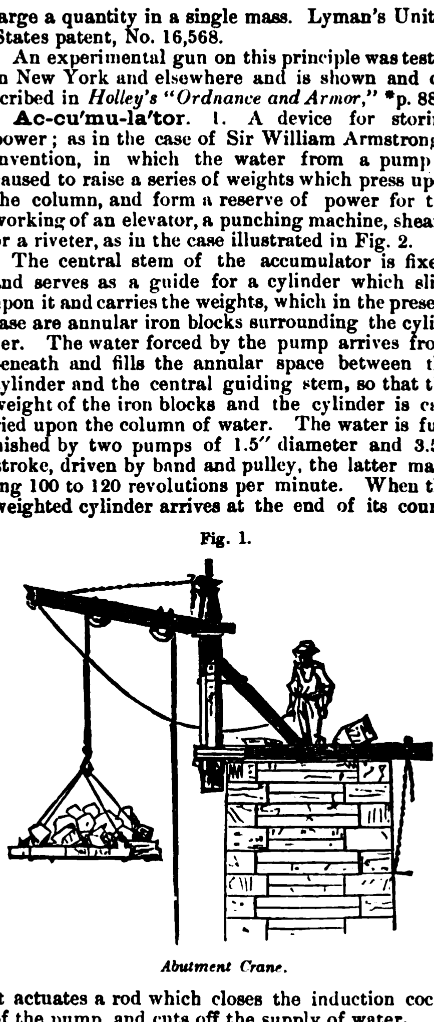
Ac-cel'er-a'tor. (*Ordnance.*) A cannon with additional charge chambers, exploded consecutively in the rear of the shot, in order to give the ball the additional force due to the consumption of a large charge without the strain incident to exploding too large a quantity in a single mass. Lyman's United States patent, No. 16,568.

An experimental gun on this principle was tested in New York and elsewhere and is shown and described in *Holley's "Ordnance and Armor,"* *p. 885.

Ac-cu'mu-la'tor. 1. A device for storing power; as in the case of Sir William Armstrong's invention, in which the water from a pump is caused to raise a series of weights which press upon the column, and form a reserve of power for the working of an elevator, a punching machine, shears, or a riveter, as in the case illustrated in Fig. 2.

The central stem of the accumulator is fixed, and serves as a guide for a cylinder which slips upon it and carries the weights, which in the present case are annular iron blocks surrounding the cylinder. The water forced by the pump arrives from beneath and fills the annular space between the cylinder and the central guiding stem, so that the weight of the iron blocks and the cylinder is carried upon the column of water. The water is furnished by two pumps of 1.5″ diameter and 3.5″ stroke, driven by band and pulley, the latter making 100 to 120 revolutions per minute. When the weighted cylinder arrives at the end of its course

Fig. 1.



Abutment Crane.

it actuates a rod which closes the induction cocks of the pump, and cuts off the supply of water.

The water from the accumulator enters the working cylinder of the riveting machine by one opening and leaves by another, each being provided with valves. A hand lever admits the water to make the effective stroke, the water exit being closed either by the pressure of water or by a spring. The induction valve remains open until the rivet is finished, or for any length of stroke required, as the case may be, and when it is desired to arrest the motion the induction valve is closed.

To make the reverse motion, the water-exit valve is opened by a motion of the hand lever in the contrary direction from that to admit the water; the water runs out of the cylinder, and the piston is driven backward by the action of a small cylinder placed in the piston and which is put in communication with the accumulator by a special pipe and valve.

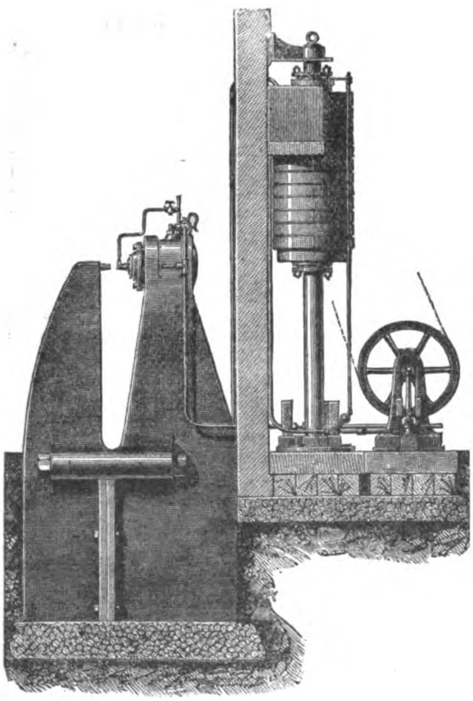
The machine is designed to place 900 to 1,000 rivets of 30 millimeters, in sheet iron of 20 millimeters, in 10 hours: and in smaller works to place 6 to 7 rivets per minute.

Machines in which the suspended swage cylinder is capable of presentation to rivet in any direction are noticed under RIVETING MACHINE, and one is shown in Fig. 4351, page 1949, "*Mech. Dict.*"

The weight-case accumulator is shown in Fig. 4, page 9, vol. i.

A hydraulic riveting machine, with two movable jaws, but without accumulator, is shown in Fig. 4354, page 1949, "*Mech. Dict.*"

Fig. 2.



Sir William Armstrong's Accumulator as applied to a Riveting Machine.

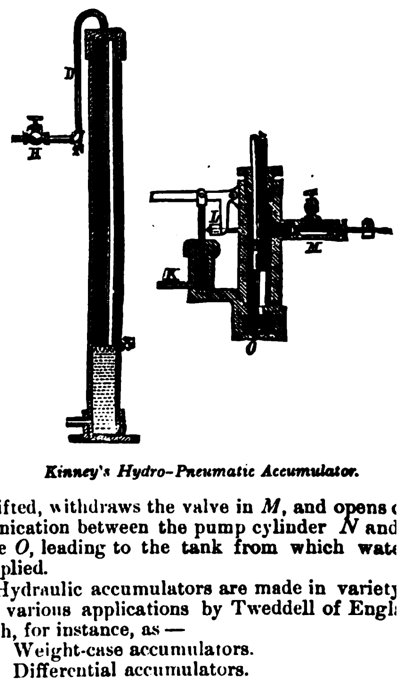
In Kinney's hydro-pneumatic accumulator, compressed air is made the reservoir of power. Like other familiar applications of the accumulator it is designed to be used in connection with the hydraulic press, but the pumps force water into and compress air in vertical cylinders. The pumps work continuously until a stated pressure is attained, when, by automatic mechanism, valves are opened which prevent any further delivery; the pumps merely working the water to and fro till a remission of pressure by the use of some of stored force puts them in service again.

A number of these vertical cylinders are (nected in series by pipes above (*D H*) and belov as to have communication, by which the pressur them is equalized, and for use in charging tl with air at the desired normal tension. See v of a battery of accumulators, page 121, vol. xxx\ "*Sc. American.*"

The cut shows a section of one of the accum tors, and a sectional view of the apparatus for : dering the pump ineffective when the maxin stated pressure is attained.

Proceeding from the gage pipe is a tube *K*, (necting with a small chamber, in which is a plu with a weighted lever whose arm *L*, when the l

Fig. 3.



Kinney's Hydro-Pneumatic Accumulator.

is lifted, withdraws the valve in *M*, and opens (munication between the pump cylinder *N* and pipe *O*, leading to the tank from which wat supplied.

Hydraulic accumulators are made in variety der various applications by Tweddell of Engl such, for instance, as —

Weight-case accumulators.
Differential accumulators.
Basement accumulators.

Morane, of Paris, makes them specifically fo stearine and other chemical industries.

Sellers & Co., of Philadelphia, for riveting chines, etc.

An excellent and compact arrangement is sl in figures 8, 9, 10, 11, article "Presse," Prof. (Laboulaye's "*Dictionnaire des Arts et Manufactu* edition of 1877.

The portable hydraulic accumulator used in works at the St. Gothard tunnel consisted of a tical cylinder, in which a piston traveled, and w had to be loaded to a weight equivalent to 450 per square inch. When the lift was not in o tion, the piston was raised to an extent proporti to the quantity of water introduced, which i turned to the lift when the ingress cock of the l was opened. The diameter of the piston was 11 diameter, and the stroke was 66.93″. The vol of water contained was 26.2 gallons, and the sure on the piston 21.18 tons; the piston and c head weighed 1.18 tons. A load of 20 tons of ingots was suspended to the cross-head at the t the piston. These could be removed at will t cilitate the moving of the apparatus from place to place on the works.

Views of the accumulator and the hydraulic pumps are reproduced in the "*Scientific American Supplement*," * pages 104, 105.

2. (*Electricity.*) *a.* In dynamo-electric machines, one in which the residual magnetism of the field magnets generates in the armature coil a feeble initial current which increases the magnetism of the field of force magnets, thus producing a stronger current, and so on reciprocally to the maximum.

The first patent in which this feature is present is S. Hjorth's English patent No. 2,198, October 14, 1854. The Dane is evidently entitled to the credit of the invention of this most important feature in dynamo-electric machines.

"This principle, of which we discover the application in almost all dynamo-electric machines, is that of the gradual successive increase of power in an electro-magnetic system under the influence of the currents of induction which it develops. It is sufficient for the purpose that a trace of magnetism remains in the armature to produce the amerçage and augmentation of the strength of the armature until the maximum is reached, dependent upon the strength, the resistance of the circuit, and the saturation of the armatures." — "*La Lumière Electrique.*"

The presentation of the memoirs of Wheatstone and Siemens on this subject at the Royal Society Meeting, February 4, 1867, was more than 12 years subsequent to the patent of S. Hjorth, of Copenhagen. See DYNAMO-ELECTRIC MACHINE.

b. See SECONDARY BATTERY. *Faure.*

3. A resilient section, in a chain or rope, usually a drum of caoutchouc, used in British dredge-lines; whereby a certain amount of elasticity is given to the towing rope, preventing the parting of the rope, and giving the man on watch a chance to cast-off, to prevent losing the dredge, which has become fouled or full.

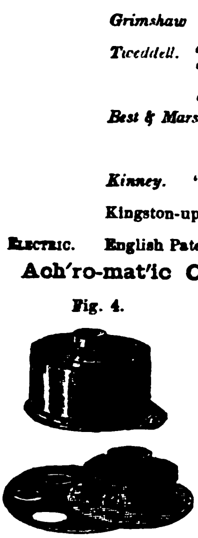
Beardslee's method is to have a certain amount of slack rope held in reserve by a check rope, which breaks when a given strain is brought upon the main rope. See CHECK-ROPE.

See the following references: —

HYDRAULIC. *Merdach.* Paris. "*Iron Age*," xvii., January 13, p. 9.
Grimshaw (Patent April 16, 1878.) "*Iron Age*," * xxi., June 20, p. 7.
Tweddell. "*Railroad Gazette*," * viii. 563.
"*Manufacturer and Builder*," * xii. 105.
"*Engineering*," * xxvi. 271.
Best & Marshall. "*Scientific American Supplement*," * 3659.
"*English Mechanic*," * xxvii. 455.
Kinney. "*Scientific American*," * xxviii. 127.
Kingston-upon-Hull, Eng. "*Van Nostrand's Mag.*," xviii. 211.
ELECTRIC. English Patent. No. 2198, October 14, 1854.

Ach'ro-mat'ic Con-den'ser. (*Optics.*) An attachment to the microscope, used when the light from the concave mirror proves insufficient for any object requiring an intense transmitted light. The condenser slides, by its tube, into the fitting under the stage of the instrument, in which it has to be moved up or down until the focus of its lenses falls upon the object, the light having been previously reflected in the proper direction by the mirror.

Fig. 4.



Achromatic Condenser.

The upper figure shows a simple form; the lower is Webster's form of Crouch's achromatic condenser, provided with a revolving diaphragm having various forms of apertures.

Ach'ro-mat'ic Right'-an'gle Prism. An achromatic form of the right-angle prism, which is an attachment to the microscope designed for throwing rays of light at right-angles, giving more perfect reflection. See RIGHT-ANGLE PRISM.

Ac'id Pump. A pump constructed for drawing off corrosive liquids, emptying carboys, etc.

It is a portable pump, made of glass, and convertible into a siphon by the addition of an extension tube of caoutchouc to the nozzle. A large India-rubber air-bulb produces the vacuum and expulsion, but does not receive any of the liquid. The valves are glass poppets, riveted, while hot, into their seats. The joints in the pump are of accurately ground glass. The nozzle is also so jointed as to be flexible.

See *Nichols'* pump. "*Scientific American*," * xliii. 232.

Also the air-forcing pump of Wyllie, of Hebburn-on-Tyne, England, used for pumping acid to cisterns at a height of 80'. The air-pressure registers from 70 to 100 lbs.

"*Engineering*," 1876.
"*Scientific American Supplement*," * 524.

A'cier-age. A mode of coating a metallic plate with a surface of iron or steel; used to enable stereotype and copper plates to print a larger number of impressions. Invented by Garnier of Paris. See *Photographic Journal*, vol. vi., p. 31 *et seq.*, September 15, 1859.

A'corn-head'ed Bolt. A carriage-bolt with an ornamental head finished in silver, oroide, or gold, and in shape resembling an acorn.

A-cou'me-ter. (*Surgical.*) An instrument for measuring the degree of hearing. *Acoumeter, Acoëmeter, Acousimeter.*

The instrument affords a source of sound of constant intensity and pitch, and is a substitute for the whisper and the watch, each of which has its difficulties. The voice is a complicated sound, the intensity of which it is difficult to regulate, and consonant sounds vary greatly in their audibility at given intensity. The watch has two tones with slight intensity, both audible when close, and but one at a greater distance.

The first acoumeter was made by Schafhäutl, who made use of a ball falling from a certain height as a source of sound. Wolke invented a pendulum acoumeter. He employed an upright sounding-board of fir, against which an oaken mallet was allowed to fall through a given space. Itard had a freely suspended copper ring which was struck by a pendulous metallic ball. The elevation of the pendulum was measured on a graduated quadrant, and the intensity of the tone thereby determined.

Politzer's acoumeter gives a sound of unvarying character, and the estimate of the degree of hearing of the patient is obtained by making the clicks of the instrument more or less remote from the ear. It consists of a steel cylinder 4 millimeters in diameter and 28 millimeters long, set in vibration by the blow of a small steel hammer, and applied in the vicinity of the external ear. The cylinder is fastened to a small column of vulcanite, the hammer being freely suspended from a slot in this column by means of a pin. The tail end of the hammer shaft, projecting behind and beyond the column can be depressed to a certain point, and, when liberated, allows the hammer to strike the cylinder from a certain height, thereby insuring a certain intensity of tone. Half rings being fastened at either end of the vulcanite column, the instrument may be held between the thumb and forefinger, the middle finger being free to set the hammer in motion.

Fig. 5.

Politzer's Acoumeter.

A small disk is fastened to the column by means of a pin, and is used for testing perception for tone conduction from the mastoid. The illustration shows this application of the instrument.

The determination of the hearing distance is usually conducted by approaching the instrument to the ear until the patient announces that he begins to hear its tone, and it is well to require him to count the number of blows.

"*Archives of Ophthalmology and Otology,*" vi., 603 *et seq.*

A'cou-sim'e-ter. A synonym for acoumeter. *Itard.* See ACOUMETER.

A-cous'tic Tel'e-graph. One which transmits sonorous vibrations. The articulating telegraph known as a telephone, is at present the acme of the art. The United States patent of Lancelot H. Everitt, of New Orleans, dated March 24, 1868, and No. 75,886, is a curious item in the history of the art. See, also, his patent No. 40,616, dated November 17, 1863. The summation states that "sounds produced at one end of the telegraph are transmitted to the other end along a wire."

The first claim (of four) may be inserted (Patent of 1868): —

"*Claim.* — 1. An acoustic battery for telegraphing, a machine which creates and modulates sounds, that, when arranged and sounded under symbolic formulæ, they are made to represent and express all the letters of the English alphabet and all Arabic notations, and when thus evoked into existence the machine reflects these sounds and transmits them through naked wire, buried in the land or water, to their destination, where they impart their various interpretations with such distinctness and order to the auditor who receives them as to become the most important and efficient commissioners of intelligence."

Ac'ti-nom'e-ter. An instrument for measuring the power of the sun's rays.

Herschel's actinometer (described on page 11, "*Mech. Dict.*"), consisted in a small open receptacle, attached to a fixed standard.

Pouillet's pyrheliometer (described and illustrated on p. 1837, "*Mech. Dict.*") was of polished silver. The vessel exposed to the solar rays contained 100 grams of water, was 100 millimeters in diameter, and 15 millimeters in thickness. It was covered on the exterior with lampblack. This instrument could not, however, be used in winter when the temperature fell below 32° Fah.

To avoid the various defects of the instrument and to obtain exact measurement of the intensity of solar heat, Capt. John Ericsson invented the actinometer, or solar calorimeter. The instrument is fixed on a movable table within a rotary observatory. It consists of a copper receptacle, filled with water, and covered with lampblack on the exterior exposed to the sun. A thermometer placed in the liquid indicates variations of temperature, and an agitator, moved by a belt passing over a little pulley, keeps the water in motion and insures its equable temperature. The water-vessel is placed in the bottom of a chamber, the flaring mouth of which receives a plano-convex lens whereby the rays are concentrated upon the calorimeter. In this chamber as nearly a perfect vacuum as is possible is maintained, and a water jacket is provided so that the interior temperature may be constant.

See "*Scientific American Supplement,*" * p. 1103, where is also shown a modified form of instrument, also by Ericsson, for obtaining the measure of the intensity of the solar radiation at a given moment.

An apparatus to measure and record the variations of daylight throughout the day, has been invented by Herr Kreusler, of Bonn.

The apparatus has a special bearing upon plant physiology, and consists of a drum, fixed with its axis in the plane of the meridian, and adjustable so as to be at right angles to the sun's rays. This drum has its border divided into 24 hours, — 12 noon and 12 midnight being in the meridian plane. A strip of paper, sensitized with solution of bichromate of potassium, and having divisions which correspond to those on the drum, is placed round this. A second drum closely surrounds the first, and is turned by clock-work (from which it can be detached) once in 24 hours, in the direction of the sun's apparent course. The second drum has a slit for admitting light to the paper; its width is such that any point on the paper is exposed 20 seconds as the slit passes over. The whole apparatus is placed in the open air under a glass bell jar. The paper strip is placed in its right position at night or under artificial shade (to avoid coloration), and the outer drum slid over and so attached to the rotating axis that the "insolation slit" is opposite the hour then present. The slit then begins to move round the inner drum correspondingly to the sun's course. The impressed slip, when removed in the evening, may be *fixed* by dipping in water and drying between blotting paper, and shows a mostly continuous succession of bands of various shades of brown. For comparison, Herr Kreusler made a scale of 10 degrees of darkening, exposing strips of the paper a given time under different angles of incidence of light. Bands of the experimental strip that appear homogeneous are then measured with reference to breadth and intensity, and the sum of the products of those quantities is taken as a measure of the action of light rays falling on the instrument in a given time.

Ac'tion. (*Fire-arms.*) Used generally, in reference to the position or some characteristic of the firing mechanism; as *side action, snap action,* etc.

Specifically — the iron body which lies between the barrels and the stock.

Back action when the locks are bedded into the stock alone.

Bar action when the locks are bedded partly into the stock and partly into the action. Also called *fore* action.

Ac'tu-al Cau'te-ry. The application of actual heat, as of the searing iron or galvanic wire, for searing or excision, as distinct from moxas or caustics. The latter are included under the terms *potential* or *virtual* cautery. See CAUTERY.

Ac'u-press'ure Pin. A needle for arresting surgical hemorrhage by insertion and torsion.

Fig. 114*b*, p. 38, Part I., * *Tiemann's "Armamentarium Chirurgicum."*

A'cus. A needle. The term is especially used in reference to surgical needles. A number are mentioned on p. 12, "*Mech. Dict.*" To these may be added the

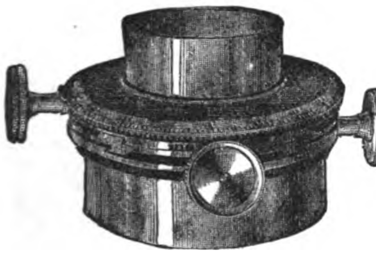
> *Acus capitata* — a pin ;
> *Acus invaginata ;*
> *Acus paracentica*, or *acus paracentelica ;*

synonyms for the *a. triquetra.*

See also ACUPUNCTURATOR ; DERMOPATHIC INSTRUMENTS ; HYPODERMIC SYRINGE, etc., "*Mech. Dict.*"

A-dapt'er. 1. (*Optics*). *a.* An attachment to the microscope for centering or throwing out of center the illuminating apparatus ; it is moved by rack and pinion. In the form shown it is specially contrived for Beck's "International" microscope.

Fig. 6.



Adapter.

b. In the case of object glasses made by different makers, and having different screws, a means for enabling such to be fitted to a body not specially adapted to receive them.

c. An arrangement on a stand to facilitate the use of the object-glass as a condenser.

2. In physical and chemical apparatus, a tube of varying sized ends for uniting apparatus of different sizes. Made of glass or rubber.

Add'ing Pen'cil. A small pencil-shaped adding device or arithmometer, usually having a metallic case and longitudinal slot with graduations and a traveling pointer, and a numbered disk.

Smith & Potts, * "*Sc. American Sup.*," page 542.
* "*Scientific American*," xxxv. 86.
October 21, 1876.
Leuner, Ger., * ('*Deutsche Gewerbe Zeitung*," reproduced in "*Sc. Am. Supplement*," * pp. 2701-2.
Pascal's Adding Machine, "*Sc. Am. Supplement*," p. 742.

Ad'it. (*Mining.*) A level. A horizontal drift or passage from the surface into a mine.

The Joseph II. mining adit, at Schemnitz, Hungary, begun in 1782, was finished October, 1878. Its length is 16,538 meters, a little over $10\frac{1}{4}$ miles; that of the St. Gothard tunnel being 14,920, and the Mont Cenis tunnel 12,233 meters.

The object of the adit is the drainage of the important gold and silver mines at Schemnitz. It furnishes a geological section more than ten miles in length, and gives not only valuable information as to the downward prolongation of the lodes known in the upper levels, but some new ones have been traversed, and the entire series of rocks, with their mutual limits as well as modifications and occasional transitions, are disclosed without interruption.

The entire cost of the tunnel was 4,599,000 florins, — about $2,300,000. Its height is 3 meters ; width, 1.6 meter. By the methods of working employed during the last three years it would have taken but 27 years to do the entire work.

"There are 19 shafts at Pribram, which are connected at various levels. The deepest is at Adalbert, which has reached the depth of 1,020.1 meters and has thirty levels. It is the deepest perpendicular shaft in the world. At the thousand-meter level a station for magnetic observations is established. The underground workings also communicate with one another through the great drainage tunnel "Joseph II.," which is 21,906 meters long. All the water of the mines is raised to the level of this tunnel, which is 445 meters above sea-level. The total length of the galleries is 245,089 meters." — *Prof. James D. Hague*, "*Report on Mining Industries*," "*Paris Exposition Reports*," iv. 297.

The length in excess of the former statement is due to the inclusion of some branch adits.

The Rothschonberger water-adit at the Freiberg mines was completed in 1877. It conducts the water of the mines to the Elbe. The tunnel is ventilated by eight air-shafts, and lies about 400 feet below the deepest previous Freiberger water-adit. It has a uniform height of 9.84 feet, with a somewhat smaller breadth. The present length of the adit with its ramifications is 43,000 meters (all of which length is now in use), and will be when completed over 51,000 meters, or $31\frac{1}{2}$ miles. The cost of the tunnel is estimated at 12,000,000 marks or $4,000,000, and will be paid for by a tax on all the mines which it directly benefits. The gradient of the floor is only 0.03m. in 100 meters.

Ad-just'a-ble-Beam' Plow. One which has a beam adjustable on a pivot upon the standard so as to throw the nose of the beam in or out of land, to adapt the implement to two or to three horses.

In one instance the beam has a pivotal connection above the standard, its rear end being adjustably attached to a heavy rod that connects the handles. The beam has what may fairly be called a *center connection*, the pivotal point being *in the middle of the work*, or center of resistance.

Ad-just'a-ble-bed' Press. A stamping, cutting or drawing press, for sheet-metal work, which can be set with level or inclined bed, to suit the requirements of special work ; notably, the making sheet-metal pans, box covers and bottoms, and similar ware.

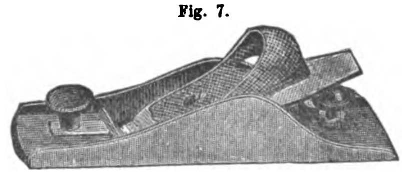
Ad-just'a-ble Plane. A joiner's plane, so arranged that the angle of the bit relative to the bed is adjustable to suit the kind of wood being worked.

The angle of the bit varies with the work : the harder the wood the steeper should be the pitch ; which may vary from 43° to 60° ; indeed, if the spokeshave be included, it may be said from 25° to 60°. The usual angle of the ground plane-iron is a bevel of 25° ; in the spokeshave the usual *back* of the bit becomes the *bed*.

The pitch of planes is considered under PITCH, 6, *Planes*, p. 1793, "*Mech. Dict.*"

See, also, *Holtzapffel's* "*Turning and Mechanical Manipulation*," vol. ii.

Fig. 7.



Adjustable Plane.

Ad-just'a-ble Vise. One the jaws of which may be inclined, being pivoted on the horizontal axis, so as to secure any desired presentation of the work.

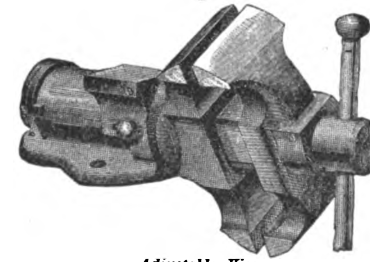
Fig. 8 shows a form of vise, the jaws of which maintain their parallelism, and are concertedly adjustable in a vertical circle to give an inclined presentation, or to bring either of the respective pairs of jaws into position for work.

Ad-jus'ter. (*Surgical.*) An instrument for bringing into coaptation the parts in case of ruptured perineum.

Dr. Agnew's, Fig. 537, p. 115, Part III., *Tiemann's "Armamentarium Chirurgicum,"*

Ad-just'ing Cone. An oculist's instrument for measuring the distance between the axes of the eyes.

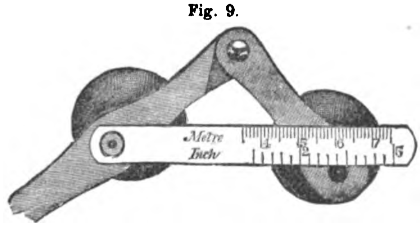
Fig. 8.



Adjustable Vise.

The instrument is shown in Fig. 9. Being held in the right hand, a distant object should be looked at with the right eye through the hole in the right hand cone; the other cone, fixed to an adjusting

Fig. 9.



Adjusting Cone.

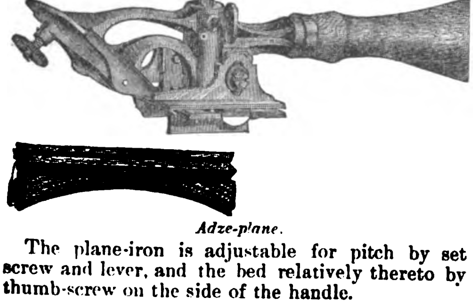
arm, should then be moved backwards and forwards until the left eye sees the same object through the aperture in the left cone, and the two holes appear as one. The distance between the eyes is then indicated on the cross bar, one side of which is divided to inches and tenths, the other to millimeters.

Adze. A wood-cutting tool used with a sweeping blow, and with a blade at right angles to the length of the handle.

Some memoranda of history and principles are given on pp. 16, 17, "*Mech. Dict.*" Fig. 10 shows strictly modern varieties of American patterns.

Adze-plane. A rabbeting and molding tool, especially adapted to solid paneling and used by coach and pattern makers. It has gage adjustments for depth and width of cut and for sweep in circular or crooked work.

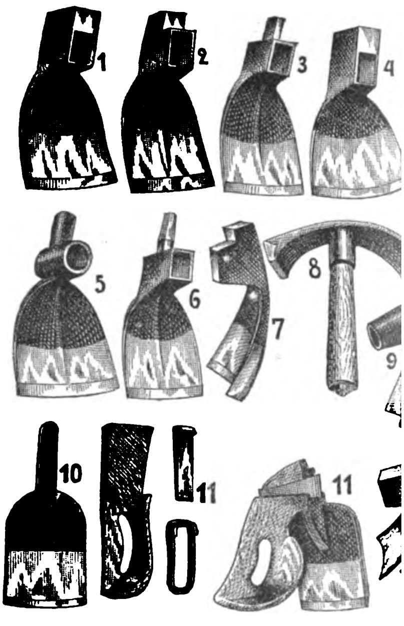
Fig. 11.



Adze-plane.

The plane-iron is adjustable for pitch by set screw and lever, and the bed relatively thereto by thumb-screw on the side of the handle.

Fig. 10.



Adzes.

1. Flat head pattern.	7. Canoe pattern.
2. Square head pattern.	8. Cooper's pattern.
3. Spur head pattern.	9. Special pattern.
4. Railroad pattern.	10. Stirrup pattern.
5. Round eye pattern.	11. Special pattern.
6. Ship carpenter's pattern.	12. Special pattern.

The small slotted arms attached to the sid the adjustable fulcrum are gages for depth, a slotted piece on the bottom regulates horiz distance from a guiding edge.

The cut shows an adze-plane and specime work.

The tool is perhaps well named as partakii the characteristics of the adze and plane ; b is also nearly related to the spokeshave, th handled in a different manner.

A'er-a-ted Bat'ter-y. (*Electricity.*) O which the exciting liquid is constantly agitate air injected into the bath in order to depolariz negative element.

Byrne, * "*Scientific American Sup.*," Fig. 36, page 252 * "*Telegr. Jour.*," vi. 222, 269, particularly us galvano-cautery.

Air as a depolarizer in a single fluid cell is f in *Pulvermacher's* battery, "*Teleg. Jour.*," vi. 3

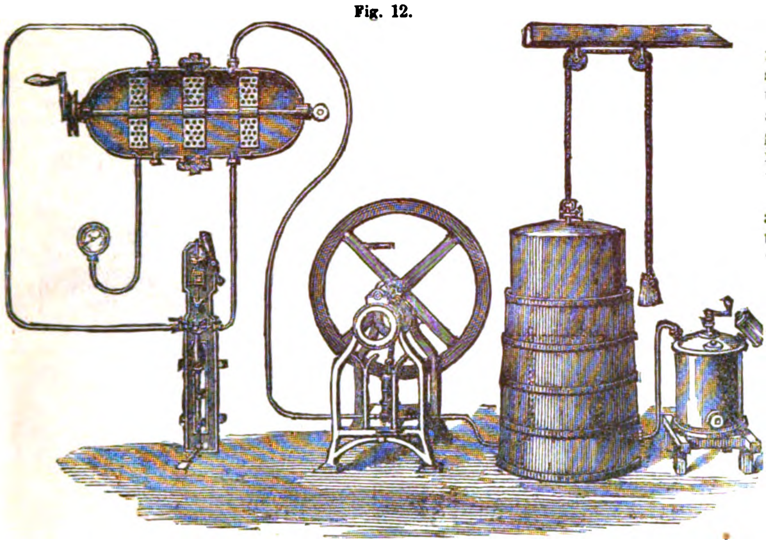
A'er-a-ted Wa'ter Ma-chin'er-y. Var ly known as "Soda-water apparatus," or "Ma ery for making carbonated waters," the latter l the preferable title.

The subject has been considered under the mer title on pp. 18–20 and 2236, 2237, "M *Dict.*" Some improvements will be noticed u CARBONATED WATER MACHINERY (which and certain specific heads.

Hayward, Tyler & Co.'s (British) aërated v machinery, shown at the Paris Exposition, 18 described in "*Engineering*," * xxvi. 287, 288, 349–352.

The principle of an apparatus intended for i ing sparkling liquids, such as sparkling wines, c ginger-ale, etc., is readily seen in Fig. 12, whi a hand-worked apparatus capable of produ

Fig. 12.



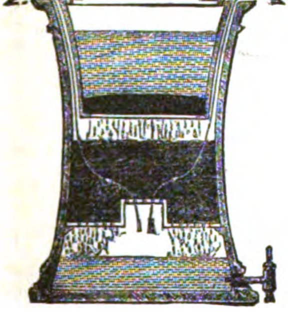
Non-continuous Aërating Machine.

sixty dozen quart bottles per day. It is on the non-continuous principle, the agitator chamber on the left being charged from time to time with the liquid. This is charged by means of the gas-pump, which receives the carbonic acid from the gas-holder, and that in turn from the generator on the extreme right.

The wine or other liquor to be charged with carbonic acid gas is poured through the gun-metal cap on top, into the cylinder, which should be filled about three-fourths full; the gas is then drawn from the gasometer by the gas pump, and forced into the cylinder containing the wine; when the indicator shows the requisite pressure, the working of the pump is stopped, and the agitator in the cylinder turned a few times, which will cause the wine or other liquor to take up the gas; a further quantity of gas is then supplied by means of the pump, and the gas must be renewed as the liquor is drawn off into the bottles.

The bottling apparatus, shown beneath the cylinder, has two cocks fitted into the cone or carriage, through which the cork is driven; one is for supplying the liquor from the bottom of the cylinder, the other takes the surplus gas and foam or froth; it is connected by a pipe to the top of the cylinder, and by this means none of the liquor or gas is wasted.

Fig. 13.



British Aërating Filter.

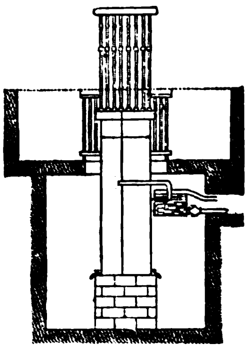
A'er-a-ting Fil'ter. One in which a current of air is conducted through the descending water.

That made by the Sanitary Engineering Co., of London, is of earthenware (Fig. 13). The upper chamber has a movable pan with a block of mineral carbon. The lower has granulated carbon. The water chamber beneath being closed, the descent of water displaces the air, which ascends through the granulated material in contact with the water.

A'er-a'tor. The apparatus for aërating the water for the fish-tanks at the Aquarium of the Trocadéro, shown in Paris, is the invention of M. Gauckler, who was also the author of the original plan of the aquarium. See AQUARIUM.

The water is that of the Vanne aqueduct, and as it is obtained very near the source of the river it is deficient in oxygen, which is essential to the life of the fish, and is supplied by the apparatus shown in Fig. 14. It is placed in the center of the system of tanks in the aquarium, and consists of an application of the principle of the Catalan trumpet (*trompe*) used to operate the bellows in the iron smelting furnaces of Spain, Elba, and elsewhere. It has a number of glass tubes into which water is forced by hydraulic pressure, carrying with it bubbles of air.

Fig. 14.



Gauckler's Apparatus for Aërating the Water of the Trocadéro Aquarium. (*Vertical Section.*)

Apparatus for aërating distilled water on board ship, belongs under DISTILLING APPARATUS.

A-e'ri-al Light Ap'-pa-ra'tus. A balloon, kite, or parachute light, used, in a military sense, for discovering the position, etc., of an enemy's camp at night. As used in recent experiments at Chatham, Britain, it consists of a kite covered with loose canvas, having a parachute provided with an arrangement for exploding the fire-balls which are sent up the line holding the kite. The fire-balls being thus discharged, illuminate the surrounding country for a considerable distance.

A-e'ri-al Pho'to-graph'ic Ap'pa-ra'tus. An apparatus for taking negatives from elevated positions. The camera is supported by a balloon steadied by guys, and the slides operated by cords from the ground. It is especially designed for mapping out an enemy's position, reconnoitering, etc. — "*Photographic News.*"

A-e'ri-al Te-leg'ra-phy. (*Electricity.*) A method of telegraphing between points, dispensing with wires, and using the aërial currents. The current is reached by flying kites to a certain height at each point, the strings being copper wires connected to instruments at the ground ends of the wire. Professor Loomis states that messages have been thus sent by him between points twelve miles apart, using the atmospheric currents only in the interval between the kites.

A'e-ro-hy'dric Blow'pipe. A blow-pipe for burning a mixture of hydrogen and air, giving an intense heat, and used for various metallurgic works, such, for instance, as soldering platinum with gold, the brazing of copper, and the autogenous soldering of lead, without the use of an alloy of tin. The latter use is especially called for in the production of leaden vessels to be used in the making of sulphuric acid. One form of the apparatus is shown in Fig. 738, p. 309, "*Mech. Dict.*" The compound blow-pipe is the invention of Dr. Hare, of Philadelphia; he used the combination of oxygen and hydrogen. The aëro-hydric was invented by the Count de Richmont, of France. It is elaborately shown in Figs. 395–398, article "CHALUMEAU," *Laboulaye's* "*Dictionnaire des Arts et Sciences*," vol. i., edition of 1877.

A'er-o-phone. 1. An invention of Edison for amplifying sound.

Its object is to increase the loudness of spoken words without impairing the distinctness of the articulation. The working of the instrument is as follows: —

The magnified sound proceeds from a large diaphragm, which is vibrated by steam or compressed air. The source of power is controlled by the motion of a second diaphragm vibrating under the influence of the sound to be magnified.

There are three distinct parts to the instrument:

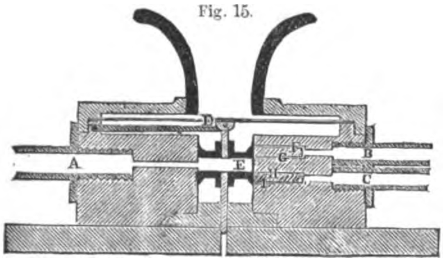
A source of power.

An instrument to control the power.

A diaphragm vibrating under the influence of the power.

The first of these is usually compressed air, supplied under constant pressure from a tank.

Fig. 15.



Edison's Aërophone.

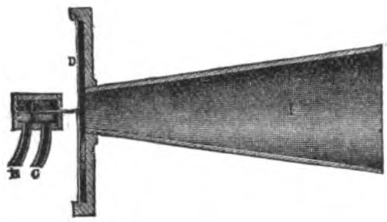
The instrument is shown in section in Fig. 15, and consists of a diaphragm and mouth-piece similar to those of a telephone. A hollow cylinder is attached by a rod to the center of the diaphragm. The cylinder and its chamber, E, will therefore vibrate with the diaphragm. A downward movement lets the chamber communicate with the outlet H, an upward movement with the outlet G. The compressed air enters at A and fills the chamber, which in its normal position has no outlet. Every downward vibration of the diaphragm will thus condense the air in the pipe C, at the same time allowing the air in B to escape *viâ* F. An upward movement condenses the air in B, but opens I.

The diaphragm D is shown in section in Fig. 16. Its center is attached by a rod to a piston, P, moving in a cylinder. The pipes C and B are continuations of those designated by the same letters in the preceding figure.

The pipe C communicates with one chamber of the cylinder, and B with the other. The piston, moving under the influence of the compressed air, moves also the diaphragm, its vibrations being in number and duration identical with those of the diaphragm in the mouth-piece.

The loudness of the sound emitted through the directing tube F is dependent on the size of the diaphragm and the power which moves it. The former

Fig. 16.



Aërophone.

of them is made very large, and the latter can be increased to many hundred pounds pressure. — *G. B. Prescott.*

"*Engineer*," * xlvi., 425, Figs. 32, 33.

2. An invention of Edison's, better known as a *megaphone*. It consists of a horn for talking, and a pair of horns communicating by elastic tubes with the ear, for listening. See MEGAPHONE.

An apparatus by Prof. Mayer for ascertaining the direction of sound is known as a *topophone*, and may be referred to in this connection. See TOPOPHONE.

A'er-o-phore. A respiratory apparatus containing a reservoir of vital air or revivifying composition.

Fig. 17.

Schultz's Aërophore.

The aërophore devised by Herr Schultz, captain of the fire brigade at Aschaffenburg, Bavaria, depends upon the regeneration of the exhaled air, the oxygen being reproduced as it is consumed. It consists of a simple reservoir of sheet-iron, into which the products of respiration are returned. The respired air is led from the mouth by a flexible pipe to a cylindrical tube containing a layer of wadding to intercept dust, and pieces of pumice-stone saturated with caustic potash absorb the carbonic acid. This tube is in direct communication with the reservoir, as is also another tube on the other side containing pumice-stone saturated with dilute acetic acid and sprinkled with crysta of permanganate of potassium. This latter is f(replacing the oxygen absorbed in respiration, and f(adding a certain amount of humidity to the ai which makes it fresher for breathing. Fig. 1 shows a German fireman provided with the appar tus. The flexible tubes for inhalation and exhal tion are connected with the bottom of the reservoi The apparatus only weighs about 10 lbs., and ma be used for half an hour together.

The *Galibert* and the *Rouquayrol & Denayrouze* respirators are shown on p. 1923, * "*Mech. Dict.*"

See, also, "*Scientific American*," * xxxviii. 99.

A'er-o-steam En'gine. See theory of the engine by Henderson, quoted by Thurston, "*Vienna Expos. Rep'ts.*," ii. 151–160.

"*Engineer*" contains a description and illustration of *Wenham's* "heated air engine," the details being taken from a paper read by C. W. Cooke before the "Institute of Mechanical Engineers," in London. It belongs to that class in which the fire is inclosed, and fed by air pumped in beneath the grate to maintain the combustion, the whole, together with the gaseous products of combustion, being made to act upon the piston.

In addition to the British and United States patents cited on pp. 20–23, "*Mech. Dict.*," the following British patents may be noted: —

Clark, 1,449 of 1863. Air is driven into the furnace, is heated, rises with the products of combustion, meets a fine spray of water, which is instantly converted into superheated steam, and the whole passes to the cylinder.

Miller, 932 of 1864. Steam and air combined.

Boulton, 1,291 of 1864. Steam and air combined; mingles gas also.

De Rosen, 5,398 of 1826. Volatile products of combustion mingled with steam.

Vrooman, 3,083 of 1861. Charges air with moisture, and then heats it in spiral passages.

James, 1,445 of 1864. High-pressure steam and compressed air. The air is compressed by the piston in the lower part of the cylinder, and the steam then admitted to it.

Stevens, 1864. Vapor of oil is added to air, steam, and volatile products of combustion.

Cruickshanks, Eng. Pat., No. 8,141, of 1839. Expands air (previously condensed) by heat obtained from liquid fuel injected upon red-hot clay balls.

Hall, 4,935 of 1824, decomposes steam by passing it through red hot fuel, whence the gases, together with those resulting from the fuel, pass to the working cylinder.

A'er-o-ther'a-py Ap'pa-ra'tus. An apparatus in which a patient is inclosed in a chamber of compressed air as a therapeutic.

It is the opposite of the *depurator*, described on p. 687, "*Mech. Dict.*," in which the expulsion of morbid matter from the excretory ducts of the skin is expedited by withdrawing the pressure of the atmosphere from the surface.

The aërotherapy apparatus is the invention of Dr. Carlo Forlanini, of Milan, Italy. It is claimed that by increasing the pressure, the air is forced into the minutest passages of the lungs, and a much greater oxygenation of the blood is secured. This is realized by those who descend into the deep caissons used in laying subaqueous foundations. Fire and lamps also burn with great energy under these circumstances.

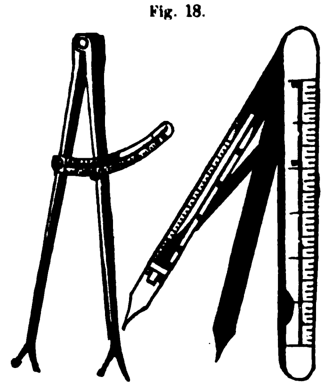
A view of the Forlanini apparatus is reproduced in the "*Scientific American*," * xxxv. 63.

See, also, *Ware's* compressed-air bath shown at Fig. 67, page 31, "*Mech. Dict.*"

Æs'the-si-om'e-ter. (*Surgical.*) An instrument for the determination of the cutaneous sensibility. Invented by Dr. Sieveking, of London, 1858. In the original form it was simply a modification of the common beam-compass. See Fig. 279, page 87, Part I., *Tiemann's* "*Armamentarium Chirurgicum.*"

The "*Medical Record*," 1872, gives a drawing and description of an instrument by Dr. Alfred L. Carroll, constructed on the general plan of the two-legged compass, but with each free extremity divided into two points, one blunt and the other sharp. (Left-hand instrument in Fig. 18.) This arrangement enables the observer to determine the comparative sensibility to contact and pain at different distances by simply substituting the one pair of points for the other. Dr. Clymer provides himself with two pieces of cork or two small shot, and accomplishes the same result by placing them upon the sharp points of the ordinary instrument when he desires to test the sense of contact without danger of exciting that of pain.

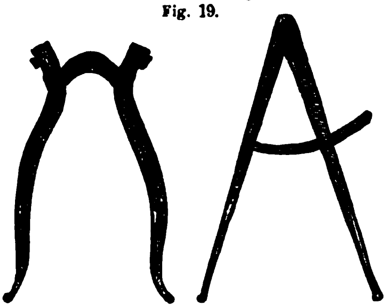
Fig. 18.



Æsthesiometer.

The right hand instrument, by Dr. Vance, exhibits a completely portable instrument. When closed, the points are in coaptation, and are received in the case the same as the blades of a knife shut into its handle. When opened and the points separated, the distance between the points is denoted by the position of the slide, which is so arranged as to move over a scale engraved on one arm of the æsthesiometer. The scale is divided into inches and twelfths of an inch. The points can be separated to the extent of 6″. When closed, the instrument is $4\frac{1}{2}''$ in length.

Fig. 19.



Dr. Elberg's Æsthesiometer.

Fig. 19 shows Dr. Elberg's Æsthesiometer with electrode points.

See description of the principles and application of the instrument, under ESTHESIOMETER, p. 809, "*Mech. Dict.*" Also, article by Dr. Reuben A. Vance in "*Canada Lancet*," iv., Feb. 1872; and "*Medical World*" of the same year.

Af'ter Wale. (*Saddlery.*) The body of a collar; the portion against which the hames bear, and which rests upon the shoulders of the horse. The forward part of the collar is the *roll*.

Aft'gate. The tail-gate of a sluice or lock.

Ag'ate. A burnisher. So called because frequently made of that hard material. Blood-stones and dog's teeth are also used for burnishers.

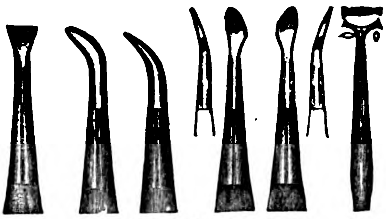
Ag'ate Bur'nish-er. A burnisher specially used in dental operations and bookbinding; in the former for surface-finishing cement or oxychloride fillings; in the latter for smoothing the surface of gold leaf on book edges and covers.

Fig. 20 shows some forms of dentists' burnishers.

A-ga've. Nets of agave fiber were shown in the Agricultural Hall, Centennial Exhibition, from the Argentine Republic.

"The *pita* (Mexican *Itle*) is a variety of the agave, very prolific and yielding fibres varying in quality from the coarsest hemp to the finest flax. It is used for the manufacture of thread, cordage, hammocks, paper." — *Squier's* "*States of Central America*," New York, 1858. See, also, his "*Notes on Central America*," 1855.

Fig. 20.



Dentists' Agate Burnishers.

Age'ing. Imparting the characteristics of flavor of ripeness or age, as of clay, wine, whiskey, calico, etc. See p. 23, "*Mech. Dict.*"

Sweet's appara'tus for ageing distilled spirits is shown in "*Scientific American Supplement*," * p. 181.

Ag-glom'er-a'ted Bat'te-ry. (*Electricity.*) One in which the deploarizing salt is united by a cement and pressure so as to form a solid block with and around the negative, the porous cup being dispensed with. The improved Leclanché is an instance.

Niaudet (American Translation), * 189.
"*Telegraphic Journal*" . . . * vii. 3.

Beaufils' sulphate of mercury battery has a solid depolarizer. "*Telegraphic Journal*," * vi. 397.

Ag'gry. Glass beads found in Ashantee and Fantee countries, and very highly valued.

They are supposed to be of ancient Egyptian manufacture. They are of many colors and patterns, the shades well marked or delicately blended, many of them resembling agates, for which they have been mistaken. The *glain neidyr*, or holy snake-beads of the Druids, found in Wales, may have had a similar origin, as the Phœnicians traded to both places, and carried Egyptian products. There are abundant evidences in the museums to prove the capability of the ancient Egyptian glass-workers to produce these objects of art. See list of Egyptian glass in Museum of "New York Historical Society," on p. 973, "*Mech. Dict.*"

Ag'i-ta'tor. 1. A stirring device used in the petroleum refining process for mixing the oil with the refining and deodorizing materials. It was formerly a series of revolving scoops, but the work is now done by blowing in air which bubbles up through the oil.

A pump used for this purpose is shown in "*Manufacturer and Builder*," * x. 128.

The oil is treated with one and one half per cent. of sulphuric acid, by which it is bleached. It is then washed with a solution of caustic soda, followed by a little ammonia, by which the acid is neutralized.

2. A device in the carbonated water apparatus to stir the gas and water together and cause the absorption of the former by the latter. See CARBONATED WATER APPARATUS; see also cuts on p. 2236, "*Mech. Dict.*"

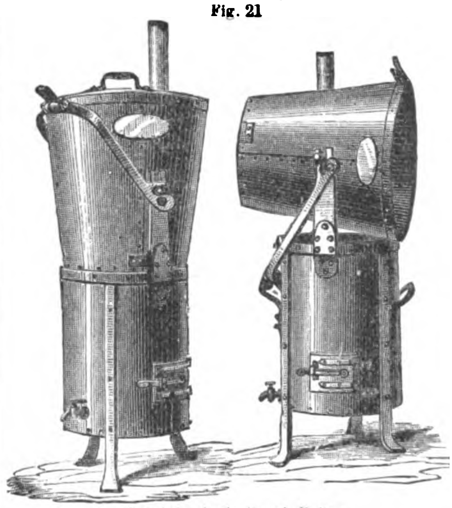
A-graffe'. (Fr. *Agrafe.*) A clasp. A hook, eyelet, or wire, by which a piano wire is firmly held, so as to prevent the translation of vertical vibration to the portion of the string between the bridge and the pin.

Decker's agraffe is a stud secured directly to the wrest-plank.

Ag'ri-cul'tu-ral Boil'er. A boiler or caldron for cooking food for animals.

The cooking apparatus made by Fouché, of Paris is shown in Fig. 21. It is made in copper or iron and is adapted to burn all species of fuel. One

Fig. 21

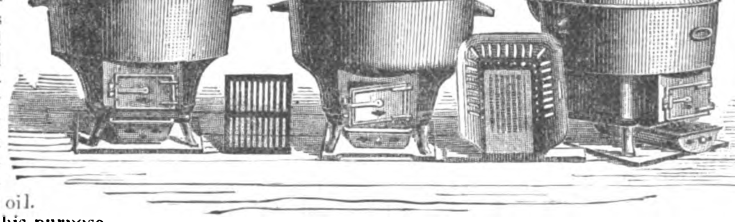


Fouché's Agricultural Boilers.

figure shows it closed for cooking, and the other position for discharging its contents.

The caldron is suspended on posts rising fr

Fig. 22.



Bodin's Agricultural Boiler.

the sides of the furnace. When at work, the tom of the caldron fits within the top of the nace, cleats on the vessel resting on the rim of lower section.

When the caldron is to be discharged, it has to be lifted clear of the furnace so that it may swing clear. This is done by means of the bail, cams on which raise the axis of suspension of the kettle, and it may then be tipped, as shown in the figure.

Bodin's agricultural boiler is made in several forms, and is of cast-iron.

It is provided with grates for wood or for coal, and has additional steaming chambers, which may be fitted on when required to increase the capacity, the contents of each being kept distinct.

It is easily transported in sections, economical of fuel, and ready for immediate use in any place without setting in masonry.

The agricultural boiler of *Tritschler*, of Limoges, France, is portable, and has a circulation of water from the water-bath to the interior caldron, and

FIG. 23.

Tritschler's Circulating Boiler.

vice versa. The water flows over the edge into the inner vessel, and out again at holes in the bottom. The flame courses twice around the caldron, following a helical flue.

Beard's hog scalding kettle and food-boiler is an oblong sheet metal tub with a fire under one end, like some species of evaporators.

Banks' farmers' boiler is circular, of sheet-metal, hung on trunnions in a furnace, the front part of which is hinged, and is moved aside when the caldron is to be tipped to discharge the contents.

The last two mentioned are made in Chicago.

Ag′ri-cul′tu-ral En′gine. A steam-engine for farm work. Used especially in this country for threshing, but having a very much wider use in Britain and France. It is specially constructed when designed for traction, and for plowing. See PORTABLE ENGINE STEAM PLOW.

Ag′ri-cul′tu-ral Im′ple-ments. See under the following heads: —

Agricultural boiler.
Aplatisseur.
Apple grinder.
Artificial mother.
Asparagus buncher.
Aspirator winnowing machine.
Baling press.
Balk.
Barb wire.
Barley fork.
Bean mill.
Bee-house.
Beetle destroyer.
Beet-root seeder.
Binder.
Binding reaper.
Bisoc.
Blade.
Black land plow.
Board fence.
Bramble scythe.
Breaker.
Broad cast seeder.
Brooder.
Broom-corn scraper.
Broom-corn sizer.
Broom sewing-machine.
Broom trimmer.
Broom vise.
Broom winder.
Brush plow.
Bush hook.
Butter box.
Butter case.
Butter print.
Butter tub.
Butter worker.
Cake breaker.
Cake grinder.
Calf pail.
Cane knife.
Cart roller.
Chaff cutter.
Chaff sifter.
Chain harrow.
Cheese press.
Chicken coop.
Chicken feeder.
Chopping mill.
Churn.
Cider mill.
Cider press.
Clevis.
Clod clearer.
Clod crusher.
Clover huller.
Clover-seed gatherer.
Cockle separator.
Colter.
Combination plow.
Compound cotton press.
Concasseur.
Coop.
Corn cleaner.
Corn cracker.
Corn cutter.
Corn drill.
Corn hook.
Corn husker.
Corn mill.
Corn planter.
Corn plow.
Corn sheller.
Corn-stalk cutter.
Cotton cultivator.
Cotton cylinder.
Cotton gin.
Cotton-picking machine.
Cotton planter.
Cotton plow.
Cotton press.
Cottón scraper.
Cotton-seed huller.
Cotton sweep.
Cotton-tie fastener.
Cotton truck.
Cotton-worm destroyer.
Cranberry picker.
Creamery.
Crutch.
Cultivator.
Cutter.
Dairy implements.
Decorticator.
Disk harrow.
Ditch cleaner.
Ditching machine.
Divider.
Double harpoon fork.
Double-mold-board plow.
Double plow.
Double shovel plow.
Double-tub press.
Drag.
Drag chain.
Drain cleaner.
Drain-tile layer
Drill.
Dropper.
Drying house.
Duck's foot cultivator.
Duster
Ear lifter.
Ensilage.
Ensilage cutter.
Epinette.
Equalizer.
Espalier.
Evaporator.
Excavator.
Expanding cultivator.
Fanning mill.
Farm cart.
Farmer's tool-box.
Farm mill.
Feed boiler.
Feed crusher.
Feed cutter.
Feed mill.
Fencing machine.
Fertilizer distributor
Fertilizer mill.
Fertilizer sower.
Field roller.
Flower-stand.
Fodder cutter.
Fodder mill.
Forage cutter.
Forage press.
Forking spade.
Fountain pump.
Frost cog.
Fruit basket.
Fruit-box.
Fruit dryer.
Fruit evaporator.
Fruit pitter.
Fruit press.
Fruit separator.
Gage wheel.
Gang cultivator.
Gang plow.
Garden engine.
Garden loop.
Garden tools.
Gate.
Geddes harrow.
Germination apparatus.
Gorse cutter.
Grafting tool.
Grain cleaner.
Grain crusher.
Grain cutter.
Grain drill.
Grain fan.
Grain measurer.
Grain screen.
Grain separator.
Grain ventilator.
Grape crusher.
Grape mill.
Grape press.
Grapple hay-fork.
Grist mill.
Groomer.
Grub hoe.
Grub hook.
Half-shovel plow.
Hand corn-planter.
Hand cultivator.
Hand rake.
Hand seeder.
Hand thresher.
Harpoon hay-fork.
Harrow
Harrow cultivator.
Harvester.
Harvester cutter.
Harvester knife.
Hay-band machine.
Hay-band twister.
Hay carrier.
Hay elevator.
Hay fork.
Hay knife.
Hay loader.
Hay maker.
Hay press.
Hay rake.
Hay tedder.
Hay unloader.
Hemp knife.
Hennery.
Hill-side plow.
Hitching post.
Hoe.
Hoeing machine.
Hog scalder.
Hog trough.
Honey extractor.
Hoof cushion
Hop picker.
Horner.
Horse biscuit.
Horse boot.
Horse collar.
Horse groomer.
Horse hay-fork.
Horse hoe.
Horse power.
Horse rake.
Horse rough.
Horse shoe.
Horse-shoe stud.
Hoverer.
Hurdle.
Husking glove.
Hydromère.
Incubator.
Insect destroyer.
Intermediate motion.
Irrigator.
Jointer.

Knife-head.
Land roller.
Lap ring.
Lawn mower.
Lawn sprinkler.
Lifting gate.
Listing plow.
Litter cutter.
Loose box.
Maize cutter.
Manger.
Manure drag.
Marc.
Meat chopper.
Milk cooler.
Milking tube.
Milk pan.
Milk skimmer.
Mole trap.
Movable fence.
Mowing machine.
Oat crusher.
Oat separator.
Oil-cake breaker.
Oil-cake grinder.
Oil-cake mill.
Olive press.
One-horse plow.
Overshot separator.
Peat spade.
Picket fence.
Picket pin.
Pig trough.
Pitter.
Planter.
Plant sprinkler.
Plow.
Plow fender.
Plow holder.
Pony plow.
Portable cider-press.
Porter.
Post auger.
Post-hole spoon.
Potato assorter.
Potato-bug destroyer.
Potato coverer.
Potato digger.
Potato hook.
Potato planter.
Poultry coop.
Poultry feeder
Prairie breaker.
Prairie renovator.
Pruner.
Pruning saw.
Pruning shears.
Pulverizer.
Rail fence.
Rake.
Reaper.
Reaping machine.
Rice drill.
Rice huller.
Rice machinery.
Rice thresher.
Riddle.
Ridging plow.
Riding cultivator.
Ripple.
Road grader.
Road plow.
Roller.
Rolling colter.
Rolling colter plow.
Root cutter.
Root grinder.
Root puller
Root pulper.
Root shredder.
Root slicer.
Root washer.
Rotary plow.
Round.
Row-marker.
Runner.
Scarificator.
Scraper.
Screw press.
Scuffle hoe.
Seed drill.
Seeder.
Seeding barrow.
Seeding machine.
Separator.
Share.
Share harrow.
Sheaf band.
Sheaf binder.
Sheep-rack.
Sheep-shearing machine.
Shoe pad.
Shovel plow.
Sifter.
Single shovel plow.
Skeleton roller.
Skim-colter plow.
Skim-plow.
Sled harrow.
Slip share.
Soil pulverizer.
Spraying machine.
Spring hoe.
Sprinkler.
Stable.
Stable cleaner.
Stable fittings.
Stacker.
Stalk cutter.
Stall.
Steam plow.
Steam plowing engine.
Steam reaper.
Stone clearer.
Straw cutter.
Straw elevator.
Straw knife.
Stream fence.
String binder.
Stump extractor.
Subsoiler.
Subsoil plow.
Sugar-land plow.
Sugar spile.
Sulky cultivator.
Sulky plow.
Sulky rake.
Sweep.
Sweep rake.
Sweet-potato digger.
Swivel plow.
Tea-preparing machine.
Tedder.
Thatch-making machine.
Three-horse cultivator.
Threshing engine.
Threshing machine.
Tie.
Tobacco cultivator.
Tobacco cutter.
Tobacco granulating machine.
Tobacco hook.
Tobacco spinning machine.
Tobacco stripper.
Toggle press
Tongueless cultivator.
Transplanter.
Treble tree.
Trenching plow.
Triple gang plow.
Triple plow.
Triple shovel plow.
Trough.
Turning-mold-board plow.
Turnip cutter.
Turnip drill
Turnip fingerer.
Vine puller.
Vineyard implements.
Vineyard plow.
Walking cultivator.
Walk scraper.
Weed scythe.
Wheat riddle.
Wheat separator.
Wheel hoe.
Wine filter.
Wine press.
Winnower.
Winnowing machine.
Wire fence.
Wire trellis.

Ag′ri-cul′tu-ral Lo′co-mo′tive. A self-moving steam-engine especially adapted for traction purposes on farms and plantations. But little used as yet in America, but much used in parts of Europe.

See the following: —

Ruston & Proctor, Br.	"*Engineering*"	* xxiii. 57.
Wallis & Steevens, Br.	"*Engineering*"	* xxiv. 142.
Aveling & Porter, Br.	"*Engineering*"	* xxvi. 26.
Brown & May, Br.	"*Engineering*"	* x. 452, 467.
Howard, Br.	"*Engineering*"	* xxv. 48.

Aig′let. The metallic sheath at the end of a lace or cord.

Ai′no Cloth. (*Fabric.*) A cloth made by the Ainos (tribes of the Saghalien, Yesso, and Kurile islands), from the divided fibers of the elm, beaten so as to obtain bast layers, which are split and woven. See Prof. Penhallow * in "*American Naturalist*," also "*Scientific American Supplement*," 3883.

Air (or *foul air*). A molder's term, signifying all the gases generated and driven through the sand and from the mold by the hot metal.

Air-ap′pa-ra′tus, Blow′ers, Ven′ti-la′tion etc. See under the following heads: —

Aërated water machine.
Aërating filter.
Aërator.
Aërophore.
Agitator.
Air bag.
Air brake.
Air chamber.
Air compressor.
Air engine.
Air equalizer.
Air filter.
Air governor.
Air injector.
Air moistener.
Air-pressure regulator.
Air pump.
Air reservoir.
Air ship.
Air telegraph.
Air trap.
Air valve.
Aspirating filter.
Aspirator.
Balloon.
Bench forge.
Bellows.
Blast regulator.
Blower.
Blowing engine.
Blowing machine.
Blow-pipe.
Brazing blow-pipe.
Carbonated-beverage app's.
Compressed-air engine.
Compressed-air governor.
Compressed-air pump.
Damper.
Damper regulator.
Double-blast forge.
Exhauster.
Exhaust fan.
Fan.
Fan blower.
Fan forge.
Fan jet.
Fanning mill.
Fog trumpet.
Forge.
Gas blow-pipe.
Greenhouse ventilator.
Guibal fan.
Hand blower.
Hot-air syringe.
Hot-blast blow-pipe
Hydraulic blower.
Hydro-pneum. accumulator
Kite.
Laboratory forge.
Miner's forge.
Mine ventilator.
Organ blower.
Parachute.
Pneumatic conductor.
Pneumatic dispatch.
Pneumatic elevator.
Pneumatic grain elevator.
Pneumatic hoist.
Pneumatic pump.
Pneumatic railway.
Pneumatic screw.
Pneumatic signal.
Pneumatic telegraph.
Pneumatic tube.
Pneumatic tubular dispatc[h]
Portable forge.
Pressure blower.
Pressure regulating valve.
Pressure regulator.
Respirator.
Riveting forge.
Rotary blower.
Speaking-tube whistle.
Steam fan.
Suction fan.
Traveling forge
Tube whistle.
Tuyere.
Vacuum chamber
Vacuum pump
Vanner.
Vanning machine.
Ventilating apparatus.
Ventilating cowl.
Ventilating light.
Ventilator.
Water aërating apparatus.
Wall ventilator.
Water column air-compressor.
Water tuyere.
Whistle.
Wind car.
Windmill.
Wind-wheel.
Workshop forge.

Air and Cir′cu-la′ting Pump. A ste[am] engine, which in addition to the duty of the pump in condensing engines, pumps the water fr[om] the hot well into the boiler. See, for instance, *Blake* combined air and circulating pump, "*M[an]ufacturer and Builder*." * xii. 4.

Air Bag. 1. Air bags for raising sunken sh[ips] were tried by Captain Gowan on the wreck of U. S. steamer "Missouri," in 1851, and again sunken Russian men-of-war at Sevastopol. In 1864 air bags were applied for raising a steamer sunk in the Lake of Boden; in this case the bags, owing to some defect, gave way. The Alexandrovsky system has rendered good service to the Government and commerce of Russia on several occasions.

"The bags adopted in the Russian navy are, when inflated, of cylindrical form, measuring 12′ in diameter and 20′ in length. They are composed of three layers of the thickest canvas saturated with India-rubber. Their lifting power averages sixty tons. In order to lift a vessel, several chains are drawn by divers under her bottom, and air bags attached to the ends of each of them as near the ship's bottom as possible: the bags, being inflated by means of air-pumps, cause the ship to rise. Before pumping air into the bags, all the chains are connected in a transverse direction, so as to form one system, thus preventing the pairs of bags from sliding off from beneath the hull of the ship. As the vessel rises the surrounding water-pressure decreases, and the excess of air passes out through safety-valves." — "*Engineering.*"

See, also, Fig. 4148, p. 1847, "*Mech. Dict.*"

2. (*Surgical.*) Specifically, Politzer's air bag for inflating the Eustachian canal and treating diseases of the middle ear. See *f*, Fig. 2678, p. 1185, "*Mech. Dict.;*" Fig. 1814, p. 869, *ibid.*

See, also, Figs. 179–182, 184, pp. 39, 41, Part II., *Tiemann's "Armamentarium Chirurgicum."*

Air Box. (*Mining.*) A wooden tube used for ventilation in a mine when there is only one shaft.

Air Brake. (*Railway.*) A railway brake operated by air, either by the *compression* or *vacuum* method.

In the former, the air is compressed by a pump on the locomotive, and conveyed by pipes, and by flexible tubes between the cars, to cylinders under each car. Each cylinder has a piston which operates the brake levers.

The *Westinghouse* brake is an instance, and is described and represented on p. 356, "*Mech. Dict.*"

The *Loughridge* brake is similarly actuated.

In the latter form (vacuum), the air is exhausted from the device beneath the car, and the pressure of the atmosphere operates the brake-levers.

The *Eames* and *Smith* brakes are of this class.

See RAILWAY CAR BRAKE.

Air Bridge. An arrangement for injecting air at the bridge of a furnace, in the rear of the grate surface. Examples of bridges are numerous in Plate LXI., and page 2327, "*Mech. Dict.*"

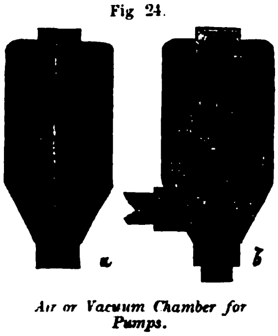
McMurray's corrugated-iron air bridge and fuel economizer, is shown in "*Scientific American,*" * xxxvii. 374.

Air Cam'el. A lightering device, consisting of a caisson placed beneath a vessel to diminish its draft of water to enable it to pass a relatively shallow channel.

The early use of the camel in Holland is referred to on p. 1874, "*Mech. Dict.,*" under the caption, RAISING SUNKEN VESSELS. See also AIR CUSHION.

Air Cham'ber. In Fig. 24, *a* is an air chamber to be placed over the suction cylinder in deep wells, the pump rod working through it.

Fig 24.



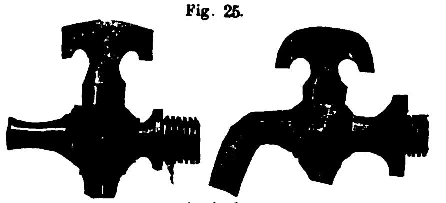
Air or Vacuum Chamber for Pumps.

Also used as a vacuum chamber under a suction pump. With a force pump two may be used with advantage; one as an air chamber above, and the other as a vacuum chamber beneath the pump cylinder.

In the same Fig., *b* is a chamber to be placed where the elbow would be in the angle of the ascending suction pipe and the horizontal water pipe, or placed alongside of the pump when the situation should require it.

Air′-cock. A faucet to allow escape of air: as in the case of the air-cock, otherwise known as a pet-cock, to allow escape of air from the steam cylinder when starting the piston.

Fig. 25.



Air Cocks.

The figure shows the ordinary straight nose air-cock, and the bibb-nozzle air-cock.

See also CYLINDER COCK.

Air Com-press'or. Applications of compressed air: —

Static: Employed in a condition of permanent elasticity.

1. Air reservoir in pumps. Regulators. Diving bells.
2. Pneumatic piles and caissons. Tubular foundations.

Dynamic: Employed in movement.

3. Elevation of liquids; ejectors.
4. Displacement of liquids.
5. Blowers: rotary, collapsible, and piston.
6. Air-guns.
7. Air-pumps and compressors.
8. Ventilation by chimney draft (vacuum).
9. Compression, and transport of compressed gas.
10. Compressed air locomotives.
11. Pneumatic railway brakes, tubular dispatch, and telegraph.
12. Ventilation by injection of compressed air (plenum).

The air compressors at Mont Cenis, and Hoosac Mountain, are referred to on pp. 27, 28, "*Mech. Dict.*"

Under the caption "AIR AS A WATER ELEVATOR," various devices of the nature of ejectors are shown to the number of nine illustrations, embracing the famous device at Chemnitz, and many novel devices growing out of the deep oil-wells. See also Calles' AËRO-HYDRO-DYNAMIC WHEEL.

AIR-COMPRESSING MACHINES are shown on pp. 31–33, "*Mech. Dict.,*" both simple and compound.

Under COMPRESSED-AIR ENGINES, are shown the Gowan colliery engine of Glasgow and the Sommeilleur apparatus at the Bardonneche end of the Mont Cenis tunnel. The latter form of apparatus, depending upon the compression of air by the body of descending water, is maintained in the Colladon apparatus, yet in much favor on the Continent of Europe, in positions where water is abundant and fall sufficient.

The tendency, however, is to the steam-driven air-pump, of which one or two examples will be offered.

The Gowan colliery engine is also shown on p. 10, article *Air comprimé*, Laboulaye's "*Dictionnaire des Arts et Manufactures,*" Fig. 3321, Tome iv., edition of 1877.

The Modane air compressors of the Mont Cenis tunnel are shown and described in the last-mentioned work, Figs. 3322, 3323, and accompanying text.

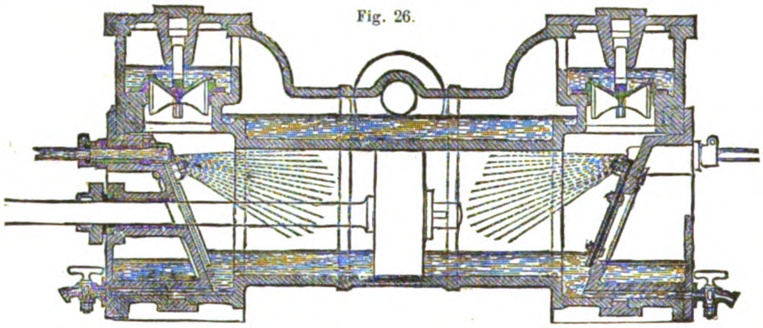
The compresseur Colladon is shown in the same work at Fig. 3324, article "*Air comprimé*," Tome iv., edition 1877. It was used at the St. Gothard tunnel.

Brunnin's water column, or air-compressor, is described in the "*Revue Universelle des Mines*," 1879, the article being reproduced in "*Van Nostrand's Engineering Magazine*," * xxi. 9.

The action of the machine is in two periods: the first consists in compressing the air in a closed cylinder by direct pressure of the water; the second, during which the water, having done its work, flows out. The compressor has a cylindrical reservoir with double seal valves of unequal diameter, one to admit the water, and the other to subsequently discharge it. Two other valves serve severally to admit fresh air and to discharge compressed air to a special holder.

The air-compressor designed by MM. Dubois and François, to drive drills for sinking shafts, is shown in Fig. 26.

Fig. 26.



Dubois & François' Air Compressor for Driving Shaft-sinking Drills.

"The arrangement consists of an air reservoir of 280 cubic feet capacity, of which from one fourth to three eighths is occupied by the injection water, and the remainder by the compressed air. Two iron pipes, 2″ in diameter, conduct the air to the drills, which are four in number, and on the Dubois and François system. The diameter of the cylinder is $3\frac{1}{2}''$, and the stroke $7\frac{7}{8}''$. The frame is formed of wood and iron, and has two vertical iron standards 3.9375″ in diameter; each standard carries a horizontal screw, and the drill is mounted on a nut moving on the screw, and having a range of half a circle. During the period of blasting and extraction of the spoil, the frame and drills are lifted, and when at work it rests upon a timber substructure. The compressor is intended to deliver air at a pressure of $3\frac{1}{2}$ atmospheres. It is actuated by a steam cylinder $29\frac{1}{2}''$ stroke and $13\frac{3}{4}''$ in diameter, and the piston-rod is attached direct to the piston of the compressor. The compressor cylinder has the same stroke and diameter as the steam cylinder, and the ends are inclined as shown in the section; they are fitted with two valves for the admission of the air, and at each end there are two gun-metal valves arranged as shown. Into each end of the cylinder there penetrates the perforated extremity of a pipe, and through these, at every stroke, water is injected against the piston and the sides of the cylinder to prevent the heating due to compression. The water is not allowed to accumulate beyond the level shown in the section, an overflow being provided, operating automatically. The following advantages are claimed for the arrangement: 1. The area of the inlet valves is very large. 2. The water injection ceases at the moment when it becomes unnecessary, that is to say, when the air reaches in the cylinder the same pressure that it has in the reservoir. 3. The compressor may be worked at a speed from 40 to 50 strokes per minute. At the coal mines of Wérister it was used in sinking two shafts, each 656 ft. deep, and the results of working with this system have been highly satisfactory." — *Revue Industrielle.*

The Clayton duplex air compressor, shown in Plate I., has two horizontal steam cylinders and two air cylinders, securely bolted on a very strong frame, the steam pistons communicating most of the power through the yokes to the compression pistons. The fly-wheel is placed between the two compressors, and on each end of the fly-wheel shaft is a crank, which cranks are set at right angles to each other, so that when the full compression of the air is attained in one compressor the opposite crank exerts its full force to complete the strokes, thus giving an even and uniform motion without any danger of the machine sticking on the center.

In the later form shown in the plate, a connecting rod is substituted for the former sliding journal boxes (shown in Fig. 1524, p. 650, "*Mech. Dict.*"); the yokes are connected at top by a rod, and at the bottom by a distance piece which serves as a slide, working on a long slipper guide which is adjustable and is placed inside the frame to relieve the cylinders from the wear incident to the weight of the pistons, rods, and connections.

The steam and air cylinders are united by tension rods above. The engine is duplex, the two portions acting upon the same crank shaft, the fly-wheel on which occupies the center of the machine. The air cylinders are cooled by the application of water in jackets so arranged that the cold water is first brought in contact with a portion of the top, and then forced around the extreme ends of the cylinders where the heat is greatest, the water then traveling upward around the center or cooler portion of the cylinders.

The adjustable tripping device can be set to lift the discharge valves at any point in the stroke, affording free escape for air in the cylinder as soon as it has reached the working pressure. The air governor can be set to any pressure desired, and will not allow the pressure on the rock drills or other machinery to vary, notwithstanding the pressure of steam or the number of drills at work. See Fig. 27.

The lubricating valve supplies the air cylinders at each stroke with a fixed amount of lubricating fluid.

The engines are disconnectable, so that one only may be worked when necessary for repairs or for other reason.

The "*Mining Journal*" (British), 1877, has a discussion on the respective constructions and uses of several air compressors; the article is in part reproduced in "*Scientific American Supplement*," * p. 1491.

It describes the "Moonta," * named from mines in South Australia, and in use in the Isle of Man, and in Cornwall; the "Flower" compressor, used at the Powell Duffryn Colliery, South Wales, and the "Festiniog"-tunnel compressor. It also refers to the cost, and some points in connection with the following air-compressors: —

Sommeiller. Colladon.
Cockerill Foundry.

The following references to air-compressors may also be consulted: —

Bowers	* "*Iron Age*," xix., April 26, p. 9.
	* "*Eng. & Min. J.*," xxv. 56.
	* "*Scientific Amer.*," xxxvii. 15.
Brunnin	"*Iron Age*," xxiv., July 20, p. 13.
Fr. (water column) .	* "*Van Nostrand's Mag.*," xxi. 9.
	"*Revue Universelle des Mines*," 1879.
Burleigh	* "*Eng. & Min. J.*," xxii. 183.

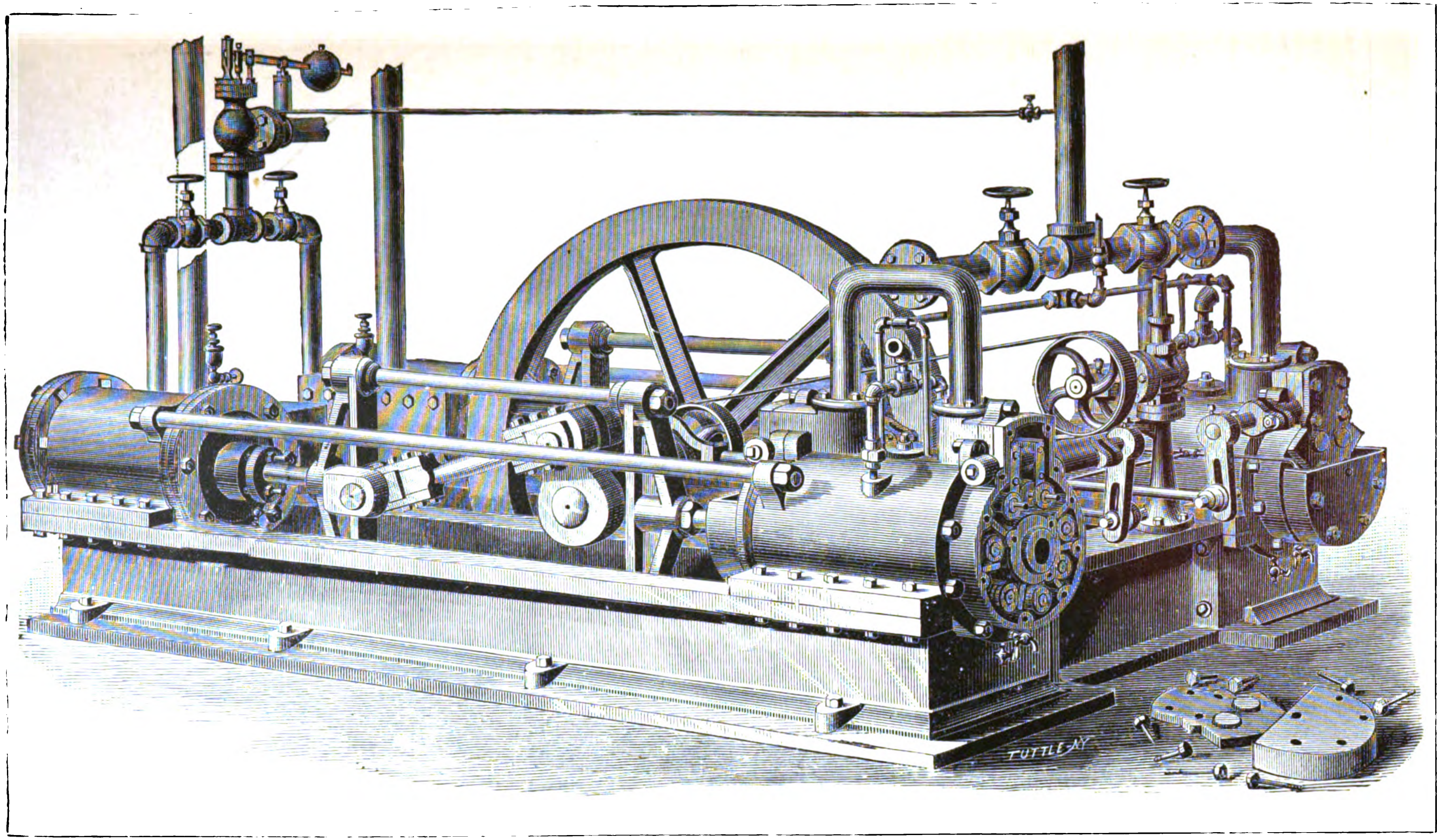


PLATE I

CLAYTON DUPLEX AIR COMPRESSOR.

See page 14.

Clayton	* "*Man. & B.*," ix. 9; * xii. 9; * xii. 100.
	* "*Technologist*," Feb., 1877.
	* "*Scientific American*," Feb., 1879.
	* "*Iron Age*," xix., May 3, p. 1.
	* "*Iron Age*," xxii., Sept. 19; Dec. 19, p. 1.
	* "*American Manufact.*," Jan. 9, 1880, p. 13.
	"*Engineering and Min. J.*," Sept. 14, 1878.
Colladon	Article "*Air Comprimé*," Fig. 3329, "*Laboulaye's Dictionary*," vol. iv.
Cranston, Br.	* "*Engineering*," xxii. 320.
	"*Scientific American Sup.*," 837.
Dubois & François	* "*Engineering*," xxi. 249.
	* "*Scientific American Sup.*," 349.
	* "*Revue Industrielle*," 1876.
(duplex)	* "*Scientific American*," xli. 410.
Ericsson	* "*American Artisan*," March 18, 1874.
Perroux	"*Scientific American Sup.*," 311.
Frizell	* "*Scientific American Sup.*," 1460.
Genesee Falls	"*Scientific American*," xliii. 318.
Gowan Colliery, Glasgow	* "*Laboulaye's Dictionary*," iv., Fig 3321.
Guild & Garrison	* "*Scientific American*," xxxvi. 310.
Hathorn, Br.	* "*Engineer*," xlvii. 116.
	"*Iron Age*," xx., Nov. 29, p. 7.
	"*Mining Journal*" (Br.), Nov. 2, 1877.
Ingersoll	* "*Min. and Sc. Press*," xxxvii. 177.
Normandy Stillwell & Co.	* "*Engineer*," xlvii. 352.
Factory at Norwalk	* "*Scientific American*," xliii. 367.
Norwalk (compound)	* "*Eng. and Min. J.*," xxx. 141.
Patton (water elevator)	* "*Min. and Sc. Press*," xxxviii. 25.
Rand	* "*Eng. and Min. J.*," xxx. 286.
Rand & Waring	* "*American Artisan*," Feb. 15, 1873.
Rider	* "*Iron Age*," xviii., Nov. 23, p. 1.
	* "*Engineer*," xlii. 263.
Robey, Br.	* "*Engineer*," xliii. 129.
	* "*Scientific American Sup.*," 774.
Royce	* "*American Engineer*," Nov. 1874.
Sawtell	* "*Scientific American*," xxxv. 390.
Sommeiller, Modane	Article "*Air Comprimé*," "*Laboulaye's Dictionary*," Fig. 3322, vol. iv.
Steel (Treatise), Br.	* "*Engineer*," xli. 478.
Sturgeon, Br	* "*Engineering*," xxviii. 51.
	* "*Iron Age*," xxiii., Jan. 9, p. 1.
Sutro Tunnel	* "*Engineer*," xlix. 96.
Wetter-on-the-Ruhr, Ger.	* "*Engineering*," xxx. 185.
Wyllie, Br.	* "*Engineering*," xxi. 517.

See: —
Zahner's "*Transmission of Motion by Compressed Air.*"
Pernolet's "*L'Air Comprimé.*" Paris, 1876.
Drinker's "*Tunneling, Explosive Compounds, and Rock Drills.*" New York, 1878.

Air'-cool'ing Ap'pa-ra'tus. See Air-refrigerating Apparatus; Ice-machine.

Air'-cross'ing. (*Mining.*) An arch built over a horse-way or other road, with a passage or airway above it.

Air Cush'ion. Air cushions, distended, serving to support a vessel upon a camel or shallow-water ship-float, are shown in "*Engineering*," * vol. xxiii., p. 369; and the same device applied to graving-docks, * on p. 511 of the same volume. The invention of the engineers Clark and Standfield.

The cushions are composed of layers of canvas and rubber, capable of resisting a strain of about 40 lbs. to the inch, and they are inflated by means of air compressors worked by engines at the side of the dock. They are protected outside with rope matting. The form of the bag when inflated resembles a bellows with a cushioned top, and the lower expanding section has inlet and relief pipes, the latter employed to allow the air to escape after a given pressure has been exceeded. Access to any part of the ship's bottom can be gained by allowing the air to escape from one or more bags, and so making it clear of the ship, while the latter is supported by the adjacent cushions.

Air Cyl'in-der. One in which air is the moving power to operate a piston, or is acted upon by the moving piston.

Such are found in various engines and devices: —

Air engines.	Air cylinders of car-brakes.
Air compressors.	Compressed-air engines.
Caloric engines.	Air-pumps.
Hot-air engines.	

Some of which names are synonyms.

Air'-drain. (*Add.*) 2. (*Molding.*) A large passage, often of considerable length, to conduct the gases safely from heavy castings deeply bedded in the floor of a foundry.

Air En'gine. An engine driven by heated air.

The air engine of Woodbury, Merrill, Patten & Woodbury, patents June 8, 1880, heats and cools the same air alternately. It has two working cylinders, 10″ diameter × 24″ stroke, and two reversers, 20″ diameter × 12″ stroke. The essential features of the engine are a heater, regenerator, and cooler, which three in combination are termed a *reverser*, and, in conjunction with a *working cylinder*, constitute a single acting engine. The rapid heating and cooling of the air is necessary with each stroke, and the rapidity with which this is accomplished is one of the peculiar excellences of this machine. The heating is by fuel in the furnace; the cooling by the circulation of water around small, thin copper tubes through which the air passes. See Hot-air Engine.

The term *air engine* has become somewhat general, and instances of one class are given under

Caloric engine,
Compression engine,
Hot-air engine,

and of another under

Compressed-air engine,
Air compressor, etc.

See list under Air Apparatus.

Air E'qual-i-zer. A device to distribute a blast of air equally throughout the working space in a machine, to prevent its tendency to establish a central current and prove inefficient at the sides of the chamber.

See, for instance, *Shaver's* device in middlings-purifiers, * "*American Miller*," viii. 2.

Air Fil'ter. A protective ventilator consisting of a cloth interwoven with thin brass wire to act as a filter for the air. It is to be attached to the upper and lower sashes so as to close the openings.

Gaston Tissandier has made some investigations into the quantity of dust contained in 35.3 cubic feet of air, by causing that quantity of air to pass through a tube packed with gun-cotton, which filters out the particles. He then dissolved the gun-cotton in ether, and was thus enabled to obtain the particles in a separated condition. After a heavy rain, M. Tissandier has collected 0.09 of a grain of dust in the above-mentioned quantity of air, but in dry weather this proportion rose to 0.3 of a grain. With regard to the nature of the material, he found that about one third was organic, one third silicious, and the rest composed of various substances.

"*Iron Age*," xxi., January 24, p. 19.
See instances, Figs. 95–100, pp. 46, 47, "*Mech. Dict.*"

Air Fur'nace. (*Metallurgy.*) One depending upon the draft of a chimney, as distinct from a *blast* furnace. A *wind* furnace.

Air Gage. A manometer to indicate the pressure of air or gas in a vessel or chamber.

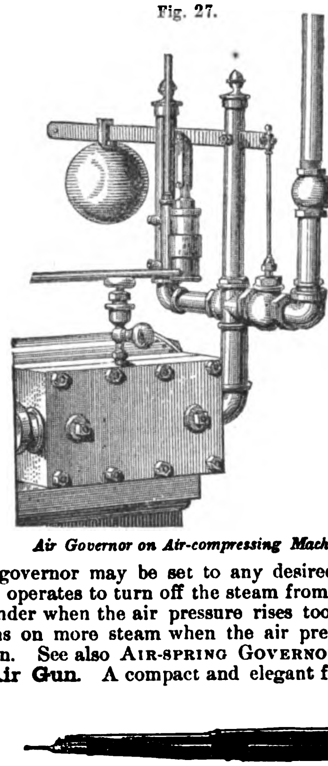
It is sometimes similar to a steam gage, but in other instances, such as the piezometer, it serves to register enormous pressures of gas in the explosion of charges of powder. See list under "Measuring and Recording Apparatus," *infra*.

Air′-gas Ap′pa-ra′tus. Another name for the Carburetor, in which coal-gas or air is passed through a volatile hydro-carbon to increase or confer the illuminating power. See CARBURETOR, p. 464, "*Mech. Dict.*"

Air Gate. (*Molding.*) An opening direct from a large mold, through which the displaced air escapes at the time of pouring, and in which the metal afterward rises. A *riser.*

Air Gov′er-nor. An instrument attached to an air-compressor, or blowing engine, to regulate the pressure of air in rock drills, blast furnaces, etc., where a uniform pressure of air is desirable. The

Fig. 27.



Air Governor on Air-compressing Machine.

air governor may be set to any desired pressure, and operates to turn off the steam from the steam cylinder when the air pressure rises too high, and turns on more steam when the air pressure goes down. See also AIR-SPRING GOVERNOR.

Air Gun. A compact and elegant form of the air gun, in which the whole of the hollow sheet-metal butt is utilized as an air reservoir, charged by a piston in the barrel, may be seen in *Laboulaye's* "*Dictionnaire des Arts et Sciences,*" Article "*Air Comprimé,*" Tome iv., Figs. 3317–3319, edition of 1877.

In the same article is the device by M. Bourdon for testing the force of the blow delivered by the bullet from an air gun, Fig. 3320.

Hyde's Air Gun, "*Scientific American,*" * xliii. 134.

Air′-head. (*Mining.*) A channel driven on a level with the top of the gate road, about four yards distant therefrom.

Air Heat′er. Generally: a device to heat air, as in a HEATING STOVE or HEATING FURNACE, which see.

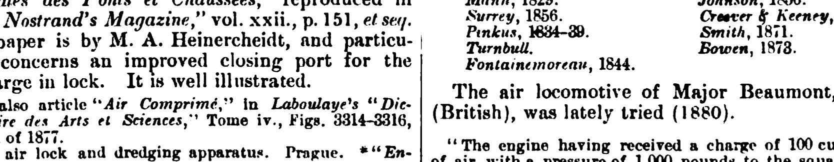
Specifically: a device to heat air to feed furnaces, whether heating or metallurgic. The Siemens, Ponsard, Bicheroux, and other furnaces of the class, have regenerators to heat the incoming air. See GAS-GENERATING FURNACE, REGENERATOR, AIR ENGINE, etc.

Thonger's air heater, for locomotive furnaces, is shown in "*Scientific American,*" * xxxv. 102.
The *Boswell* air heater, for stoves, furnaces, laundries, fruit dryers, etc., is shown in "*Mining and Scientific Press,*" * xxxvii. 281.
Air heater by waste gases, * "*Engineer,*" xlviii. 321.

Air In-ject′or. A blowing device to throw a jet of air. Such are found in atomizers, in some classes of fine sawing machines, to blow away the dust, and, as in the instance shown, in connection with dentists' burring engines.

A rubber bulb is compressed automatically by means of a simple mechanism, which is connected with and worked by the driven pulley. The air is forced from the bulb through the connecting rubber tube to a fixed nozzle at the hand-piece, whence it is thrown into the cavity of the tooth. The air thus driven out of the bulb leaves a vacuum which is instantly filled again with air from the patient's mouth. This alternate exhaustion and supply is kept up so rapidly, even at the ordinary speed of the pulley, that the air is injected in a continuous stream into the cavity. This appliance operates to keep the cavity clear of bur-dust and cuttings, and also to keep the bit cool while in use.

Fig. 28.



Dr. Hickman's Air Injector for Dental Engines.

Air Lock. An intermediate chamber between the outer air and the compressed-air chamber of a pneumatic caisson. See Plate II., op. page 49, "*Mech. Dict.,*" and Figure 1021, page 421, *ibid.*

The air lock is the subject of a paper in the "*Annales des Ponts et Chaussées,*" reproduced in "*Van Nostrand's Magazine,*" vol. xxii., p. 151, *et seq.* The paper is by M. A. Heinercheidt, and particularly concerns an improved closing port for the discharge in lock. It is well illustrated.

See also article "*Air Comprimé,*" in *Laboulaye's* "*Dictionnaire des Arts et Sciences,*" Tome iv., Figs. 3314–3316, edition of 1877.
Also air lock and dredging apparatus. Prague. * "*Engineering,*" xxix. 14.

Air Lo′co-mo′tive. A locomotive driven by heated air or compressed air, usually the latter.

See COMPRESSED-AIR ENGINES; STREET CAR MOTORS, etc.

See notices on p. 603, "*Mech. Dict.,*" of

Bompas, 1828.	*Parsey*, 1847.

Also, on pp. 2422–2424, *ibid.*, of

Medhurst, 1800.	*Anderson*, 1846.
Bompas, 1828.	*Fell*, 1847.
Wright, 1828.	*Van Rathen*, 1847.
Mann, 1829.	*Johnson*, 1856.
Surrey, 1856.	*Creever & Keeney*, 1859.
Pinkus, 1834–39.	*Smith*, 1871.
Turnbull.	*Bowen*, 1873.
Fontainemoreau, 1844.	

The air locomotive of Major Beaumont, R. E. (British), was lately tried (1880).

"The engine having received a charge of 100 cubic feet of air, with a pressure of 1,000 pounds to the square inch, left the Royal Arsenal station, on October 6th, at 12.22 P. M., for a run to Dartford and back, about 16 miles. In order to increase the energy of the air, it was heated, on being admitted to the cylinder, by a very small quantity of steam. The indications on the pressure-gage, as different stations were passed, were 940 pounds at 12.27 P. M.; 860 pounds at 12.33; and 760 pounds at 12.40; 540 pressure being the store of energy on arriving at Dartford at 12.50. Waste having been occasioned by shunting, the return journey began with a pressure of 510 pounds at 1.35 P. M., and Plumstead station was again reached at 2.10. This locomotive, not so large as one of our common street-cars, weighs about 10 tons, and draws a load of 16 tons up a moderate incline. It can be charged with air in fifteen minutes, does not send out any rush of steam or noxious gases, and makes only a trifling noise. Its sanitary advantages for underground work are obvious, and it can also be used for surface roads." — *British Paper*.

The compressed-air locomotive (model) of the "Polytechnic College of Philadelphia," is noticed in "*Scientific American Supplement*," p. 624.

See, also, Official Reports of Paris Exposition of 1878, vol. iv., p. 461, Commissioner Anderson's Report, for

* *Mekarski's* compressed-air motor.
* *Lamm-Francq's* fireless locomotive.

See, also, for *Mekarski's*, "*Scientific American*," *xxxv. 82.

Air Me'ter. An instrument for measuring the rate of motion of an air current; used in mines, hospitals, etc.

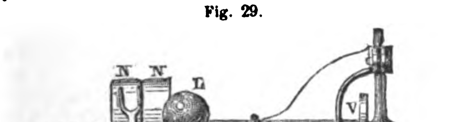
Casella's air meter is shown under ANEMOMETER, which see.

Air Mois'ten-er. An evaporator exposed to the heat of a stove, heating pipes, or radiator, to impart moisture to the atmosphere. See EVAPORATOR.

Air Pis'tol. A small weapon differing in no substantial respect but size and portability from the air gun.

Air-press'ure Reg'u-la'tor. An instrument for preserving an even pressure in pneumatic apparatus.

Fig. 29.



Air-pressure Regulator.

A, Chamber filled with air at the desired pressure.
B, Space filled with water.
C, Caoutchouc membrane separating the air from the water, and lifted by the levers *H I* by means of the rod *T*.
D, Pressure pump, with its supply and discharge-pipes *F E* respectively.
G, Water-pipe leading to the machines in communication with the chamber.

H, Two-branched exterior lever. *I*, Single interior lever.	In prolongation on the same axis, the journals of which are packed in the box *S*.

J, Rod terminating in a cap-piece *R*, and connecting the slotted sector-guide *P* to the lever *H*.
K, Regulation cock, moving automatically by means of its lever and a link connecting it to the rod *J*. Its purpose is to prevent overstrain of the caoutchouc diaphragm when the latter is at its farthest depression.
L, Counterpoise on the belt-shipping lever axis *V*.
O, Levers fixed on the axis *V*, and connected at their ends by a gudgeon traversing the slot of the sector *P*.
P, Sector-guide loose on the axis *V*.
Q, Forks loose on the arbor *V*, jointed to the piece *M*, which limits their movement.
N N', Fast and loose pulleys on the axis of the eccentric *V*, which works the pump rod.

The cut represents the diaphragm near the end of its downward extension. The cock, *K*, is nearly closed, and allows passage to the minimum quantity of water.

In the disposition of parts exhibited in the cut, the pump is about to start; the ball *L*, in consequence of the position given to the levers, *O*, by the sector *P*, has passed the vertical, and is about to draw on the belt fork, and bring the belt upon the fast pulley *N*.

The pump continues to work until the raising of the diaphragm by excess of water shall act inversely, by the connections already cited, upon the ball *L*, and shift back the belt to the loose pulley, *N'*.

Air'-pump. The uses of the air-pump have largely multiplied since its invention by Otto von Guericke.

Fig. 30.

Otto von Guericke's Air-pump, and the Magdeburg Hemispheres. (From a recent photograph.)

The original pump, lately brought to light at a loan collection, is 5′ high; the hemispheres are 26″ diameter; two receivers form a part of the group.

See Father Schott's "*Technica Curiosa.*"

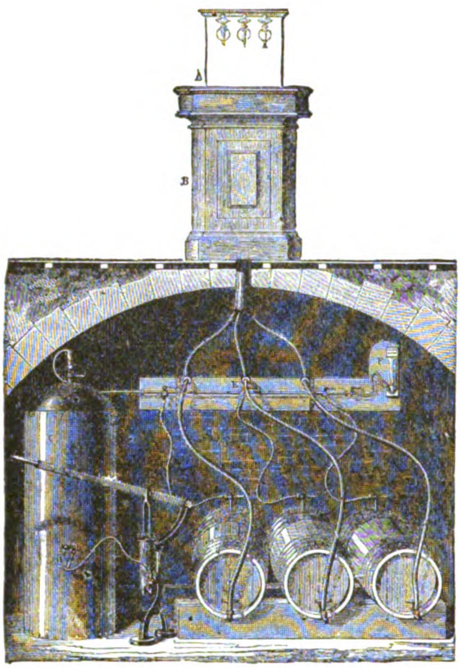
1. The air-pump used by divers has usually three cylinders and three single-acting pistons, operated by a three-throw crank. A form manufactured in Boston is shown under SUBMARINE AIR-PUMP. See AIR COMPRESSOR, DIVING-BELL, RESPIRATOR, etc., "*Mech. Dict.*"

2. The air-compression pump of the Westinghouse air-brake has a steam cylinder and air cylinder placed in line, and with piston-rod connecting the two pistons. The steam and air admission and exhaust of the respective cylinders are governed by valves in the passages. See RAILWAY-CAR BRAKE.

3. The air-pump used in carburetors is usually a form of meter wheel, or a device like the tympanum. See pp. 464 *et seq.*, "*Mech. Dict.*"

4. An air-pump used for beer fountains is shown in Fig. 31. It is somewhat of a refinement upon the mere lift-pump leading from each cask to the dispensing tap at the counter.

Fig. 31.



Compressed-air Beer-pump.

A single pump, *D*, condenses air in a cylinder, *C*, which connects by pipes to the spile-hole of each cask. From the faucet of each cask proceeds upwardly a pipe through the case *B*, to the dispensing table *A*. *F* is a manometer, to indicate the pressure.

Arrangements on similar principles are used in France in cellars and wine-vaults for transferring and racking wines; for heating them on the new process, to give the quality of age, etc.

Air-pumps of this class are largely used in the United States in breweries and other factories, where quantities of liquids are to be moved. For this purpose direct pressure of air is more manageable and convenient than the ordinary liquid pump of whatever class. They are classed as *air-pumps* up to a pressure of thirty pounds.

5. Air-pumps for a pressure exceeding thirty pounds per square inch are known as *air-compressing machines*, which see. The air locomotive of Colonel Beaumont, of Woolwich, England, is said to start with a reservoir filled at a pressure of 66 atmospheres, while the Dubois and François air-compressor delivers air to the rock drills at 3½ atmospheres.

6. Blowers may be classed as air-pumps, but whether for urging fires or for ventilation, their force is usually far inferior to that of the ordinary air-compressing engines, for the service of rock drills, for instance.

7. *Geissler's* air-pump without valve, as improved by MM. Alvergniat Frères, of Paris, and which suppresses *l'espace nuisible*, is shown with illustration on p. 491, vol. iii., of the "*Reports of Paris Exhibition*" of 1867. Succeeding pages describe

* *Kravogl's* mercurial air-pump.
* *Richards'* valveless air-pump (Plate VIII.).
* *Deleuils'* free-piston air pump.
The *Sprengel* air-pump is shown at Fig. 398, p. 170, "*Mech. Dict.*"

8. The independent air-pump is one driven by another motor, in place of being actuated by a crank on the main shaft. Such an air-pump is sometimes used in connection with a condenser, and being independent, a vacuum may be formed for the engine before it is started.

Otherwise the air-pump is combined with a circulating pump which takes the water from the hot-well and sends it to the boiler.

9. (*Surgical.*) Air-pump for cupping; Fig. 195, p. 64, Part I., *Tiemann's "Armamentarium Chirurgicum."*

Junod's boot and arm for dry cupping. *Ibid.* Figs. 176, 177, pp. 112, 113, Part IV.

Air-pump for spray producer and atomizer. *Ibid.* Fig. 364 *b*, p. 89, Part II.

See also AIR-PUMP, p. 50, *et seq.*, "*Mech. Dict.*" ASPIRATOR, pp. 169, 170, *Ibid.*

The following references may be consulted:—

Air-pump.	*Otto Von Guericke* .	* "*Sc. Am.*," xl. 70.
	Simple. *Hopkins* .	* "*Sc. Am.*," xl. 35.
	Moll	* "*Sc. Am.*," xxxiv. 371.
	Weindel	* "*Sc. Am.*," xxxv. 246.
	Sprengel	"*Sc. Am.*," xxxvii. 343.
Air-pump and Condenser.	*Tangye*	* "*Engineering*," xxii. 51.
Air-pump Condenser (Engl.) . .		* "*Sc. Am. Sup.*," 1731.
Air-pump for supplying air-vessels of pumps.	*Wipperman & Lewis*	* "*Engineer*," xlviii. 462
Air-pump "Niagara," Duplex . .		* "*Sc. Am. Sup.*," 499.
Air-pressure acid pump.	*Wyllie* (Br.)	* "*Sc. Am. Sup.*," 524.

Air-re-frig′er-a′ting Ma-chine′. A machine constructed by Hall, of Dartford, England, for refrigerating the hold of an Australian meat-ship, has a pair of horizontal trunk-engines mounted on top of a condenser. To one side is bolted a compressing cylinder, 27″ diameter and 18″ stroke; to the other side is bolted the expansion cylinder, 22″ diameter and 18″ stroke. Both these cylinders are open-topped. The valves are placed in the bottoms of the cylinders, and are worked by cams on the crank-shaft and levers. Air is drawn into the compressing cylinder on the up-stroke, and delivered on the down-stroke into the surface condenser, at a pressure of about 50 lbs. to 55 lbs. on the square inch. The air here parts with its heat in the condenser, and it is then delivered into the expansion cylinder, the valve of which cuts off at about one fourth stroke. The expanded air is then delivered through a pipe into the room to be cooled. About fifty per cent. of the work expended in the compressing cylinder is returned in the expansion cylinder, the difference being made up by the engine. In the form recommended for ordinary use, the height is kept down to render it specially suitable for the space between decks; but the machine can be made to take almost any form, and can be made of any dimensions to suit particular requirements. The condenser or refrigerator consists of nests of brass tubes, through which the water circulates. The tubes have an outside diameter of ½″, and are accessible through man-holes.

See illustration in "*Sc. Am. Supplement*," p. 4039. See also *ibid.*, 4011. See also * "*Engineer*," l. 248. See REFRIGERATOR.

The apparatus of MM. Nezereaux and Garlandat has a perforated plate, over which a body of cold water runs, while a body of air, driven by a fan, courses through the holes, and acquires within a few degrees the temperature of the water. "*La Nature.*"

See also "*Scientific American*," xxxiv. 82.

By the use of an air-compressor, with tanks and cisterns, the temperature of a given space may be readily reduced nearly to the freezing point, if desired. Many processes, primarily intended for producing ice, are available for air-refrigerating purposes.

See AIR-COOLING APPARATUS; ICE-MACHINE; in former volumes.

The following United States patents may be examined: —

Nos.	Nos.	Nos.	Nos.
89,456	211,700	162,920	138,411
198,830	226,908	102,660	14,510
164,421	191,232	195,374	184,291
229,374	87,041	44,731	175,291
149,980	161,515	227,796	168,654
233,072	209,892	140,375	139,470

Air Res'er-voir. The reservoirs constructed by Dr. C. W. Siemens, for Colonel Beaumont, of Woolwich, Britain, to be used in his air locomotive, and withstand a pressure of 1,000 lbs. to the square inch, are made of cylindrical rings of steel rolled out of solid ingots in a tire-mill, and hemispherical ends beaten out of steel boiler-plate.—*Paper before "Institution of Mechanical Engineers"* (Br.), 1878. Reproduced in "*Scientific American Supplement,*" * 2033.

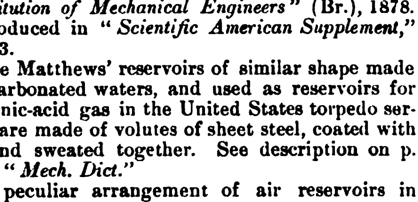
The Matthews' reservoirs of similar shape made for carbonated waters, and used as reservoirs for carbonic-acid gas in the United States torpedo service, are made of volutes of sheet steel, coated with tin, and sweated together. See description on p. 2237, "*Mech. Dict.*"

A peculiar arrangement of air reservoirs in pumps, to totally exclude the shock, is shown in "*Dinglers' Journal,*" and reproduced in "*Scientific American,*" xxxvii. 329.

Air'-spring. A spring in which the elasticity of air is utilized in place of metallic or other material.

1. The air-spring used in a reciprocating flat bed printing-press, to stop and reverse the movement of the bed, is a very important improvement over the wire spring, being almost indispensable for high rates of speed. To overcome the momentum of the bed of a 32″ × 46″ drum cylinder press with a full form of type running at the rate of 1,600 impressions per hour, is calculated to require about 2,550 pounds of resistance on each center.

Fig. 32.



Air-spring for Bed of Printing Press.

The air-spring is used on the presses of several of the superior makers. The press-spring shown in Fig. 32 has a governor attachment, by which, when the press is started, the air-spring is automatically put on, according as the feed progresses, and in stopping the spring power is decreased as the feed declines. The bed is provided with two cylinders to engage with as many plungers at the ends of the frame, and the hollow rods of these plungers are connected by a pipe running along the lower part of the frame; which pipe is opened or closed by the valve of the governor. (See next article.)

The plunger has a hollow rod and an automatic valve at its extremity. This valve rises on the return motion of the bed, and prevents a vacuum forming in the cylinder. Fig. 32 shows a longitudinal section of the device.

2. Air-springs are also used in gun earriages to arrest the recoil of the gun; or to utilize the recoil of the gun to assist in elevating the gun in battery, after being depressed for loading.

Notices are given on p. 1035, "*Mech. Dict.,*" of the invention of Eads (1865–1871).

Moncrieff has another form. See HYDRO-PNEUMATIC GUN-CARRIAGE.

3. The use of the air-spring in car-springs is shown in Figs. 3852, 3853, p. 1755, "*Mech. Dict.*"

4. The air-spring is used in the spring hammer of Hotchkiss, air being used as the elastic medium, holes in the reciprocating cylinder allowing free ingress and egress of air, insuring a perfect cushion at each stroke.

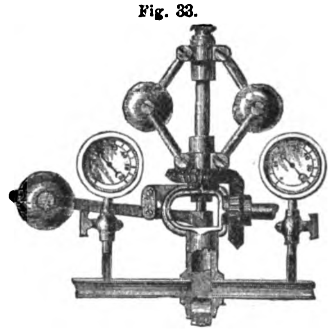
U. S. PATENTS FOR AIR AND PNEUMATIC SPRINGS.

4,965	Pneumatic Spring (Railway).
9,107	Car Spring.
13,248 . . .	Pneumatic Spring (Carriage).
19,764 . . .	Pneumatic Spring (Railway).
24,184	Air Spring for Cars and Wagons.
32,848	Pneumatic Spring (Carriage).
51,956	Pneumatic Spring for Cars, etc.
65,135	Pneumatic Spring (Railway).
70,177	Pneumatic Spring (Railway).
83,043	Air Spring (Railway).
87,307	Pneumatic Spring (Railway).
90,657	Air Spring (Railway).
111,303	Pneumatic Spring (Railway).
111,438	Pneu. and Rubber Spring (Railway).
125,749	Pneumatic Spring (Railway)
139,346	Automatic Vent-opener for Air-springs.

Air'-spring Gov'er-nor. An attachment to an air-spring arrangement to regulate the pressure.

The instance illustrated represents the governor attached to an improved form of flat-bed printing press, to regulate the pressure of the air in the recoil spring. Fig. 33 shows the governor attached to the connecting pipe, with the plug valve, which it operates, and two spring gages to indicate the amount of condensation in the cylinders. The valve is shut by the motion of the press when running at speed, and is open when the press is at rest. This enables the press to be started at any point without helping it over the centers by hand. The spring gages indicate the pressure in the air cylinders, and this is determined by setting the plungers backward or forward on their rods, readily adjusting the amount of spring to the speed of the press. The press is furnished with a table showing the gage pressures indicating the amount of spring required for the different speeds run. The workman simply adjusts the plungers until the gages indicate the pressure laid down on the table.

Fig. 33.



Air-spring Governor.

Air Strain'er. A gauze or perforated plate to prevent ingress with the air, of dirt, dust, or insects. Such are used with the pump of the railway air-brake, in filtering the air for ventilation, etc.

See also AIR FILTER.

Air Tel'e-graph. A mode of communication known in France under the name of Sonnerie télégraphique, système Sparre. The principle is, that a compression of air produced by the pressure on or squeezing of an India-rubber ball at one end of a long tube (generally a leaden pipe) is immediately transmitted to the other, and there makes audible signals. This mode of telegraphing is used in hotels, manufactories, vessels, etc., for limited distances.

Generally known as *Pneumatic telegraph*, and illustrated by Fig. 3854, on p. 1755, "*Mech. Dict.*"

Air Test'ing. To detect the presence of miner's fire-damp, various instruments have been employed. See FIRE-DAMP DETECTOR; GRISOUMETER.

Professor Wanklyn and W. J. Cooper have brought before the Sanitary Institute of England a new process for testing air. A strongly alkaline solution of permanganate of potassium is prepared, the strength of which is determined accurately. They allow a known volume of this solution to act on a given volume of air heated nearly to the temperature of boiling water. After allowing the solution to act on the air they again determine the strength; the loss of strength represents the amount of oxygen consumed by a known volume of air. The purer the air the less the consumption of oxygen.

Air Ther-mom'e-ter. In a loan collection of scientific apparatus lately exhibited at the "South Kensington Museum," London, the air thermometer of Galileo was shown. It was substantially like that of Santorio, of Padua, shown at Fig. 116, p. 53, "*Mech. Dict.*" The illustration in the "*Illustrated London News*" of the period is reproduced in "*Scientific American Supplement*," p. 742.

The same work, at p. 8929, gives an account of Witz's air thermometer.

For Winstanley's air thermometer, see "*Engineering*," * xxx., 459.

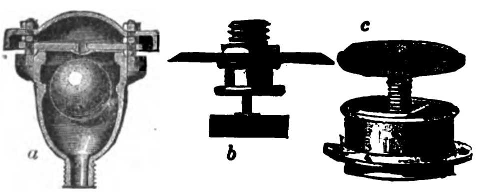
Air Trap. A device in a conduit to allow air to escape at the more elevated portions where it passes over summits.

A stop-cock, to be used as occasion may require, is the simplest form, but automatic appliances have been invented. That of Felix (French), used on the pipe-lines for the conveyance of beet-juice, is an iron bell tested to 15 atmospheres, placed at an elevated point on the pipe, where it is adjusted by two opposite tubulures soldered to its lower part. In the center is a pump cylinder in which slides a piston, the rod of which passes through the summit of the bell and communicates motion to a safety-valve. The air rises to the summit of this, passes into the cylinder, and gradually exercises a sufficiently strong pressure upon the piston to cause it to descend and open the escape-valve. A large portion of the air is ejected, the piston rises and closes the valve, and so on.

Air Valve. A valve to regulate the admission or egress of air.

1. Such are used in bends and traps of water-pipes to allow escape of accumulated air; as in *a* of Fig. 34.

Fig. 34.



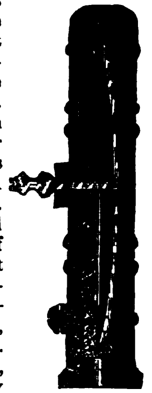
Air Valves.

2. A valve to be operated by a float to close a pipe communicating with a cistern (*b*).

3. A screw valve, *c*, to close the opening of an air reservoir; such as an air cushion, for instance.

4. An automatic air valve is shown in Fig. 35. It consists of an oblate spheroidal disk placed in a chamber, and having attached to its radial axis a valve, which has its seat in the passage to be guarded. Changes in the heat of the disk chamber affect the oblateness of the disk and move the valve toward or from its seat. Expansion by heat acting in greater degree upon the exterior surface decreases the oblateness and shuts the valve opening. A curved plate would act similarly. A plate of two metals of unequal expansibility by a given degree of heat would do the same without being normally curved. See instances of thermostatic arrangement in LOW-WATER ALARMS (2), *D E* of Fig. 3008, p. 1359, "*Mech. Dict.*" See, also, THERMOSTAT, pp. 2551, 2552, *Ibid.*, especially Fig. 6374, p. 2552.

Fig. 35.



Self-acting Air Valve.

Al'a-bas'ter Im'i-ta'tion. Coat a statue of plaster-of-paris, or of papier-maché, with thick white damar varnish, and then dust with a pulverized glass.

To give it the appearance of Carrara marble, varnish it a second time, and dust it with coarsely pulverized white glass or mica. If the marble veins be first traced on it with some delicate blue pigment, the imitation will be enhanced.

Paraffine wax makes a fine imitation of alabaster.

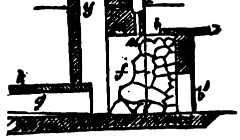
Another recipe for imitating alabaster ornaments prescribes brushing over plaster-of-paris models with spermaceti, white wax, or a mixture of the two, or steeping the models in the warm mixture. Or instead of this process, they may be brushed over several times with white of egg, allowing each coating sufficient time to dry.

A-lan'dier. (*Ceramics, French.*) A species of fire-place, of which several are placed around the base of a porcelain kiln, fed from the outside. Some of them have a downward draft on to the fire, from which the flames are conducted into the body of the kiln; others are ordinary furnaces at the base of the kiln.

The porcelain kilns of Sèvres, and the fine faïence kilns of Staffordshire, have furnaces of this kind.

In the figure: —

Fig. 36.



Furnace à Alandier.

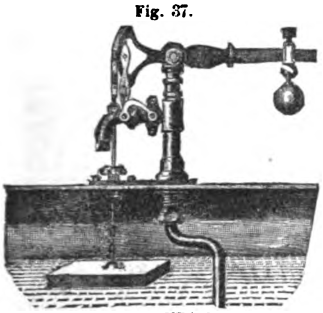
f, Is the fire.
b', Entrance of air.
b, Opening used only in starting the fire.
y, Chimney leading into the kiln.
g, Duct for flame below the kiln floor *k*.
x, *v*, Openings to examine contents of kiln.
u, Duct for cold air when required.

A-larm' Whis'tle. (*Steam.*) One constructed to be automatically sounded when water in the boiler sinks below a certain level.

In Fig. 37, the sinking of the float moves the counter-weighted lever and opens the valve, which permits steam to escape to the whistle.

Alarm whistles have also been constructed, to be sounded when the abnormal heat of a chamber, acting upon a thermostat, gives an alarm of fire. Tampering with a lock or a safe may, by electric connection, produce the same effect.

Fig. 37.



Alarm Whistle.

The alarm water-gage of *Ledent*, of Liége, is shown in "*Scientific American Supplement*," * 3899.

Al'bert-type. A printing process from films of bichromated gelatine exposed in a camera. See p. 57, "*Mech. Dict.*"

A modified Albert-type process, to produce colored pictures, was described in the New York "*World*," and the article reproduced in the "*Scientific American Supplement*," p. 2079.

The Albert process is described at length on p. 18 of the Report of Dr. C. A. Doremus, "*Vienna Exposition Reports*," vol. ii., section D.

Al'bo-car'bon Light. One in which the ordinary illuminating gas is enriched by the volatilization of so-called *albo-carbon*, the solid residuum of creosote, placed in the form of cylinders in a reservoir adjoining the burner, and heated thereby.

"*Engineering*"	xxvii., p. 157
"*Scientific American*"	xl., p. 201.

Al-bu'men-ized Pa'per. Paper prepared for photographic uses by dipping in a bath of white of egg, drying, and pressing.

Al'co-hol En'gine. In this connection the following items may be considered, in addition to the notices on pp. 58, 59, "*Mech. Dict.*"

Abbé d'Hauteville (1682) describes an engine, the action of which was produced by alternately evaporating and condensing, without allowing it to escape. — "*Reflexions sur quelques Machines à elever des Eaux*," p. 9. Paris, 1682.

See, also, English patent, No. 5,262 of 1825.

See, also, No. 9,118 of 1841. Tubes of alcohol or ether in a steam boiler, and connecting with a cylinder, the latter with a condenser. Vapor re-used.

Also, W. Ketland, Eng. Patent, No. 7,526 of 1838. Applies alcohol to condense steam that has worked an engine and uses the vapor generated to work another engine. Saves the condensed spirit vapor.

Al'co-hol'me-ter. The alcoholmeter of Dr. Siemens is an instrument by which a stream of alcohol and water mixed in any proportion is measured in such a manner that one train of counter wheels records the volume of the mixed liquor, while a second counter gives a true record of the amount of alcohol contained in it.

"The volume of liquid is passed through a revolving drum, divided into three compartments by radial divisions, and not dissimilar in appearance to an ordinary wet gasmeter; the revolutions of this drum produce a record of the total volume of passing liquid. The liquid, on its way to the measuring-drum, passes through a receiver containing a float of thin metal filled with proof-spirit, which float is partially supported by means of a carefully adjusted spring, and its position determines that of a lever, the angular position of which causes the alcohol counter to rotate more or less for every revolution of the measuring-drum. Thus, if water only passes through the apparatus, the lever in question stands at its lowest position, when the rotation motion of the drum will not be communicated to the alcohol counter, but in proportion as the lever ascends a greater proportion of the motion of the drum will be communicated to the alcohol counter, and this motion is rendered strictly proportionate to the alcohol contained in the liquid, allowance being made in the instrument for the change of volume due to chemical affinity between the two liquids." — *Nature*.

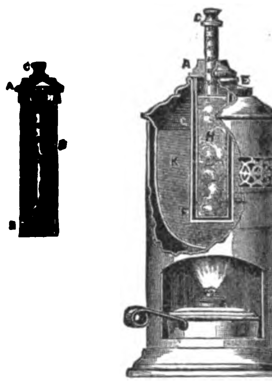
Ale Re-frig'er-a'tor. 1. An apparatus in which malt liquor is cooled either by surface exposure; in pipes exposed to a cool bath; or in a vessel traversed by pipes containing a refrigerating liquid. See Fig. 631, p. 264, "*Mech. Dict.*;" see, also, devices in CONDENSER, *Ibid.*

2. A case or box in which barreled beer is kept for dispensing. See Fig. 632, p. 265, "*Mech. Dict.*"

Al'eu-rom'e-ter. An instrument invented by M. Boland to measure the elasticity of the gluten of flour, when submitted to the temperature required to bake bread. Described, without cut, on p. 60, "*Mech. Dict.*"

The apparatus has a bath, *K*, of neat's-foot oil, beneath which is a lamp. The bath being heated to 318 F. (150 C.), the cover *E*, with the tube *F*, are lowered and then the aleurometer proper is put in. This is a brass tube, *D*, with a movable base-piece, *B*, and a cap, *A*, in which is a piston, *C*, the upper part of which has a scale graduated from 25 to 50. The piston being down, half the space beneath it is filled with a ball of gluten, prepared by kneading and working flour. The effect of the heat is to evaporate the water of the gluten (66 per cent.) and the gluten swells. Until it has doubled its volume the piston is not moved. Beyond this it registers from 25 to 50. Gluten which does not more than double in volume is not fit for bread, and the best has not exceeded 50.

Fig. 38.



Boland's Aleurometer.

"*Sc. American Supplement*"	* p. 1871.
"*English Mechanic*"	* xxvi. 85.
"*Sc. American*" (by chloroform) . .	xxxvi. 323; xxxvii. 120, 258.
"*Leffel's Milling and Mech. News*" .	* vii. 83.
"*American Miller*"	* vii. 59.

Al'ge-rine'. (*Fabric.*) An all-wool French goods.

Al'i-dade. 1. The movable arm of a graduated instrument carrying sights, or a telescope.

2. A theodolite, or telemeter, provided with such an arm.

Two Viennese alidades shown in the Austrian Exhibition may be noticed: —

"Kraft & Son, of Vienna, had on exhibition an alidade, of which the pillar carrying the telescope was swung on a joint, so that both pillar and telescope could be lowered and made to lie flat and parallel with the rule. The object of this rather hazardous variation from the ordinary construction was to make the instrument more portable by reducing the size of its packing-box.

"Starke & Kammerer, instrument-makers for the Austrian Polytechnic Bureau, exhibited an alidade, with a telemeter attached to and parallel with the telescope, by which the distance of the instrument from the divided staff was determined by the angle subtended by two fixed points on the staff. In other cases, the distance was obtained by observing the vertical distance on the staff subtended by a known angle or two fixed wires in the diaphragm of the telescope." — Report of R. D. Cutts, "*Instruments of Precision*," Vienna Exposition Reports, vol. ii.; § II, p. 8.

Al'i-ment'a-ry Ap'pa-ra'tus. (*Surgical.*) Devices for feeding the helpless or refractory, such are: —

Nasal, esophageal, rectal. See Figs. 403–405, p. 101, Part II., *Tiemann's "Armamentarium Chirurgicum."*

Masticator, Fig. 406, *Ibid.;* and Fig. 3087, p. 1407, "*Mech. Dict.*"

A-liz'a-rine. The coloring principle of madder. It is made artificially from anthracine, a white crystalline substance obtained from coal-tar, which contains about 0.63 per cent. of anthracine.

Paper by Johnson	"*Sc. American Sup.*," 2128.
Alizarine. *Rumpff*	"*Sc. American Sup.*," 620.
Alizarine Blue. *Prud'hommé* .	"*Sc. American Sup.*," 2080.
Alizarine, Printing with . .	"*Sc. American Sup.*," 619.
Alizarine	"*Sc. American*," xli. 232.

Al'li-ga'tor For'ceps. (*Surgical.*) Forceps with long jaws toothed throughout their length.

Such are Thompson's urethral forceps for lithotrity; Figs. 169–171, p. 45, Part III., *Tiemann's "Armamentarium Chirurgicum."*

Farabeuf's and *Hamilton's* Osteophors, Figs. 53 *b*, 53 *c*, p. 12, Part I., *Ibid.*

And numerous other instances.

Al'li-ga'tor Leath'er. The tanning of alligator skins was commenced about 1855, and now from 17,000 to 20,000 are tanned yearly, which are consumed by boot and shoe manufacturers in the United States, as well as exported to London and Hamburg.

Al-loy'. Tellurium has been proposed as a substitute for copper as an alloy for gold and silver in coinage. "*Engineer*," San Francisco.

The Japanese alloys are mostly used for ornamental castings, statues, musical instruments, and bells. The name given to an alloy generally corresponds to the color produced by the treatment which the objects have to undergo before they are finished; thus some of the alloys are named *green copper, violet copper, black copper*, etc. This color depends both upon the composition of the alloy and the chemicals used in coloring the metal. There are many different means used to produce one and the same color, and it so happens that almost every manufacturer uses particular compositions of his own; generally it is only the proportions that differ, but sometimes even the constituent elements are different, although the alloy is called by the same name.

Green copper (*Sei-Do*) is composed of copper and lead, or copper, lead, and tin.

Sentoku-do of copper, lead, and spelter — similar to the old Corinthian alloy — is said to have been first produced by a large conflagration which took place in China during the earlier part of the fifteenth century.

Black alloy called *U-do*, of copper, lead, and tin; the brass, of copper and spelter, sometimes with a slight addition of lead, as, for instance, in Yechiu, one of the chief places of production of ornamental castings inlaid with gold and silver; the purple alloy is composed of copper and lead.

Gin-shibu-ichi is generally composed of four parts of copper or alloy and six parts of silver.

Shaku-do, copper with a small percentage (two to five per cent.) of gold, which produces a beautiful dark blue color, and is mostly used for articles formed by hammering, or for *repoussé* work, generally inlaid with gold and silver, and producing designs somewhat similar to *Niello*.

Bronze for locomotive whistles: —

Copper	80
Tin	18
Antimony	2
	100

Bronze for ball valves and pieces to be brazed: —

Copper	87
Tin	12
Antimony	1
	100

For working models; easily wrought: —

Copper	4
Tin	1
Zinc	0.25

Phosphor-tin for journal boxes: —

Tin with from 2.5 to 5 per cent. of phosphorus.

Ravenue & Co., of Berlin, Ger., "*Sc. Am.*," xl. 118.

Professor Silliman's process of making articles of metallic alloys resonant consists in exposing them for a determinate time to a temperature just short (say within 10° Fah.) of their melting point. This is claimed to endow them with a musical quality. — "*Scientific American Supplement*," 182.

An alloy by Matthey, of London: —

Platinum	80.660
Iridium	19.079
Rhodium	.122
Iron	.098
Ruthenium	.046

Density at 32° Fah., 21.6139.

This is so malleable and ductile, that it may be drawn to a wire a few hundredths of a mm. in diameter.

Organ pipe metal: —

Tin and lead in equal parts, cast into sheets and smoothed with a *planer;* that is, with a flat block beaten by a hammer.

White alloy, by Beirman & Clodius, of Hanover: —

Copper	72.25
Manganese	16.25
Zinc	8.75
Iron	2.50

This alloy is malleable, does not change when immersed in water for forty days, takes the silver plating well, but is a little yellowish.

White alloy, by Le Marquand, of Paris. It is not liable to oxidation: —

Copper	750 parts.
Nickel	140
Oxide of cobalt	20
Tin	18
Zinc	72
	1,000

Alloy, for jewelry, having the appearance of red gold $\frac{750}{1000}$ fine. By Meiffren & Co., Marseilles: —

Copper	800
Platinum	25
Tungstic acid	10
Gold	170

The three former are melted together in a crucible, and then granulated in —

Water	1 cubic meter.
Slaked lime	500 grams.
Carb. potassa	500 grams.

The granulated metal is dried, remelted, and the gold added.

The flux consists of boric acid, nitrate of sodium, and chloride sodium in equal proportions.

Alloy for jewelry, in imitation of silver — sideraphthite — (unchangeable iron), by Meiffren & Co., Marseilles: —

Iron	65
Nickel	23
Tungsten	4
Aluminum	5
Copper	5

The first two are melted together and granulated in a bath of —

Water	1 cub. meter.
Slaked lime	1 kilo.
Carb. potassa	1 kilo.

The latter three ingredients are similarly treated. The flux is one part boric acid to one of nitrate of potassium. Sodium and charcoal are added in melting the last-mentioned batch. The separate batches of granulated metal are then melted together.

The following patents may be consulted: —

Aluminum bronze	223,900	*Webster*	Nov. 2, 1880
Manganese bronze	206,604	*Parsons*	July 30, 1878
Nickel-zinc	225,977	*Fleitmann*	Mar. 30, 1880
Journal-box metal	179,616	*Schoenberg*	July 4, 1876
Metal coating alloy	234,482	*Jones*	Nov. 16, 1880
Bell-metal alloy	169,648	*Macker*	Nov. 9, 1875
Mock silver	153,154	*Campbell*	July 21, 1874
Coin alloy	219,265	*Hubbell*	Sept. 2, 1879
Coin alloy	191,146	*Hubbell*	May 22, 1877
Coin alloy	209,265	*Hubbell*	Oct. 22, 1878
Coin alloy	219,097	*Hubbell*	Sept. 2, 1879
Plating alloy	194,365	*Page*	Aug. 21, 1877
Shot alloy	204,856	*Sparks*	June 11, 1878
Manganese alloy	178,490	*Ward*	June 6, 1876
Anti-incrustation alloy	169,810	*Holden*	Nov. 9, 1875
Aluminum alloy	220,149	*Howard*	Sept. 30, 1879
Coin alloy	211,630	*Hubbell*	Jan. 28, 1879
Coin alloy	211,909	*Hubbell*	Feb. 4, 1879
Manganese bronze	203,266	*Hale*	May 7, 1878
Journal-bearing alloy tin, copper, antimony	221,400	*Downs*	Nov. 11, 1879
Door-knob alloy	149,506	*Morand*	April 7, 1874

See also ANTI-FRICTION METAL.

Notices are to be found under the following heads: —

Aluminium bronze.	Ferro-silicium.
Anti-friction alloy.	Fusible metals.
Anti-incrustation alloy.	Gold alloy.
Bell metal.	Lubricant alloy.
Brass.	Manganese bronze.
Bronze.	Metallikon.
Bronze iron.	Melting point of alloys.
Chromeisen.	Phosphor bronze.
Chrysoid.	Phosphor tin.
Dysiot.	Sideraphthite.
Electro-silicon.	Silver alloy.
Ferro manganese.	Solder.

Numerous recipes for alloys for solder, fusible plugs, white metal, type metal, jewelers' uses, and various mechanical purposes, are given under ALLOYS, pp. 61–68 of "*Mech. Dict.*" On p. 68 of that volume is a list of 77 alloys, which are considered in their alphabetical order in the volumes of "*Mech. Dict.*"

The following works treat on the subject: —

Guettier's "*Metallic Alloys.*" (Translated from the French.)
Scoffren's "*Useful Metals and their Alloys.*"
Collins's "*Useful Alloys.*"
Overman's "*Metallurgy.*"
Larkin's "*Practical Brass and Iron Founders' Guide.*"
Graham's "*Brass-founders' Manual.*"
Greenwood's "*Manual of Metallurgy.*"
Spretson's "*Practical Treatise on Casting and Founding.*"

Al'lu-mette'. A match or taper for lighting a lamp or candle.

Al-lu'vi-um. (*Mining.*) A deposit of loose gravel between the superficial covering of vegetable mould and subjacent rock.

Al'man-riv'et. (From *Allemand.*) A form of joint in German armor in which the plates were slotted to slide on rivets to give flexibility to the armor.

Al-pac'a. (*Fabric.*) 1. A taffeta woven goods made of alpaca wool.

2. A dress goods of cotton chain and long luster wool weft.

3. Figured fancy weaving makes *fancy alpaca.*

Al-pa'ga. (*Fabric.*) A French dress goods made in a taffeta loom. It has a cotton warp and Lincoln wool weft.

Al'pine. (*Fabric.*) A French goods, made on a "serge 2 and 1" loom; silk warp and merino wool weft.

Alt-az'i-muth In'stru-ment. A theodolite with adjustments for altitude and azimuth.

Al'ter-na'ting Cur'rent Ma-chine'. (*Electricity.*) One in which the current traverses in opposite directions alternately, as in the Gramme machine used with the Jablochkoff light.

* "*Telegraphic Journal,*" vi. 491.

Al'ti-tude Meas'u-rer. Pickering's altitude instrument is designed for measuring the distances and heights of mountains. It consists of a common telescope, with a level attached, a scale of equal parts in the eye-piece, and with a mirror of plate-glass fastened to the object-glass, so that it can be set at any angle. Two images are seen, one through the glass, and the other by reflection from its surface, and any two objects may be made apparently to coincide by turning the mirror through the proper angle. Selecting as our object the mountain whose distance is to be measured, and as the other any convenient, well-defined point, the telescope is moved through a known distance, and the apparent change of position of the two images is measured by the scale. The altitude is then determined by leveling the telescope and reading the apparent elevation from the graduated scale, which is now turned round. By a second inclined level higher mountains may be measured.

Al'um Bat'te-ry. (*Electricity.*) Useful in operating open circuit. It consists of zinc and copper, or zinc and carbon, without porous cups, immersed in a concentrated solution of alum.

Sabine, "*Electric Telegraph,*" 1867, p. 228.
Niaudet, American Translation, New York, p. 78.

Al u-min'i-um. The metallic base of clay. A white, sonorous metal of increasing importance.

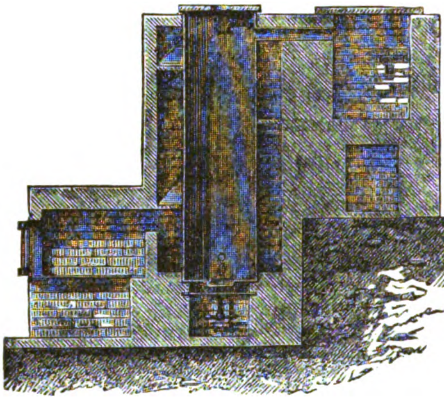
The history of the production of the chloride of aluminium from alumina, by Oerstedt, the segregation of a gray metallic powder, by Wöhler, in 1827, and the production of metallic globules of aluminium by the last named in 1845, are mentioned on p. 70 of "*Mech. Dict.*" The modification of the Wöhler method, by M. H. Deville, in his works at Javelle, near Paris, under the patronage of Napoleon III., about 1857, are also referred to. The Deville process of that time is described with more detail in *Laboulaye's* "*Dictionnaire des Arts et Manufactures,*" tome iv., article "*Aluminium*" (edition of 1877), but more recent improvements have rendered it unnecessary to redescribe it.

Very important in this connection are the successes of M. Deville in the production of sodium, so necessary in the aluminium process. Starting with the foothold acquired by MM. Mareska and Donny, who published a work on the extraction of sodium in 1852, "M. Deville has arrived at the production of sodium with a facility and in such abundance as but a short time ago would have been regarded as impossible." — *Laboulaye.* See the Dictionary above referred to for details of the sodium process.

"It is now certain that the fabrication of sodium is at least as easy as that of zinc, with which it has, for that matter, a very strong analogy." — *Dumas.*

Aluminium (by the later Deville process) is manufactured by decomposing the double chloride of aluminium and sodium (cryolite), with the aid of metallic sodium. The sodium is obtained by heating to redness a mixture of 100 parts of calcined soda, 15 parts of chalk, and 45 parts of coal. The chloride of aluminium is prepared by passing chlorine gas over a moderately heated mixture of pure alumina (obtained either from alum or the mineral bauxite), common salt and coal tar. The idea of this mode of producing the chloride of aluminium is attributed to Thénard, and its first execution to Oerstedt, but it passed from a laboratory expedient to a practical use in the hands of M. Deville.

Fig. 39.



Deville's Chloride of Aluminium Apparatus.

The operation is conducted in an iron gas-retort, and the result of the interaction of the several substances present is the combination of the coal tar with the oxygen of the alumina, and the production of aluminium chloride, which unites with the chloride of sodium (common salt), forming a double salt, which volatilizes and is passed off into a separate chamber, where it condenses. From this method of obtaining the chloride, it is impossible to keep it free from chloride of iron, for which reason the Parisian aluminium is invariably adulterated therewith. From this double chloride of aluminium and sodium the metallic aluminium is obtained, either by passing it in the form of vapor over a heated surface of metallic sodium, in a simply constructed and connected system of iron cylinders appropriately heated, or the materials are at once mixed and heated.

The apparatus of M. Deville is shown in Fig. 36. The principal feature is a retort of fire-clay, like those used in gas-works, but set upright in the furnace. The retort has a capacity of 300 liters, and is heated by an envelope of flame, which follows a spiral course around it. It is pierced with three openings, two near the bottom, and two at and near the top. The opening *O*, near the bottom, is for a tuyere of porcelain, which reaches to the axis of the retort and introduces the chlorine gas into the charge. A second opening, opposite the former, is for cleaning out the debris of the exhausted charge.

Of the openings above, one on top is for the introduction of the charge, and the other at the side leads the volatile choride of aluminium into a condenser chamber, L, of masonry; or it may be made of boiler iron, and lined with glazed faïence tiles. The condensing chamber itself has a conduit for the escape of waste gaseous products.

The alumina employed is the result of the calcination of ammoniacal alum or sulphate of alumina. In place of adding to the alumina, first the pulverized coal, and then the oil, to render the mixture plastic, Deville employed simply coal tar, the refuse of the gas-works, which is very cheap and replaces the oil and coal. This mélange is calcined in earthen pots in a reverberatory, heated from the waste heat of the chloride furnace.

The mixture, being calcined, is charged into the retort, and the heat is gradually raised to a red. The current of chlorine gas is then introduced by the tuyere previously referred to, the production of gas being in stoneware pots containing peroxide of manganese and hydrochloric acid, heated in a sand-bath.

The chlorine does not attack the retort, but follows its axis in an upward direction, not extending laterally more than two decimeters, so that the sides of the retort are protected by a thickness of the charge not attacked by the gas. The chlorine is totally absorbed, and does not even show a trace in the condenser.

Rousseau has a substitute process, in the heating of a mélange of sea-salt, alumina, and coal, producing a liquid chloride which condenses continuously.

The employment of Greenland cryolite, which is a double fluoride of aluminium and sodium, is attributed to Rose, of Berlin. The cryolite is heated with an excess of sodium, when metallic aluminium and fluoride of sodium are produced, and the latter compound gotten rid of by treatment of the mass with caustic lime.

Of late, the metal has been manufactured from the mineral *bauxite*, especially at the factory in Salindres, near Alais (*Gard*), France. There the *bauxite* is heated with soda in a reverberatory furnace, the resulting aluminate of soda is extracted by means of water, and alumina precipitated by a stream of carbonic acid; this is then formed into balls, with salt and coal, and heated to a white heat in vertical retorts during the introduction of chlorine gas. The double chloride of sodium and aluminium, which distills over, is fused with the addition of 35 per cent. of sodium and 40 per cent. of cryolite as a flux, and the metal which settles at the bottom of the crucible is poured into molds. The cost of producing one kilog. of aluminium is stated to be 80 f., while the selling price is 100 f.

The employment of *bauxite* (*l'argile des Baux*) has served as a new point of departure in the aluminium industry, having more than any other increased the scale of production and the diminution of price of the metal. This may now be said, in round numbers, to cost but half as much as silver, and as it is but one quarter the weight of the latter, the metal for an object of a certain size in aluminium costs but one eighth of the same dimensions in silver.

Wilde's process has attained some notoriety.

Lead or sulphide of lead melted is poured on dried or burned alum; the result is crucibled with fluxes, the resulting metallic mass contains aluminium, which is separated, or the alloy can be used for some purposes.

Aluminium resists the action of the air, sulphurous gas from coal, weak acids, but is attacked by alkalies. It molds well. Its appearance resembles oxidized silver and makes it suitable for statuettes and vases; it is useful for culinary vessels, bottoms of sirup pans, and in many cases where its extreme lightness is an important consideration.

The difficult problem of soldering aluminium, seems to be resolved by the use of the alloys of that metal with zinc. See also ALUMINIUM SOLDER.

At present there are three aluminium works in France and one in England. Their total production amounts to about $17,500 yearly, of which $10,000 are produced in France, and $7,500 in England.

The following references may be consulted:—

"Scientific American."

Uses	xxiv. 136: xxxvii. 153.
In Telegraphy	xl. 232; xliii. 106.
Manufacture	xxxviii. 121; xl. 197.

"Scientific American Supplement."

Uses	*552, 798, 1635, 3058, 3509, 3923, 3906.
In Telegraphy	3502.
Manufacture	3906.
Gallium Alloy	3394, 2153, 2345.
At Paris Exposition	2511, 2519.
Wearing Properties	1213.
Production	1337, 1366.
Oxidation	2170.

"Iron Age."

Uses	xvii., May 18, p. 7.
Uses and Articles	xxiv., August 7, p. 7.
In Telegraphy	xxiv., September 4, p. 1.
Resistance to Oxidation	xix., May 24, p. 15.
Electro-plating	xiv., January 25, p. 25.
Making	xx., July 26, p. 24.
In Germany	xxiii., April 10, p. 7.
Alloys	xxiv., December 11, p. 13.

"Engineering & Mining Journal."

Uses	xxi. 582; xxiii. 157, 262, 302; xxix. 355, 409.
Making	xxv. 80; xxvii. 28.
In Germany	xxvii. 279.
Bronze	xxvi. 354.
Alloys	xxix. 85, 186, 188.
In Telegraphy	xxv. 260; xxviii. 6; xxix. 186, 188.

"Mining & Scientific Press."

Uses	xxxii. 198; xxxvi. 115.
Wire	xl. 83.

"Leffel's Milling & Mech. News."

Uses	ix. 131.

"Van Nostrand's Engineering Mag."

Making	xxiii. 280.

"Manufacturer & Builder."

Uses, etc.	ix. 270; xii. 71, 143, 162.
Manufacture	xii. 127, 162.
Alloys	ix. 201; x. 182.
Cost: Coins	xi. 120.
Bronze	viii. 240.

"Telegraphic Journal."

In Telegraphy	vii. 53.

"English Mechanic."

Its Future	xxiii. 454.
The Metal	xxiii 97.
Alloys	xxv. 228.

United States Patents.

Manufacture	*Howard.*	220,148	Sept. 30, 1879.
Manufacture of Alloys	*Howard.*	220,149	Sept. 30, 1879.
English Patent	*Thompson.*	2,101	Mar. 27, 1879.

Al'u-min'i-um Al-loy'. Aluminium now enters as an ingredient into various alloys; that with copper is perhaps the most notable. See ALUMINIUM BRONZE.

Alloyed with 10 per cent. of copper, the alloy remains ductile.

Alloyed with small quantities of zinc, tin, gold, or silver, it remains ductile, but is rendered harder and more brilliant.

Alloyed with 3 per cent. of zinc, is a superior metal. — *Débray.*

Alloyed with 7 per cent. of tin, can be worked, does not take a fine polish, but is rendered non-homogeneous by fusion.

Does not alloy with lead.

Alloyed with 3 per cent. of silver, is of beautiful color.

With 50 per cent. of silver, is hard as bronze.

With 1 per cent. of gold, is hard, ductile, and greenish.

With 10 per cent. of gold, is crystalline.

With 5 per cent. of silver, can be worked like pure aluminium, but is harder, takes a fine polish. See also p. 71, *"Mech. Dict."*

With 4 per cent. of silver, it is used by Sartorius, of Göttingen, for the beams of analytical balances.

One per cent. of aluminium with copper makes the latter more ductile, more fusible, enables it to fill the mold better, harder, more capable of resisting chemical re-agents.

Copper, with 2 per cent. of aluminium, is used by Christofle, in Paris, for works of art, and numerous " Articles de Paris."

True aluminium bronze has from 5 to 10 per cent. of aluminium. See ALUMINIUM BRONZE.

Silver, with 5 per cent. of aluminium, is hard as coin-silver, and is excellent for coinage.

Al'u-min'i-um Bat'te-ry. (*Electricity.*) One in which one or both of the elements consists of a plate of aluminium.

Al'u-min'i-um Bronze. An alloy credited to M. Débray, in which aluminium takes the place of tin or zinc, in combination with copper, to form a bronze.

This application of aluminium is at present the most important use of the metal. Even so small an addition as 1 per cent. of aluminium to copper considerably increases its ductility and fusibility, and imparts to it the property of completely filling the mold, making a dense casting free from air-bubbles. At the same time the copper becomes more resistant of chemical re-agents, increases in hardness without losing in malleability, and unites in itself the most valuable qualities of bronze and brass. The " alloy formed of copper 9 and alluminium 1, constitutes a new precious metal for industrial uses, which will find still more numerous applications when its price, still rather high (15 fr. the kilo), shall be reduced." — *Laboulaye.*

On account of its grain, it is especially suitable for parts subjected to friction, and slides of locomotives lined with aluminium bronze have outlasted more than twofold those of ordinary bronze. Besides its great tenacity, which much extends its applicability, it can, like iron, — and it is the only alloy which possesses that property, — be welded and hammered hot, at a distance sufficiently remote from its point of fusion.

The true aluminium bronzes, according to Rudolph Wagner, were first made by John Percy, in 1856. They are alloys containing 90 to 95 per cent. of copper, with 10 to 5 per cent. of aluminium. The direct mixture, by first fusion, of 10 parts of aluminium and 90 of copper, gives a brittle alloy, which, however, increases in strength and tenacity by several successive fusions. At each operation a little aluminium is lost. After the compound has been melted three or four times, however, the proportion of aluminium does not appear to change, and the alloy may be again re-melted several times without alteration. These fusions are effected in crucibles. The aluminium bronze is homogeneous, and possesses sufficient expansion to fill the remotest parts of the mold. It affords sharp castings that can be worked more readily than steel. Aluminium bronze may be forged at a dull-red heat, and hammered until cooled off without presenting any flaws or cracks. Like copper, it is rendered milder and more ductile by being plunged into cold water when hot. The bronze polishes beautifully, and possesses great strength — according to Anderson's experiments, an average of 75,618½ lbs. per square inch. The resistance to compression is feeble. From the experiments of Col. Strange on the relative rigidity of brass, ordinary and aluminium bronze, it appears that the last named is four times as rigid as brass, and three times as rigid as ordinary bronze.

According to M. Morin, the director of the manufactory of Nanterre, very homogeneous alloys are obtained with copper and 5, 7½, and 10 per cent. of aluminium. The alloys with 5 and 10 per cent. of aluminium are both of a golden color, whilst that with 7½ per cent. has a greenish tint. A copper alloy with 2 per cent. of aluminium is said to be used in the Parisian ateliers, for works of art. It works well under the chisel and graver.

It is considered excellent for organ reeds, giving a better tone than brass or German silver. Also used for piano strings, and vibrating bars of music-boxes.

The uses of aluminium bronze in making various articles, such as cutlery, hardware, works of art, etc., and by M. Hulot, of the Postage Stamp Factory in Paris, are mentioned on pp. 70, 71, "*Mech. Dict.*;" and the series of Farmer's aluminium alloys is given on p. 71, *Ibid.*

The popularity of aluminium bronze is due to its beautiful golden color, which has enabled it to replace silver-gilt to a considerable extent. Its luster is very durable, which M. Debray explains by the great quantity of heat liberated when aluminium is combined with copper, showing that the alliance is very energetic and complete.

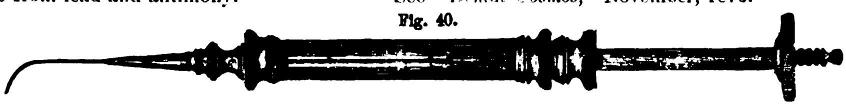
In England, kettles made of aluminium bronze are employed for making preserves and ices from acid fruits.

Morin & Co., of Nanterre, manufacture weavers' shuttles of bronze, which, of course, do not oxidize so readily as steel.

Cambrien recommends this alloy for type casting. Type made of it can be used fifty times as long as those from lead and antimony.

The alloy is largely used in the making of mathematical, optical, surgical, and scientific instruments.

Fig. 40.



Alveolar Abscess Syringe.

" Aluminium bronze is used in France for making the large preserving pans used by wholesale confectioners, and is recommended as an alloy in type metal. Lange, in Glashütte (Saxony), employs an aluminium in the manufacture of watch-springs. The new springs have the advantage over the old in not being subject to rust, in not being magnetic, and in possessing greater hardness and elasticity. An alloy of 100 parts aluminium and 5 silver can be worked like pure aluminium, but is harder, and takes a beautiful polish. An alloy of 5 parts aluminium and 100 silver is almost as hard as ordinary silver, but has the advantage over it of containing no metal which is of a poisonous nature, or which can effect a discoloration of the silver." — "*Engineering and Mining Journal*," xxiii. 157.

Farmer's series of aluminium bronzes are given on p. 71, second column. "*Mech. Dict.*" They are hard, tenacious, laminable, and ductile.

See United States Patents: —

220,149	*Howard* .	September 30, 1879.
223,900	*Webster* .	November 2, 1880.

See also: —

"*Manufacturer and Builder*," viii. 240.
"*Eng. and Mining Journal*," xxvi. 364.

Al′u-min′i-um Gold. A substitute for gold.

Copper	90
Aluminium	10
	100

Has a color like 14-carat gold.

Copper	85
Aluminium	10
Gold	5
	100

Has a color like 18-carat gold, and is an excellent alloy for jewelry, and should be soldered with brass, silver, or gold solders. Avoid all potash for cleansing or as flux for soldering.

See, also, four of Farmer's formulas for *chrysoid* (Cu. Al. Ag.; Cu. Al. Zn.; Cu. Al. Fe.; Cu. Al. Ni.), giving alloys which in color and texture resemble gold. Page 71, "*Mech. Dict.*"

Al′u-min′i-um Gun-met′al. Two per cent. of aluminium added to the usual gun-metal.

Declared by Schulter to be equal to steel for guns. Good for statues, and bells also.

Al′u-min′i-um Sil′ver.

Silver	1
Aluminium	4
	5

Melted together. Valuable in instruments in which lightness is an object, such as sextants, octants, etc., which will weigh in this alloy but about one quarter as much as if made of silver. Aluminium pure is too soft for such purposes and works with difficulty.

Al′u-min′i-um Sol′der.

	Gold.	Silver.	Copper.	Brass.
Hard . .	88	6	6	–
Medium .	54	28	18	–
Soft . . .	14	57	15	14

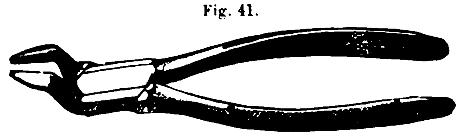
Bottone recommends in preference to coat the surfaces to be soldered with a layer of copper in electro bath, and then use ordinary solder.

Al′ve-o-lar Ab′scess Syr′inge. A syringe for injecting abscesses in the alveolar ridge or processes. It has straight or curved canulas for more convenient access to the parts.

See "*Dental Cosmos*," November, 1876.

Al′ve-o-lar For′ceps. (*Dentistry.*) Forceps for gnawing away portions of the alveolar process, or for extraction of fragment of roots beneath the summit of the alveolar ridge. They have variously shaped beaks: bayonet, straight, curved.

Fig. 41.



Bayonet-shaped Alveolar Forceps.

A-mal′ga-ma′tion. (*Galvanic Battery.*) Coating the zinc plate with mercury so as to present to the liquid a surface of metal which shall be equally affected by the excitant, in order to prevent the establishing of local currents, which the impurities of the zinc would otherwise occasion.

Ganot, "*Physics*," N. Y., 1877, pp. 684, 692.

It is usually done by cleansing the zinc plate with dilute sulphuric acid, and then rubbing over the surface a small quantity of mercury.

A-mal′ga-ma′tor. The amalgamating machinery exhibited by the Republic of Chili at Philadelphia, 1876, was a facsimile of the apparatus in use at Autofagosta, on a scale of ⅙th. It is under the system of Kröhnke. The series of machines and operations is as follows: —

The *washing and reduction* of the ore is accomplished by means of two vertical iron rollers, resting on an iron plate, and kept in motion, thereby producing the necessary friction. The rollers sit in an iron cup, into which the ores to be ground are received by means of a self-feeder. The water necessary is conducted to the cups by means of pipes, and is kept running continually. The reduced ore is carried with the water through gutters into the open, flat tanks below, and there allowed to settle; the water is then run off, and the ore carried to the drying shed.

In the *amalgamating* section are 12 large and 2 small revolving casks; 4 upright tanks, wherein the chemical solution is mixed: one washer; one centrifugal machine.

The powdered and dried ore is placed in the large casks, and mixed with sufficient cold water to saturate the whole thoroughly. The necessary quantity of the chemical solution from the tanks is then added, previously mixed with boiling salt water. After revolving the cask a sufficient length of time to transform the silver ore from a sulphite into a chloride, the quicksilver is added, and the whole subjected to the action of the amalgam. Thence the contents of the casks are run into the washer and there freed from the remaining impurities, acids, chemicals, etc., etc., leaving the pure silver and quicksilver. This then goes into the centrifugal machine, where the quicksilver is separated from the silver as much as this can be done by mechanical action. In case there should still be left some impurities, which may be easily detected by a dark color, the whole is returned to the two smaller casks, and there washed with boiling salt water, until its appearance shows the true silver color. It is then discharged and stamped into molds, to be ready for section three.

The *condensing and smelting* apparatus comprises four condensers and one smelting furnace.

The condenser consists of a cylindrical body closed hermetically at the upper end, while the lower end is open.

The cylinder or retort rests upon an iron plate, one third of which is below and two thirds is above the plate, this retort is surrounded by a furnace made of fire-brick. Below the retort is a mechanical apparatus, part of the machinery to be used to raise the silver into the retort. This apparatus is connected with a railway on which is placed a car fitted with an iron water-bucket, in which is an iron stand whereon the mold containing the silver and the residue of quicksilver not separated by the centrifugal machine is placed by the aid of a derrick. The mold, which is made of two equal pieces fitted and held together by means of iron pins, is then taken off, the car is run on the mechanical apparatus and the bucket filled with water, and the whole wound up, so that the silver column enters the open aperture in the retort and with the water-bucket closes this hermetically. The bucket being so much larger the retort stands from five to six inches in the water. After heating the silver column a proper length of time the quicksilver begins to evaporate, the vapors of which are so heavy that being brought into contact with the water they will soon condense and appear as metallic quicksilver at the bottom of the water-bucket. After all the quicksilver has been evaporated and condensed, the silver column is taken to the smelting furnace and there molded into bricks and bars.

Thirty-nine tons of silver ore are worked daily, and the loss is stated not to exceed 2 oz. of silver to 3 tons of ore, whatever the quality of the latter. The machinery cost $230,500.

Amalgamators involving electrical action are: —

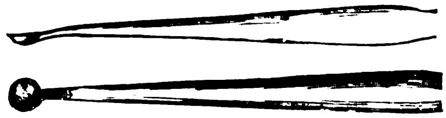
Nos.	Inventor.	Nos.	Inventor.
34,881	*Davis.*	83,868	*McDougal.*
37,278	*Deetken.*	86,249	*Rae.*
61,866	*Rae.*	90,777	*Paul.*
62,776	*Rae.*	90,965	*Partz.*
66,529	*Swith.*	91,878	*Stevens.*
83,091	*Rae.*	96,931	*Paul & Wood.*

The following references may be consulted: —

Dickson	* "*Scientific American*,"	xli. 262.
Egleston	* "*Engineering*"	xxvii. 43, 128, 135.
Egleston	* "*Engineering*"	xxvii. 473, 491.
Egleston	* "*Engineering*"	xxvii. 190.
Wheeler, *Varley*,	*Horn*, *Patton*,	*Wheeler-Patton*, *Stevenson*.
Forster-Firmin	* "*Min. and Sc. Press*,"	xxxvi. 129, 137.
Forster-Firmin	* "*Scientific American*,"	xxxvii. 383.
Forster-Firmin	* "*Scientific American*,"	xxxix 271.
Irwin	* "*Scientific American*,"	xxxv. 131.
Kröhnke	"*Iron Age*"	xviii., Nov. 16; 18.
Kustel & Hoffman	* "*Min. and Sc. Press*,"	xxxv. 145.
Mitchell	* "*Min. and Sc. Press*,"	xxxviii. 193.
Peck	* "*Scientific American*,"	xl. 275.
Porter-Firmin	* "*Eng. and Min. J.*,"	xxvi. 310.
Reynolds	* "*Min. and Sc. Press*,"	xxxviii. 136.
Russell	* "*Min and Sc. Press*,"	xxxvii. 97.
Secor	* "*Min. and Sc. Press*,"	xxxiv. 372.
Stevenot	* "*Min. and Sc. Press*,"	xxxviii. 153.
	* "*Sc. Amer. Sup.*"	xxvii. 56.

A-mal'gam Car'rier. A scoop for carrying a small quantity of amalgam to fill a cavity in a

Fig. 42.



Amalgam Carrier and Burnisher.

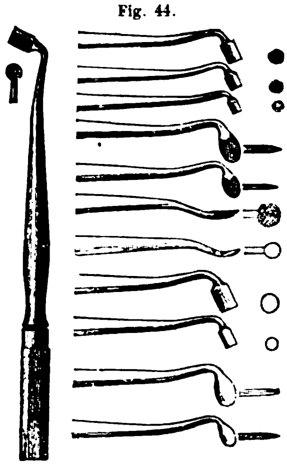
tooth. In the form shown, the back of the bowl serves as a burnisher.

A-mal'gam Ma-nip'u-la'tor. An instrument designed to facilitate the preparation of amalgam for fillings, having a cup at one end for taking up the desired amount of filings or powder, and a curved spatula at the other end for combining the mercury with the filings and packing it in the cavity.

Fig. 43.

Amalgam Manipulator.

Fig. 44.



Amalgam Pluggers.

A-mal'gam Plug'ger. A dentist's instrument for packing and condensing amalgam or allied stopping material in the cavities of teeth. Used with a mallet.

FIG. 45.

Amalgam Retort.

A-mal'gam Re-tort'. An iron retort with a luted and keyed lid, with a hollow inside the latter for expansion.

Am'a-to'ri-i. (*Ceramics.*) Dishes in majolica with portraits of the ladies to whom they were presented. An Italian device.

Am'ber. A fossil resin, noted as being the first electric substance known. It is largely found on the shores of the Baltic, which was formerly the only source of supply.

The word electricity is derived from the Greek name of this substance, ἤλεκτρον. Amber is largely used as mouth-pieces for pipes, etc. In the London Exhibition of 1851 there were four of these mouth-pieces, valued collectively at £1,000.

The Baltic is the principal source of amber, as it was perhaps in the time of Nero, but it is also found in Roumania, the latter the product of a different tree, and assuming various colors, red, pink, brown, blue, green, and black. These colors are frequently found mixed in a single piece, and lumps also occur with silver-colored veins and gold specks. On account of this variety of colors, the Roumanian amber is highly esteemed, and the darker and more beautiful pieces are more costly than yellow amber, especially as they are more rare.

German amber is found in the sea or in alluvial earth; the Roumanian amber is only found in mountainous places and highlands, where it is sought and dug out by the peasants.

On Amber. *Reboux* . . "*Scientific American Sup.*," 1847.
Sources of Amber . . . "*Scientific American Sup.*," 168.

Am'ber, Ar'ti-fi'cial. True amber is the fossil resin of a pine.

Artificial amber is principally colophony, a resin obtained by the decomposition of turpentine.

The detection is by means of heat or solution.

True amber melts at 545°–550° Fah.; the spurious at a much lower temperature.

True amber is slightly attacked by ether and alcohol; the spurious very readily.

Am'ber Bronze. A mode of coloring iron.

An artificial bronze surface upon iron, obtained by rubbing brass upon the smooth iron surface, and protecting with varnish.

U. S. Patent, 197,572, November 27, 1877.

Am'ber Ce-ment'. A solution of hard copal in pure ether, of the consistency of castor oil. — *Rust.*

The carefully-cleaned surfaces of fracture, coated with the solution, should be pressed together, and retained in contact by a band. A few days are required for complete hardening.

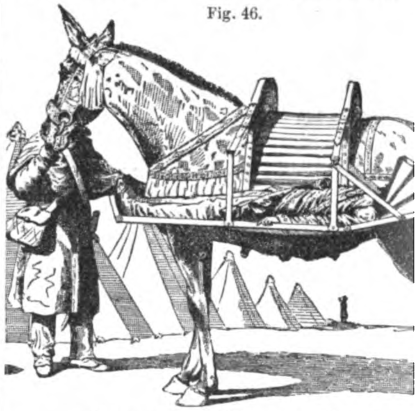
Small pieces of amber may be united to form a much larger one by moistening the surfaces to be united with caustic potash, and pressing them together.

Am'ber Var'nish. Yellow amber is bleached by being treated with a hot solution of salt; 1 lb. of the white product is dried, powdered, and melted over a fire in a clean iron pot. 1 lb. of fine nut-oil is then added, after which the whole is well stirred until thoroughly mixed. The pot is then removed from the fire, and when the heat is sufficie moderated, 2 lbs. of the essence of turpentii added to form a composition of the proper cor ency for use.

"*Scientific American*," xxxix. 35.

Am'bu-lance. Fig. 46 shows one style of bulance used in various semi-Asiatic armies.

Fig. 46.



Transport of the Wounded. Crimea.

The Turkish ambulance, on porter-back, is in a picture from the London "*Graphic*," repro in "*Scientific American*," *xxxvi., 151. S cular No. 6, Surgeon General's Office, U. S 81–86.

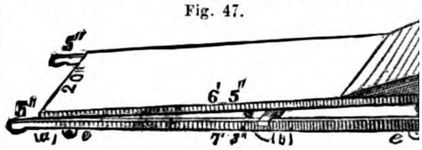
Am'bu-lance Cot. A cot adapted to be (or at least, as to the legs) to fit in an amb for transportation, or to stand on its legs wl field-hospital service.

See "*Art of War in Europe*," Official Rep General McClellan, War Department Series 80, where a French ambulance cot is shown.

Am'bu-lance Stretch'er. A litter cupy a place in an ambulance wagon. U convey a soldier from the spot on which he l the ambulance depot, and then to form his the wagon.

It is composed of two wooden frames, the one with handles, carrying an upper one, s at one end with a hinge (*a*), and rising sligl wards the other, retained in the inclined p by India-rubber springs at *b* and *c*, which a

Fig. 47.



Ambulance Stretcher.

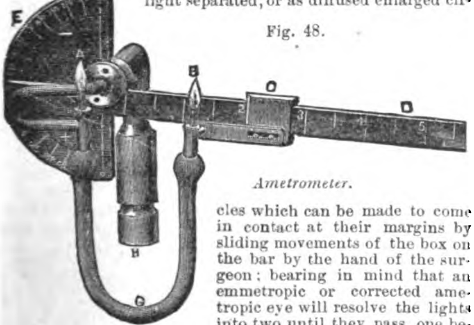
cased with spiral steel cases. The bottom stretcher is formed of leather, and stuffed elevated end of the wooden frame to form a Rollers are attached to the under part of th frame at *e e*, to facilitate its being shoved i ambulance wagon from the rear.

A'me-trom'e-ter. An instrument inve Dr. Thomson for the diagnosis of refractio examination for defects in the human eye.

"It consists of a small fixed gas-jet *A*, a second o tached to a box *C*, which slides upon a bar *D*, the nected by a flexible rubber tube *G*; the end of tl forms a pointer, which, by elevating or depressing end of the bar, can be placed at any part of the g half-circle *E*, which is fixed firmly to the thimb which means the entire instrument can be attached to a common gas-burner, and the lights regulated by its stop-cock.

"The jets having been lighted and turned down into two small flames about 5 mm. in diameter, the patient, placed 5 meters away, is directed to observe the flames, and to say whether he sees them as small points of light separated, or as diffused enlarged circles which can be made to come in contact at their margins by sliding movements of the box on the bar by the hand of the surgeon; bearing in mind that an emmetropic or corrected ametropic eye will resolve the lights into two until they pass, one behind the other, and become fused, whilst in ametropia the circles will seem to touch; whilst a distance, depending upon the degree of ametropia, remains between the small light points. To determine the kind of ametropia, the patient is directed to pass slowly in front of the eye under examination a slip of red glass in such a manner as to color half of each diffused circle, and if the red half seems to be on the same side with the red glass, myopia is recognized, and if on the other side, hypermetropia; this may be as well done by passing before the eye a card or paper in such manner as to exclude from view one half of each circle.

Fig. 48.

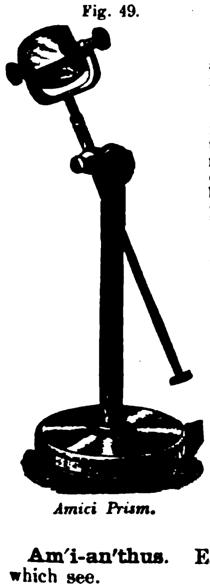


Ametrometer.

"To determine the degree of ametropia, the bar has been divided on one side into spaces of 2.5 cm. with a half space between, and on the other into English inch and half-inches, and it will be found that each space of 2.5 cm. will indicate an ametropia of one dioptric, metric system, and each inch $\frac{1}{40}$ of the old system. The cut represents the two flames as apart 2 dioptrics, and they would appear to a person having myopia or hypermetropia of 2 dioptrics or $\frac{1}{20}$ as two circles of light, with their margins in contact at one point, separating on the removal of light *B*, and overlapping when it is placed nearer to light *A*.

"For those who prefer the old system to the metric, it will be remembered that the old glasses are not based upon their exact powers of refraction, but are ground on *radii* of Paris inches, and that, owing to the index of refraction of the glass commonly used, they by a happy chance correspond in focal length almost exactly with the English inch; hence each inch of distance between the test-lights as determined by the use of the inch scale on the bar, will indicate an ametropia of very nearly $\frac{1}{40}$; and the higher degrees can be found instantly by dividing 40 by the number of inches between the lights when their margins seem to have come into contact." — "*Beck.*"

Fig. 49.



Amici Prism.

Am'i-an'thus. Earth flax: *i. e.*, ASBESTOS, which see.

A-mi'ci Prism. A device adopted by Amici, for throwing an oblique pencil of condensed light upon an object. See Fig. 49.

Am-mo'ni-a En'gine. The ammonia engine, which utilizes the expansion of liquefied ammonia, is described and represented on p. 90, "*Mech. Dict.*" and references made to Dr. Lamm, and to the dissertation of Dr. Barnard on the subject.

Gamjee's engine, U. S. Patent, No. 240,000, and dated April 19, 1881, uses the vapor or gas of ammonia expansively to the extent of more or less complete liquefaction, and then reconverts it from the liquid to the vaporous condition by means of heat, which restores it to its original tension. See THERMO-DYNAMIC ENGINE.

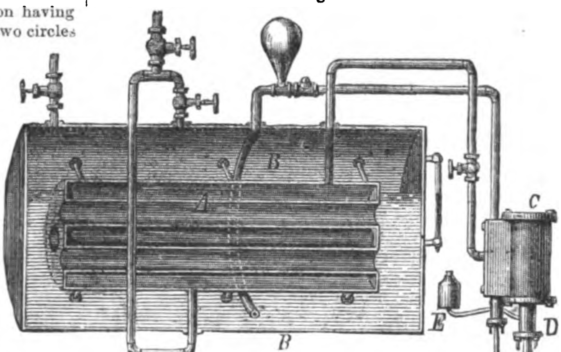
Seyforth's Ammonia Engine, "*Scientific American*," * xxxix. 333.

M. Frot's machine is described in article "*Air Chaud*," *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," edition of 1877.

The principle upon which the theoretical utility of ammonia, as a motor, is based, may be thus stated: As the gas is absorbed by water its latent heat becomes sensible, and the temperature of the solution consequently rises. This heat may again be used for the expansion of liquid ammonia into a gas, under great pressure — the pressure thus generated being converted into work behind the piston of an engine. The heat thus transformed into work cannot be recovered and utilized as heat, and, consequently, to maintain the efficiency of the combination, additional increments of heat must be supplied, from external sources, to be again converted into work, and so on.

In the apparatus of Dr. Emile Lamm (Fig. 50), the liquefied ammonia, which parted with its latent heat during condensation by pressure, is placed in the inner shell *A*, through which tubes traverse, the whole being inclosed in an outer shell, *B*. The fountain communicates with the valve chest of the cylinder *C*, in the same way as the steam induction pipe of a steam-engine connects the boiler and the

Fig. 50.



Lamm's Ammonia Engine.

cylinder. In the outer shell *B* is placed some of the water, or weak solution of ammonia that was left in the boiler of the still, of a suitable temperature to generate the required pressure at starting. This heat exists, then, in the liquefied ammonia as expansive force, and passes out with the gas to the cylinder, where, a portion having been converted into work, the remainder passes, with the exhaust gas, back to the weak solution in the shell *B*, where, the latter becoming instantly condensed, the heat is again rendered sensible and passes through the walls of the tubes, to generate expansive force, and so on, the total loss of heat for a given amount of work being the equivalent of the work performed, *plus* that which may have radiated from the shell during the performance of the work; while the loss of the material itself is only that due to whatever leakage has taken place.

An oil-packed stuffing-box is shown at *D*. An annular chamber surrounding the piston-rod is kept supplied with oil from the chamber E, through a suitable pipe; this forms a practically impassable barrier to the escape of free ammonia. The oil becomes more or less saponified by the action of the ammonia; but this does not interfere with the usefulness of the packing, or the proper lubrication of the moving parts.

Lamm's United States Patents: —

No. 105,581	
121,527	December 5, 1871.
121,909	December 12, 1871.
124,485	March 12, 1872.

See English Patent, No. 2,768, of 1853. A hot-air engine, mixes vapor of ether with air.

Jean Frot's Ammonia Engine, No. 60,500, December 18, 1866. Specially designed for condensing, washing, and retaining for re-use the exhaust vapor.

See also English Patents: —

5,212 of 1825.
9,221 of 1842.

Lauback, U. S. Patent, May 28, 1872 . . . 127,250.

See also AIR AND GAS ENGINES FOR PROPELLING CARS. See also COMPRESSED-AIR ENGINE.

Bompas, Engl. Pat. No.	5,644 . . .	1828,	Compressed air.
Stevens & Kershaw . .	1,092 . .	1863,	Compressed air.
S. Carson, U. S. Pat. .	December 9,	1856.	
N. H. Barbour . . .	March 14,	1865,	Carb. acid gas.

Am-mo'ni-a Me'ter. An instrument by Griffin, for testing liquid ammonia; one spindle, with 125°, which includes the strongest ammonia that can exist at the temperature of 62° F., and extends to all weak solutions: sp. gr. .875 to 1.000.

Every degree shows seventeen grains of dry ammonia in a decigallon of liquor. In "*Chemical Recreations*," p. 329, a table is given which shows every particular respecting solutions of ammonia; the strength in atoms, the percentage of ammonia, its weight per decigallon in grains, the comparative money value of different solutions per lb., etc.

Am-mo'ni-a Ore Pro'cess. The copper and silver salts, after calcination of the ore, are dissolved by means of ammonia and ammoniacal salts; this solution is then passed through a galvanic tank, formed by a suitable and economical arrangement of sheets of platinum and copper, by which means the whole of the silver is deposited in practically a pure state, whilst the copper passes on — still in ammoniacal solution — and is precipitated as oxide, by passing steam into the solution, with the simultaneous addition of a very small amount of caustic alkali. This not only precipitates the copper as oxide, but drives off the ammonia, which may be collected for re-use. The special advantages claimed for the ammonia process are chiefly its economy and simplicity, and the purity of the products obtained.

Am-mo'ni-a So'da Pro'cess. A process of soda manufacture, the success of which is mainly due to the ingenuity and perseverance of M. E. Solvay, of Couillet, Belgium. See p. 2234, "*Mech. Dict.*"

The fundamental reaction in the manufacture — the decomposition of common salt in solution by bicarbonate of ammonium into insoluble bicarbonate of sodium and chloride of ammonium, and the regeneration of the ammonia by treatment with lime — as contrasted with the cycle of reactions involved in Leblanc's process, attracted the attention of technical chemists long since. As early as 1838, the method was patented in England by Dyar, Gray, Harrison, and Hemming.

The subject is fully and lucidly treated in the Report of Dr. Jenkins, "*Paris Exposition Reports*" (1878), vol. iv., pp. 44 *et seq.*

See also "*Scientific American Supplement*," * 2707, 2719, * 3969, * 4112.
"*Scientific Amer.*," June 24, 1876; and vol. * xxxvi. 405.

Am-mo'ni-a Test Ap'pa-ra'tus. W. W. Goodwin's ammonia and sulphur test apparatus, for gas works.

"*American Gas-light Journal*," * July 3, 1876.

Am'o-ri'ni Vase. A vase to be presented as a love-token. For instance, one at the Paris Exposition, by Solon, in the style of Louis XVI., the body in céladon, and an upper zone in blue with cupids in white. The vase supported by cupids (amorini), molded in oxydized silver.

Am'pli-fi'er. (*Microscope.*) A plan for increasing the magnifying power by means of a double concave lens placed in the body tube of the microscope, between the object-glass and the eye-piece.

The *Tolles* amplifier is discussed in the "*American Journal of Microscopy*," February, 1878. The remarks are reproduced in part in "*Scientific American*," xxxviii., 152, 202.

The Rev. J. H. Wythe, M. D., describes two amplifiers used by himself, as follows: —

"Either of them is used in a sliding tube between the eye-piece and objective, and the proper position is found by trial. The first consists of a cylindrical lens, conical in shape, with the smaller end concave, toward the object-glass, and the larger end convex. This gives a large increase of magnifying power and excellent definition when used with the strongest eye-piece of Gundlach, or other makers. The second form is better still, and consists of a double concave lens, having a virtual focus of about 1¼", at the end of a tube about 6" long, at the other end of which is the ordinary negative eye-piece. In both these forms the extent and flatness of the field is quite remarkable, as well as the amount of light, while the amplification is very great. With a periscopic eye-piece of Gundlach, or the No. 3 of the same maker, or with the strongest eye-piece of Crouch, my ⅛th objective defines the semi-lenses on the frustule of *Pleurosigma angulatum*, the markings on *S. gemma*, or *Grammatophora subtilissima*, with a power of 4,000 diameters."

See also "*Carpenter on Microscope*," 1875 ed.

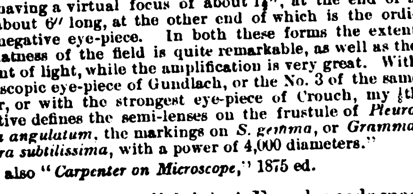
An'a-cos'ti-a. (*Fabric.*) A French goods made on a serge loom, and having a worsted warp and merino wool weft.

An'æs-thet'ic In-ha'ler. An instrument for the administration of ether, chloroform, nitrous oxide, etc. See pp. 92, 93, "*Mech. Dict.*"

In the illustration is a metallic inhaler consisting of —

A, A metallic hood containing
B, A flexible rubber hood covering both mouth and nose.
C, Exhaling valve.
D, Two-way stop-cock.
I, Packing through which passes a silken cord attached to a mouth-gag.
J, Contains the inhaling valve.
F, Hollow sphere containing sponge saturated with the anæsthetic liquid through the opening *G*.
H, Cover to close it when out of use.

Fig. 51.



Anæsthetic Inhaler.

Anæthesia, Early use of .	"*Sc. American Sup.*"	1290.
Plant . . .	"*Sc. American*" .	xxxv. 1[illegible]

A'nal Di-la'tor. (*Surgical.*) Instruments f[illegible] distending the *sphincter ani* to permit examinati[illegible] of the mucous wall of the rectum, are shown [illegible] *Tiemann's* "*Armamentarium Chirurgicum*," as f[illegible] lows: —

Anal Dilator, Fig. 563, p. 119, Part III.
Thebaud's Sphincter Ani Dilator, Fig. 534, p. 119, Part III.

Called also Rectal Dilator.

A'nal Spec'u-lum. (*Surgical.*) *Speculum ani.* An instrument for exposing to view the interior of the rectum. The references are to *Tiemann's* "*Armamentarium Chirurgicum*": —

Gorget-formed Speculum, Fig. 549, p. 117, Part III.
Trivalve Trellis Anal Speculum, Fig. 547. *Ibid.*
Ashton's Fenestrated Anal Speculum, Fig. 546. *Ibid.*
Bodenhamer's Recto-colonic endoscope, Fig. 548. *Ibid.*
Bivalve Speculum Ani, Figs. 534, 559. *Ibid.*
Williams's Rectal Speculum, Fig. 623. *Ibid.*

See also Anal Dilator; Hemorrhoid Instruments, etc.

A'nal Sup-port'er. (*Surgical.*) A pad of similar application to a truss, for supporting the part in cases of *prolapsus ani. Matthieu's, Tiemann's* "*Armamentarium Chirurgicum,*" Part IV., p. 134, Fig. 207; and p. 19, Fig. 46.

An'a-lyz'er. (*Optics.*) The upper one of the two Nichols' prisms in the polariscope; the lower one being the polarizer. See Polariscope.

An-a-mor'pho-scope'. A device to illustrate certain optical effects.

The object has distorted figures, which become perfect on being looked at in the mirror.

Fig. 52.

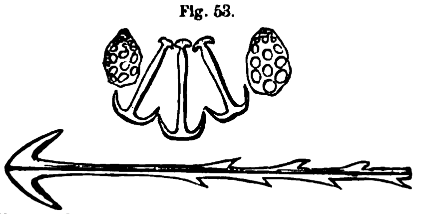
Anamorphoscope.

An'a-tom'ic-al Syr'inge. For injecting the arteries of the human body with an embalming fluid, or, in subjects for demonstrating anatomy, with a colored fluid which solidifies *in situ.*

An'chor. 1. The analogues in nature of the mariner's anchor are amusingly like the grapnel.

The upper one in Fig. 53 is from a relative of the sea-cucumber (*Leptosynapta Girardii*). It is covered with the symbol of the deep. The skin is filled with minute perforated oval plates, to each of which is attached by the shank a perfect little anchor. Doubtless the flukes of these anchors give it the means of keeping itself in place. The lower specimen is the *Pheronema*, which has its threads near the extremities marked by projecting notches, while at the very extremity it is actually anchor-shaped, as shown by a thread greatly magnified.

Fig. 53.

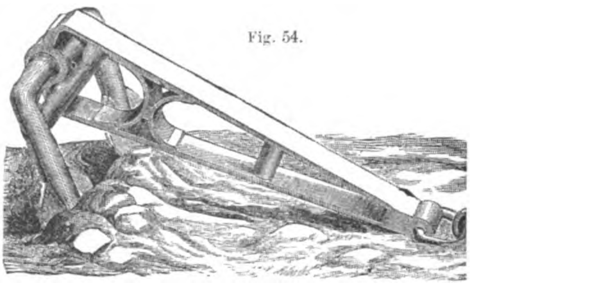


Natural Grapnels of a Holothurian. Anchor and Barbed Threads of a Pheronema.

Rosella, also, has a great outlay of mooring-threads, with frequently a line quadrate-barbed at its extremity. These lines have actually at the bottom a four-hooked grapnel.

Williams's "Reliance" anchor is without a stock, and is designed to be non-fouling and self-canting. It holds by both flukes at once, and has no stock

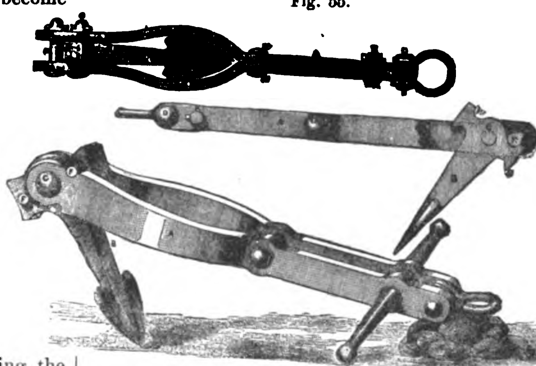
Fig. 54.



"Reliance" Anchor.

to foul the cable, like the Latham anchor, Fig. 190, p. 95, "*Mech. Dict.*" The pair of flukes hinged in the head are also like the Latham and the Morgan (Fig. 188, *Ibid.*). The Marshall (Fig. 189, *Ibid.*), has also hinged flukes, but they are independent.

Fig. 55.



Tyzack's Anchor.

In the celebrated Trotman anchor (Fig. 182), the arms are hinged to the shank.

Tyzack's anchor (Fig. 55, British) has a shank, *A*, made in two parallel parts secured together by pins, and a single arm with a fluke *B*, fitted with a *T*-head, which rests against a pin *H*. The advantages of this form are similar to those just recited: Relative lightness, absence of stock, ready assumption of holding position, ease of handling, etc.

This anchor was tested to destruction at the Lloyd's proving-house, Netherton, England, finally giving way at 250 per cent. overproof.

"*Engineer*," * xliii. 355.

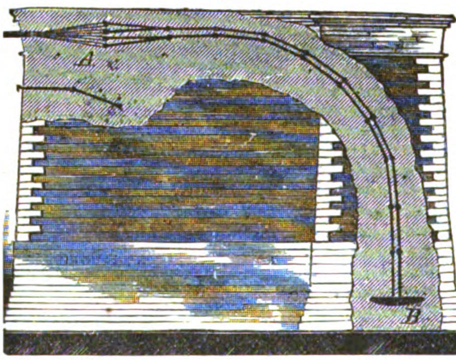
The Martin self-canting anchor is in much favor with the British admiralty, all the turret-ships being provided with it, has no stock, nor steadying arms. Admiral Inglefield's modification of the Martin resembles the latter in the special feature that the arms are on parallel lines, and so grip the ground simultaneously. It differs from it, however, in the very important characteristic, that instead of the arms being made of one forging, and working through the crown, they are formed of separate forgings, and are attached to the shank by a swivel pin. The advantages gained for the anchor are greater holding power and less liability to foul.

The parts of, and apparatus concerned with, the anchor and cable: —

Anchor lift.	Arm.
Anchor shackle.	Bill.

Blade.
Bower.
Bull rope.
Buoy rope.
Cable shackle.
Capstan.
Cat.
Cat back.
Clutch.
Compressor.
Controller.
Crown.
Deck stopper.
Devil's claw.
Dog stopper.
Fish.
Fluke.
Forelock.
Grapnel.
Kedge.
Kedging.
Kevel.
Link.
Messenger.
Mooring swivel.
Nippers.
Palm.
Passing nippers.
Pawl.
Pee.
Point.
Racking turns.
Ring.
Shackle.
Shank.
Slip stopper.
Square.
Stock.
Stopper.
Stream anchor.
Stud.
Swivel.
Swifter.
Throat.
Trend.
Warping.
Whelps.
Wing stopper.

Fig. 56.

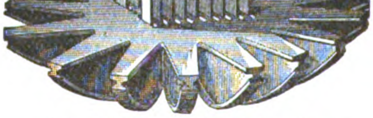


Section of a Pier, East River Bridge, New York.

The following references may be consulted: —

Smith (Stockless), Br. . *"*Engineer*," xlvii. 219.
Spedden & Stafford . . *"*Scientific American*," xli. 7.
Swinburn (Portable), Br. *"*Engineer*," xliii. 427.
*"*Scientific American Sup.*," 1471.
Tyzack, Br. . . . . . *"*Engineer*," xliii. 355.
*"*Scientific American Sup.*," 1282.

Fig. 57.



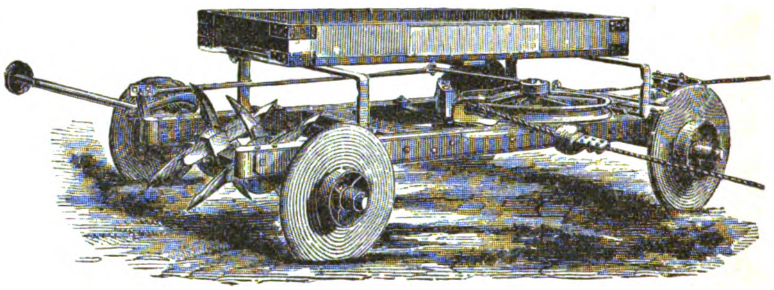
Anchor-plate, East River Bridge, N. Y.

2. The anchors for the suspension cables of the East River bridge are shown in Figs. 56 and 57. In the former the cable and anchor are shown in position, and in the latter figure an anchor-plate is shown separately.

Each anchor-plate weighs 23 tons, and is made with 16 radiated arms. Four of these anchors are required at each end of the bridge, two meeting on the central longitudinal line, and the others disposed one at each side. Each is imbedded in concrete in the third row of stone. Through apertures left in the centers of the plates the first set of bars for the chains is placed. Each chain has 10 sets of links and two sets lead from each plate. The section Fig. 56 exhibits the arrangement. To each pair of bars a strand of the cable is attached so that 19 strands in all will be fastened to the ends of two chains of bars leading from each anchor-plate. The strain on each of the four cables is estimated at 1,833 tons, or 7,332 tons on the collected four cables. Against this is the dead weight of the masonry structure, amounting to 44,000 tons. There is besides a pressure on the joints of the imbedded links which has been considered and provided for.

"*Scientific American*" . . . . * xxxiv. 15.
See also "*Scientific American Supplement*," * 754, 755.

Fig. 58.



Traction Rope Anchor for Steam Plow.

3. A movable pulley carriage to which the traction wire-rope of a steam plow passes at the headlands.

The frame carries a horizontal sheave and rests on thin disk wheels, which cut into the ground, and resist the side strain of the engine and implement. It is moved along the headland by the motion of the sheave or pulley, which is turned by the rope: the sheave is connected by gear to a drum, which winds up a rope stretched along the headland, and keeps the anchor opposite its work. The apparatus is provided with a steerage, which enables it to be worked along a crooked headland, and is managed by a boy, who also attends to shifting rope-porters. The box is to hold stones, intended as a counterpoise, to prevent the anchor from being pulled over when doing very heavy work.

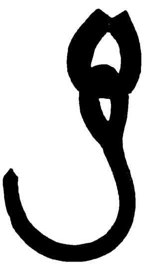
The particular form shown is designed for the roundabout system. Two anchors are employed, occupying positions opposite to each other on the headlands, and proceeding at a right angle to the course of the plow. This form of anchor is automatically moved the regulated distance, equal to the width of cultivation of the implement at one passage, and this without the draw-rope reaching to a claw-anchor at the other end of the field.

See STEAM PLOW, "*Mech. Dict.*"

An'chored Net. (*Fishing.*) One secured by sunken anchors or stones, as with some seines. In contradistinction to *drifting* or *staked* nets.

An'chor Fish'-hook. An anchoring hook for fish-nets or lines. The line is bent around the grommet and lashed.

Fig. 59.



Anchor Fish-hook.

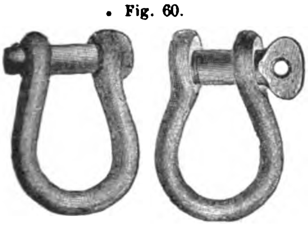
An'chor Lift. A device to lift the pile or pole wherewith a dredge or lighter is anchored. Such a pile is known — in Mississippi River parlance, at least — as a *grouser*, which see.

Canan's anchor-lift is a device on the dredge operated by hydraulic power to grip the anchoring pile during its upward movement, and slacken from it on the return motion, and so by a succession of movements to raise it from the mud or sandy bottom into which it had been driven.

"*Scientific American*," * xxxv. 70.

An'chor Shack'le. (*Nautical.*) The bow or clevis, with two eyes and a screw bolt, or bolt and key, for securing the cable to the ring of the anchor. Also used for coupling lengths of chain cable.

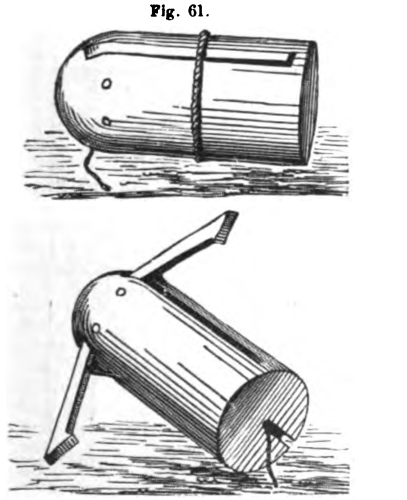
Fig. 60.



Anchor Shackles.

An'chor Shot. (*Life-saving Apparatus.*) A three-fluked anchor, with cord attached, fired from a gun on shore or aboard: in the first case, to afford communication with a stranded vessel; in the second case, to get a rope ashore, to enable boats to land through the surf. A *grapple-shot*; or *barbed shot*, which see.

Fig. 61.



Chandler's Anchor Shot. Before firing and after firing.

The invention of Capt. Ralph Chandler, U. S. Navy; the shot has hinged anchor flukes projecting from its sides, and folding back into slots, so as not to interfere with the entrance of the shot into the gun; but expanding when fired, to catch in the rigging. To the rear of the shot a chain or wire rope is attached, and carried to the front of the shot through another slot.

"*Ordnance Report*," 1878, Appendix P, p. 313, and Plate LII.
"*Army and Navy Journal*," April 27, 1878, p. 607.
"*Harper's Weekly*," June 15, 1878.

An'chy-lo'sis Ap'pa-ra'tus. (*Surgical.*) An apparatus for the gradual extension of contracted muscles. Used also for the breaking up of false anchylosis. Also as a safeguard against mal-position, allowing the joint to anchylose in the position of greatest usefulness in cases where a cure is impossible.

See *Tiemann's* "*Armamentarium Chirurgicum*," Part IV.
Elbow-joint Apparatus, Fig. 53, p. 23.
Long Knee-joint Apparatus, Fig. 90, p. 48.
Short Knee-joint Apparatus, Figs. 91, 92, p. 49.
See also Fig. 202, p. 79, "*Mech. Dict.*"

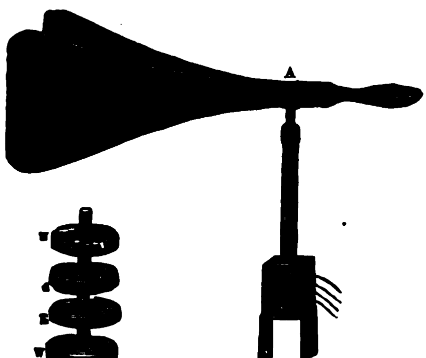
An'der-son Bat'te-ry. (*Electricity.*) The ordinary zinc and carbon elements are employed; the zinc being placed in the porous cell and immersed in a solution of muriate of ammonium, and the carbon in oxalate of chromium and potassium, in combination with free bichromate of potassium and hydro-chloric acid.

"*Scientific American*," * xliii. 115.

A-ne'mi-us. A small chemical smelting furnace.

A-nem'o-graph. The vane for recording the direction of the wind, used in the observatories of France, consists of two connected strips of thin copper, about 2′ in length, attached to an axis at *A*, and having a counterpoise, which enables the vane with its axis to turn with great readiness.

Fig. 62.



Wind Vane of French Anemograph.

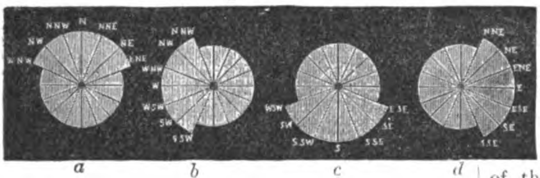
The axis has four copper disks attached. These are shown detached to the left of the cut, Fig. 62, and also in Fig. 63. Each disk is so cut that only $\frac{6}{16}$ths of its circumference has the full size; this portion only comes in contact with a metallic spring, of which there is one for each disk, and this wire connects with electric apparatus in the office of the observer. But two of the disks can be in electric connection at the same time.

Take the left-hand disk (Fig. 63), for instance, Its surface has the 16 divisions, but only the 6, from E. N. E. to W. N. W., are on the extended portion of the perimeter, so as to touch the spring belonging to this disk. The other disks have each also the same proportionate parts of extended perimeters: the second disk from N. N. W. to S. S. W., and so on.

To illustrate, by tracing the action through a portion of a revolution, — at the compass point N. N. E. the North disk (*a*, Fig. 63) alone touches a wire, and but one pencil records upon the traveling paper ribbon until N. N. W. is reached, when the West disk (*b*) closes the electric circuit, and two pencils record until W. N. W. is reached, when the circuit of the N. disk is broken, and the W. disk alone records. So on of the other portion of the circuit.

It will be noticed that at the cardinal points, N., W., S., E., and two points on each side (32 points

Fig. 63



French Anemograph Disks on turning axis.

to the compass), only one telegraphic pencil is at work; at intermediate points two pencils record. Thus the direction of the air current is read within a point or two. Greater accuracy might be attained by multiplying the number of disks. The French observatories have four recording cylinders moved by clock-work. In the United States instruments one cylinder receives the four traces.

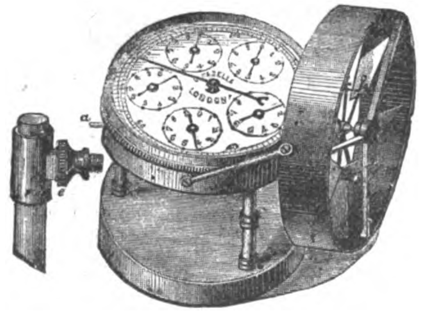
The anemograph of M. Redier, of Lyons, has a vane supported on a wheeled tripod revolving on a circular rail. The axis prolonged downward has a paper-carrying cylinder upon it; this is graduated vertically and horizontally, and a pencil applied to the paper is moved vertically by clockwork. The tracing gives wind direction and time.

An′e-mom′e-ter. An instrument for ascertaining the rate of the wind.

Casella's anemometer is a portable instrument, and is especially intended for measuring the velocity of currents of air passing through coal-mines, and the ventilating spaces of hospitals and other public buildings.

The indications are shown by a large dial and hand, and five smaller ones. The large dial is divided into 100 parts, and represents the number of

Fig. 64.



Casella's Anemometer.

feet up to 100 traversed by the current of air. The five smaller dials represent 1,000, and so on, multiplying successively by 10, to 10,000,000 = 1,893 miles. By means of the large dial, as low a motion as 50 feet per minute may be measured. By means of the catch, *a*, the work is put out of gear. A handle and universal joint, *e*, allow the apparatus to be lifted to a higher level, or thrust into an aperture.

See the following papers by J. W. Osborne, "*Proceedings of the American Association for the Advancement of Science*": —

"Construction of a Sensitive Wind-vane," * St. Louis Meeting, Aug., 1878.
"Wind-vane Rotations," * Nashville Meeting, Aug., 1877.

See also —

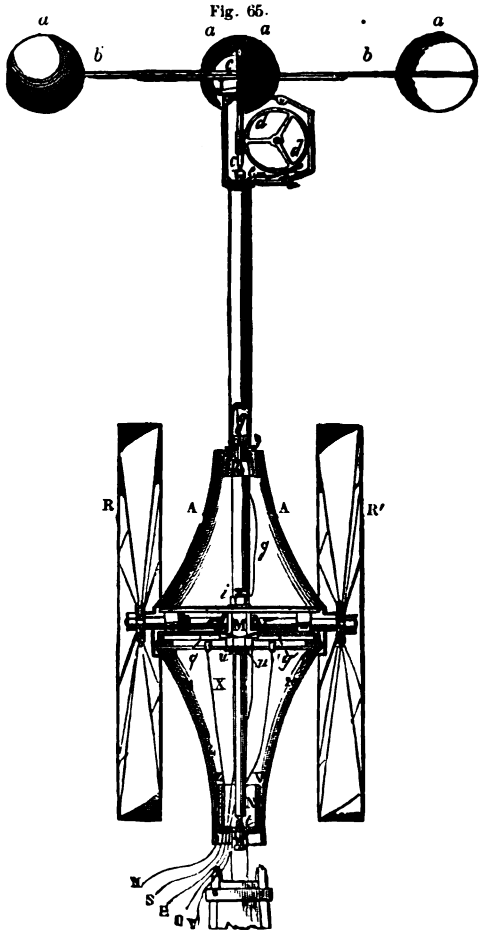
Anemometer, Electric.	*Hardy*	"*Teleg. Jour.*," iv. 134.
Anemometer	*Long*	"*Sc. Am. Sup.*," 1746.
Anemograph	*French*	"*Sc. Am. Sup.*," 112.
Anemometer	*Negretti*	* "*Man. & B.*," x. 156.
Anemoscope, Br.	*Vernon*	* "*Engineer*," xlviii. 268, 326.

An′e-mo-met′ro-graph. An instrument for recording the rate and direction of the wind.

The anemometrograph of *l'Ecole des Ponts et Chaussées* of France, is composed of two parts which may be regarded as distinct: the *anemometer* proper and the *register*.

The anemometer is on the principle of that invented forty years since by Dr. Robinson, of the Armagh Observatory, Ireland. It is composed of a hollow vertical shaft, of which the lower portion is secured on a mast of any convenient height. The upper end carries four radial horizontal spokes, *b*, at angles of 90°, each terminated

Fig. 65.



Anemometrograph of the Ponts et Chaussées, France. (*Elevation.*)

by a light hemispherical metallic cup *a*, so disposed that the concavity of each is presented towards the convexity of the next one.

When this windwheel — as it may be called — is exposed to a current of air, the wind strikes in the hollow of that cup, the concavity of which is favorably presented, but glides from the convexity of the others. Thus the windwheel assumes a rotary motion on its axis. It was demonstrated by Dr. Robinson that the number of turns in a given time are proportioned to the rate — that is force — of the wind, and it has been found that the number 3 expresses the relation between the speed of the wind and the space traversed by the wings. Thus an anemometer, of which the circle described by the center of the wings is equal to 1.67 meter, will give for each turn of the wings an indication of 5.01 m. as the distance traversed by the wind.

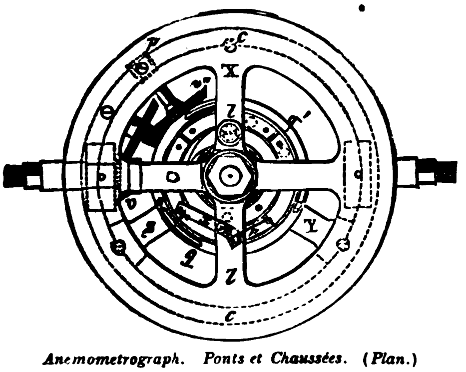
Below the windwheel is a counter, which, by means of an electric wire (*V* in Fig. 65), transmits to the register (Fig. 67), the indications of speed.

Farther beneath, on a horizontal arbor, are fixed two large wheels *R R′*, with inclined vanes, which are driven by the slightest current of air.

The spokes of the wind-cups *a a* are mounted on a small vertical axis, *c* (Fig. 65), the pointed foot of which reposes upon an agate plate in a socket. A worm-wheel on the axis rotates a wheel, *d*, which has 200 teeth, and which carries on its side face two metallic pins which successively touch in passing a spring, *e e*. A wire *g* connects this spring with a binding-post, *i*, to which it is secured.

The shaft which supports the windwheel and the counter is hollow to permit passage to the insulated wire *g*, and is united by a screw-joint to the portion beneath, in which the axis of the windwheels *R R′* is journaled. *J* is a cap to protect from rain and dust.

Fig. 66.



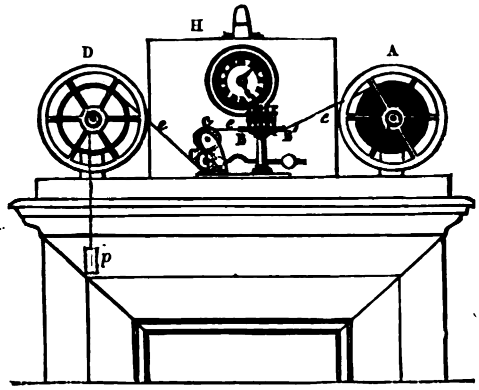
Anemometrograph. Ponts et Chaussées. (Plan.)

The horizontal arbor of the wheels *R R′* operates by means of the wheels and pinions *v v″* (Fig. 66), and a pinion meshing into a fixed crown wheel, *c c*, attached to the body *X Y Z*, which supports the whole instrument. Owing to this arrangement, when the wheels commence to turn under the influence of the wind, the pinion *p* turns also, but, in virtue of the reaction which it receives from the fixed teeth of the crown-wheel *c c*, it is displaced, and the wheels take a movement of translation around the vertical axis *M N* (Fig. 65), until the plane of their wings becomes parallel to the direction of the wind. The axis *M N* rests in a socket, *t*. A brass ring, *u*, secured by a screw, *u′*, holds it in the socket, and at the same time preserves the necessary connection between the moving and fixed portions of the instrument.

A cross-piece, *l l*, attached to the moving portion of the instrument, carries two springs, *x r*, which, drawn by the movement of translation, strike successively on four metallic sectors, separated one from the other, and inlaid in an insulated disk. From these four sectors, which correspond to the cardinal points, N., S., E., W., proceed four electric wires, *N S E O* (Fr.) as seen in Fig. 65. The binding post *i* communicates with another spring, which strikes in all positions upon a metallic circle, also imbedded in the insulated disk. The metallic contacts of the springs on the sectors, or on the circle, suffice to establish electric connection with the register, which remains to be described.

The registration is effected on a paper ribbon, *e e* (Fig. 67), which is unrolled from a bobbin, *A*, and which, having passed over an anvil, *B B′*, envel-

Fig. 67.

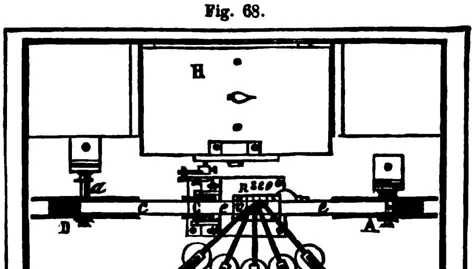


Anemometrographic Register. Ponts et Chaussées. (Elevation.)

ops in part the engine-turned cylinder *C′*, on its way, in turn to be again wound on the wooden drum of a pulley, *D*, which is turned by a weight, *p*, suspended by a silken cord from its axis.

The cylinder *C′* is governed by a clock movement inclosed in the box *H*, which gives the paper a uniform rate of motion. The inscription of the meteorological indications derived from the apparatus formerly described, takes place upon the paper ribbon by means of 5 steel points, *v, n, s, e, o,* put in

Fig. 68.



Anemometrographic Register. Ponts et Chaussées. (Plan.)

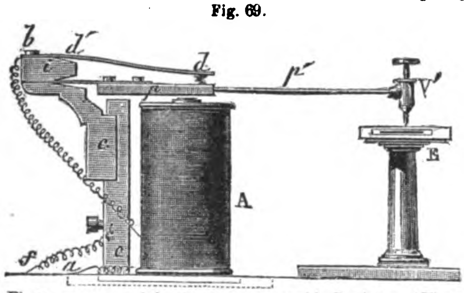
movement by the passage of an electric current in the electro-magnet corresponding to each point.

The 5 electro-magnets are identical with the pulsating armature electric bells; an improvement due to M. Hervé Mangon, now Director of the *Conservatoire des Arts et Métiers.*

The following is M. Hervé Mangon's arrangement of the electro-magnet in the registering apparatus of the Anemometrograph of *l'Ecole des Ponts et Chaussées* of France.

One of the poles of the battery communicates with the extremity a (Fig. 69), of the wire of the bobbin A. The other extremity of the wire of the bobbin is fixed by the screw b to the steel spring

Fig. 69.



Electro-magnet of the Anemometrographic Register. (Elevation.)

d' d. The other pole of the battery connects by the wire f, with a metallic piece, c c, which supports by a steel spring the soft iron armaturé p, the rod p', and the tracing point V'. An insulator block, i, separates the spring b d' d from the piece c.

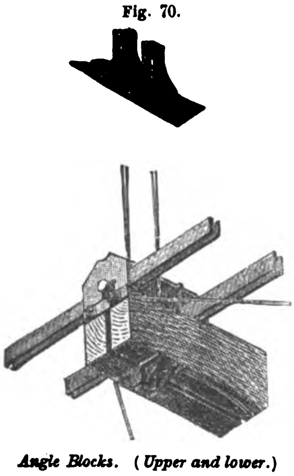
It will be seen that the electric current entering at a, follows the wire of the bobbin, arrives at b d' d, passes by the contact d, in the palette p, arrives at the piece c, and passes off by the wire f. As soon as a current is thus established the soft iron core of the electric coil attracts the palette p; the point V' descends, and strikes the paper placed beneath it on the anvil E. This descent destroys the contact between d and p, and breaks the circuit, consequently the palette p, obeying the spring which sustains it, rises to resume its former position and elevates the point V'. The contact is re-established in d and the preceding phenomena are repeated.

The point V' thus receives a rapid vertical vibration as long as the current is maintained.

It will thus be understood, referring to Fig. 65, that the point v will strike every time that the current shall be closed by the contact of the pin on the wheel d d, and the spring e e; that is to say, each time that the windwheel makes 100 turns.

As to the matter of the direction of the wind, it will be recalled that the striking springs are always in contact with one, or, at most, two of the four sectors answering to the winds of the cardinal points. It results from this that the electric current will pass by one, or at most by two, of the electro-magnets N S E O. The traces left then on the paper ribbon indicate the successive directions of the wind. If the two springs are in simultaneous contact with two opposite sectors, the two electro-magnets corresponding thereto will operate together, and will indicate

Fig. 70.



Angle Blocks. (*Upper and lower.*)

that the direction of the wind is comprised b the two cardinal points to which the two appertain.

The anemometograph of M. Secchi is sho article *Météorographes*, vol. iv., ed. 1877, *Labo* "*Dictionnaire des Arts et Sciences*," Figs. 14,

An'e-roid. (Preferably, *a-ne'roid.*) Pillis (London), is self-registering, at certain inte by means of electro-magnets and a break-c clock. Shown at Vienna, 1873.

Aneroid, on the . . * "*Engineering*," xxi. 223, 490.
* "*Van Nostrand's Mag.*," xvii * 201.

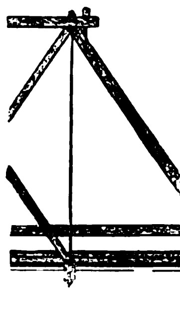
Cf. Plympton's "The Aneroid and how to use it."

An-gel'o-phone. An English name for a monium or parlor organ.

An'gle Block. 1. (*Bridge-building.*) Figs. 70, 71. A casting at the junction of the braces with the chord, in a bridge truss, and affording points of bearing for the suspension rods.

2. (*Nautical.*) Fig. 72. A swivel dock-block used in changing the direction of a rope in hoisting or moving cargo, etc.

Fig. 71.



Portion of Bridge Truss.

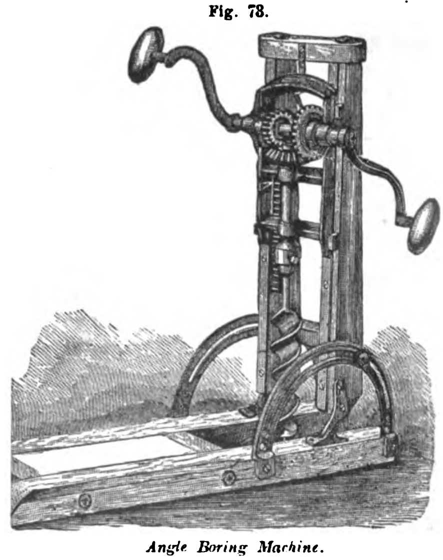
Fig.

Angle Blo

It has usually an iron frame and sheave, an anchored to a stake, or lashed to a ring-bolt.

An'gle Bor'ing Ma-chine'. A carpent machine for boring mortises. The semi-circu guides allow the standard to be set at any an with the base which lies flatly upon the timber, order to allow the holes to be bored at any desi angle.

Fig. 73.

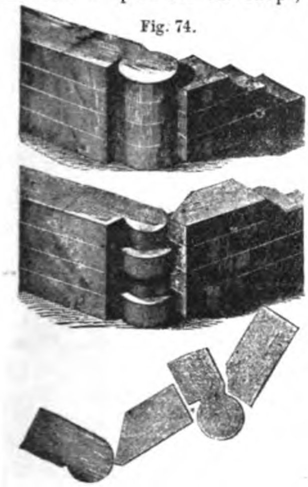


Angle Boring Machine.

An'gle Brick. Bricks specially formed to enable other than square angles to be turned; either to make acute or obtuse angles, or to make the quoin ornamental. The angle bricks, shown in Fig. 74, are of the latter character, admitting of a molding in the corner, either cylindrical or with assizes of varying diameter.

An'gle Car-bor'ing Ma-chine'. A framing machine adapted for car shops, bridge work, etc. being capable of straight, angle, and end boring, saving the moving of the timber by being itself adjustable. (See Fig. 75.) Especially useful in boring holes in truck and body bolsters for truss-rods. The spindle has a horizontal movement of 24″. The head has a horizontal movement in planed slides in the frame, which permits it to be brought close up to the stuff when doing angle-work. The head is adjusted vertically by the hand-wheel, obviating the necessity for movement of the timber. The overhead belt is kept at a proper tension by a weighted pulley, which is hung in a slack loop of the belt.

Fig. 74.



Angle Bricks.

Fig. 76.

Angle Check Valve.

Fig. 77.

Angle Cock for Sugar-house use.

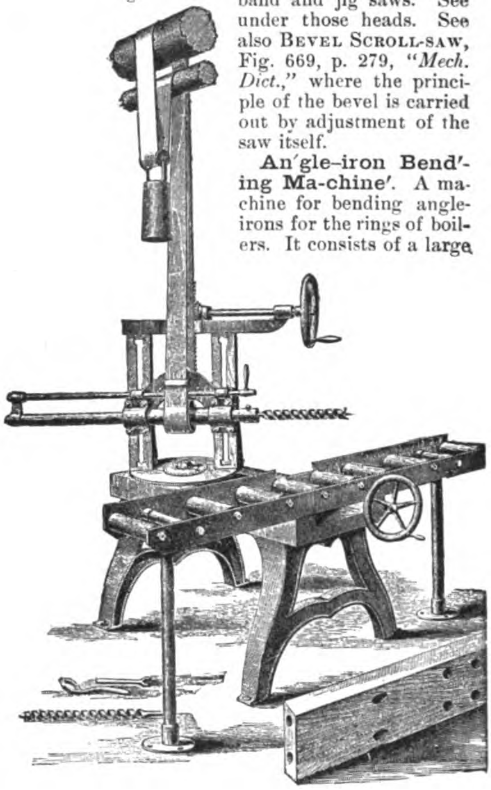
An'gle Check Valve. A valve in a pipe meeting another at an angle.

An'gle Cock. One occupying a position at a turn or bend of a pipe, as in the instance shown, Fig. 77, which is one adapted to sugar-house use.

An'gle-cut'ting Cir'cu-lar Saw. One adapted by adjustable bed and fences to rip, groove, or cross-cut, on any line oblique to the general working-line of the piece.

Angle cutting adjustments are found on other classes of saws, such as band and jig saws. See under those heads. See also BEVEL SCROLL-SAW, Fig. 669, p. 279, "*Mech. Dict.*," where the principle of the bevel is carried out by adjustment of the saw itself.

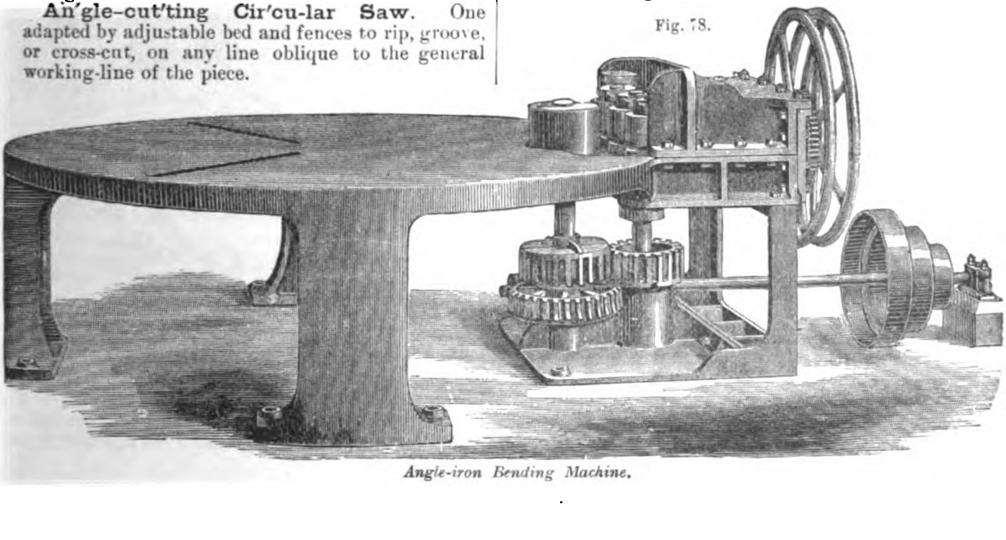
Fig. 75.



Angle Car-boring Machine.

An'gle-iron Bend'ing Ma-chine'. A machine for bending angle-irons for the rings of boilers. It consists of a large circular cast-iron table, to one side of which the bending mechanism is attached. There are one large and three small vertical rolls. The larger one revolves upon a fixed spindle, while the spindles of the others can be traversed by means of screws. The angle iron to be bent is gripped between the fixed and the middle traversing roll, and the two outer ones are then moved forward simultaneously to bend the bar to the curves required. One of the large hand-wheels is used for moving

Fig. 78.



Angle-iron Bending Machine.

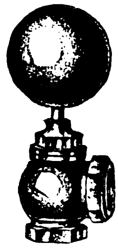
the gripping roller, and the other for traversing the bending rolls, the screws employed for this being geared together. The two gripping rolls are driven by the gearing shown in the drawing, the moving roll being connected to the gearing by universal clutches, which allow a free motion to be given to the sliding bearings. The two bending rolls are free on the spindles, and are not driven. For carrying the angle-irons upon the table, rollers may be recessed into its face.

The machine illustrated in Fig. 78, was made for bending angle-irons for boilers 8′ in diameter.

"*Engineering*," * xxiii. 421.

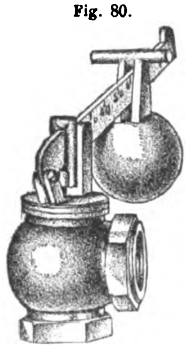
An'gle Meas'u-rer. Rutherford's glass scale, for the mensuration of angles of astronomical photographs, is about 10″ in diameter, divided to 10 minutes of arc, and adapted to a spectrometer similar to the one used by Mascart, and described in his paper on the measurement of wave lengths. The measurements are read by two microscopes, each magnifying 75 diameters. — "*Scientific American*," xxxv. 133.

Fig. 79.



Angle Pressure Valve.

Fig. 80.

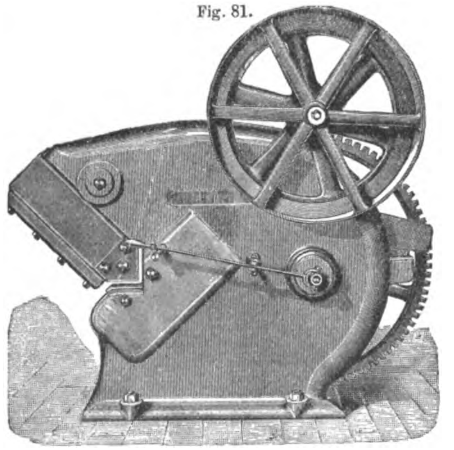


Angle Safety-valve.

An'gle Press'ure-valve. A weighted valve at the bend of a pipe. Fig. 79.

An'gle Safe'ty-valve. One placed at the bend or angle of a steam-pipe. Fig. 80.

Fig. 81.



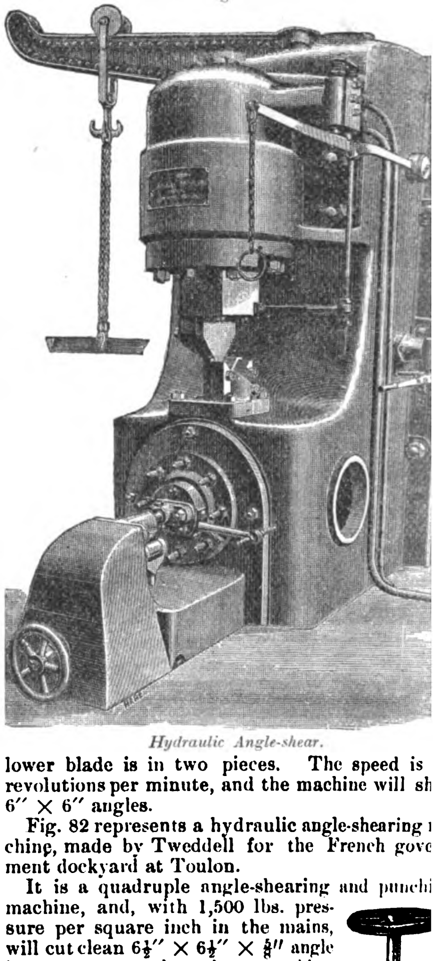
Angle-shearing Machine.

An'gle-shear'ing Ma-chine'. A shear adapted for cutting angle-iron while resting on trestles. Fig. 81.

The blades have no shear given to their edges; but by punching the angle off with a cut extending over all parts of the iron with uniform pressure, the piece cut off is not bent out of shape.

The shear is operated by a heavy wrou lever within the housing. An independe motion will permit the blades to rest open

Fig. 82.



Hydraulic Angle-shear.

lower blade is in two pieces. The speed is revolutions per minute, and the machine will sh 6″ × 6″ angles.

Fig. 82 represents a hydraulic angle-shearing chine, made by Tweddell for the French gove ment dockyard at Toulon.

It is a quadruple angle-shearing and punchi machine, and, with 1,500 lbs. pressure per square inch in the mains, will cut clean $6\frac{1}{2}'' \times 6\frac{1}{2}'' \times \frac{5}{8}''$ angle iron or any equal section, punching 1-inch holes in the same. The machine is really composed of four distinct tools, having independent connections to the main. In the shop the machine is partly sunk below the ground line.

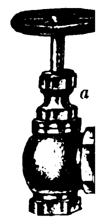
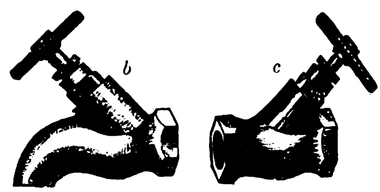


Fig. 83.

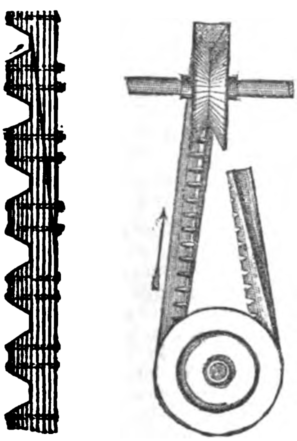


Angle Valves.

a. Angle valve in bend.
b. Full-way angle bib-valve.
c. Full-way angle stop-valve.

An'gle Valve. 1. One placed at a bend of a pipe or tube. In *a*, Fig. 83, it is operated by a screw and hand-wheel, and has screw connection sockets.

Fig. 84.



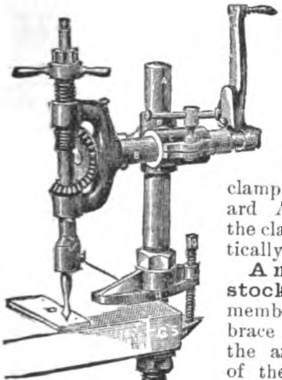
Angular Belting.

2. One having an angular presentation relatively to the line of direction of the pipe, as in *b*, *c*, Fig. 83.

An'gu-lar Belt'ing. A belting made of truncated wedging pyramids of leather of many plies, cemented and riveted together, the whole strongly riveted to a conveying strap of leather. (See Fig. 84.) The belt fits into the angular peripheral channel of the belt pulley, and has great adhesion.

An'gu-lar Bench Drill. A portable drill attachable to a bench, and capable of angular presentation relatively to the surface of the latter. Fig. 85.

Fig. 85.

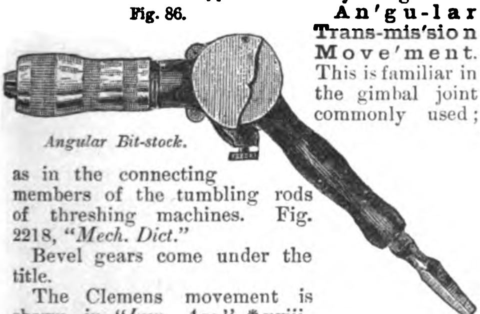


Angular Bench Drill.

The clamp *H* attaches it to the bench. The hollow shaft, *B*, may be slipped, or it may be rotated in the clamp *C* on the standard A, upon which the clamp itself is vertically adjustable.

An'gu-lar Bit'-stock. An extension member to the ordinary brace having a joint for the angular transmission of the movement to the bit so that the latter may reach an object to which the brace cannot be applied vertically. Fig. 86.

Fig. 86.



Angular Bit-stock.

An'gu-lar Trans-mis'sion Move'ment. This is familiar in the gimbal joint commonly used; as in the connecting members of the tumbling rods of threshing machines. Fig. 2218, "*Mech. Dict.*"

Bevel gears come under the title.

The Clemens movement is shown in "*Iron Age*," *xviii., September 28, p. 1.

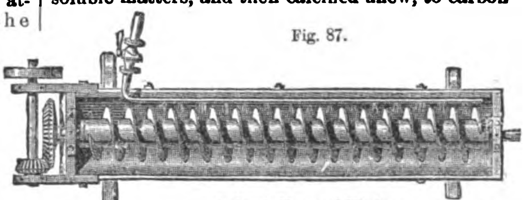
An'i-line Pen'cil. From Portuguese *anil*, derived from *nil*, the Sanskrit name of indigo, the *indicum* of Pliny.

French aniline pencils are made in grades, according to the hardness, very much like common lead pencils. The materials used are aniline, graphite, and kaolin, in different proportions. Made into a paste in cold water, the material is pressed through a screen that divides the mass into the slender sticks used in filling the pencils. When dry, the sticks are fitted to the wooden parts, and these are glued together in the usual way. They may be used in copying, marking in permanent color, and in reproducing writing or designs. In copying, a thin sheet of moistened paper is laid over the letter, design, or document, and the lines are traced with the pencils. The action of the water on the aniline gives a deep, fast tracing, resembling ink in color. On ordinary dry paper they give a well-defined mark that cannot be removed by India-rubber. When the paper is dampened with water, the markings assume the appearance of ink. Moistened sheets laid over the writing, under a slight pressure, will transfer good impressions, that do not blur, and that resemble the original in every respect.

An'i-mal Char'coal Re-viv'i-fi-er. The fabrication of bone-black, employed in sugar-houses as a decolorant and absorbent, consists in the carbonization of bones in a closed retort; the bones having previously been broken, and deprived, by boiling, of their fatty components. Green bones give a maximum of organic substance rather than those long exposed to the air, and give by calcination a more active decolorant.

The revivification of the charcoal consists in the processes employed to restore the decoloring property. For this purpose it is first washed to remove soluble matters, and then calcined anew, to carbon-

Fig. 87.



Animal Charcoal Washer.

ize the organic matters absorbed. This may be done twenty to twenty-five times, as the loss is from 4 to 5 per. cent. at each operation. This loss represents the diminution in weight, but the loss in value is greater, as the quality also deteriorates.

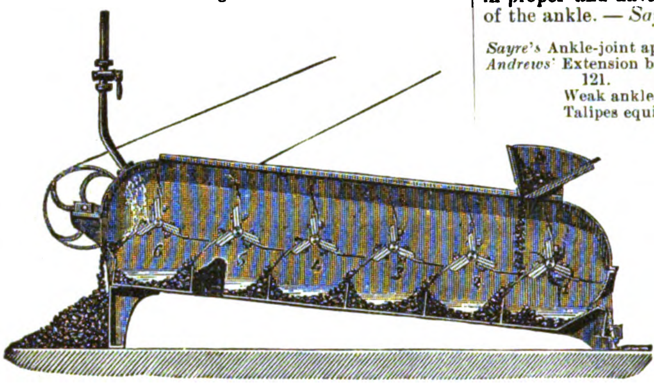
The washing may take place in water or in an alkaline liquor; but the preference is given to a weak solution of hydrochloric or acetic acid. Following the washing in the acidulated solution, which has, in the beet sugar process, for its special object, the separation of the carbonate of lime absorbed, it is necessary to wash in clear water to remove the lime and traces of acid not neutralized. The washing takes place in the apparatus, Fig. 87, or Fig. 88; the former being customary in France, and the latter — the Klusemann washer — being used principally in Germany.

The action of the French machine is evident, the bone-black, fed in at one end, is passed to the other by means of the endless screw, being subjected to jets of water from the horizontal pipes throughout its whole course.

The German machine receives the charcoal from the hopper *A*, at the lower end of the machine. A stream of water is introduced at the other end, and the charcoal is advanced against the stream by successive liftings from one partition to another, until it is dumped at the upper end.

Furnaces, for recalcination of the bone-black, are shown in Figs. 786, 787, p. 328, "*Mech. Dict.*" The usual French charcoal revivifying furnace is that

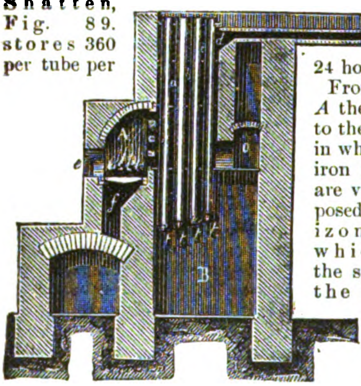
Fig. 88.



Klusemann's Animal Charcoal Washer.

of Blaise, mentioned in most books treating of the Beet-root industry (which see). A favorite German furnace is that of Shatten, shown in Fig. 89. This restores 360 kilograms per tube per 24 hours.

Fig. 89.



Animal Charcoal Furnace.

From the hearth *A* the gas passes to the furnace *B*, in which the cast-iron retort tubes are vertically disposed, having horizontal plates which separate the space around the retorts into four divisions. The upper and second quarters of the tubes are exposed to moderate and increasing heat respectively. In the third is the full heat of the fire, and the lower extends beneath the furnace bottom and allows the bone-black to cool before being discharged by the withdrawal of the register, which closes the lower end. The upper end of the retort is open, and the bone-black, somewhat dried upon the platform over the chimney, is shoveled into the tubes, the production being at the rate, say, of 11 pounds per 20 minutes, that quantity being retired below, and additional charge shoveled in above. The temperature is about 275° C., and the material augments in density in varying proportions, ranging from 77–80, up to 90–115.

It has been proposed by MM. Laurent and Thomas to revivify charcoal by superheated steam at a heat of 300° C., but it has not, according to M. C. Laboulaye, been reduced to practice.

An'kle Boot. (*Manége.*) A covering for the ankle of a horse, to protect it from injury when struck by the other feet; made of leather or heavy felt, with a small piece, called a shield, placed over the part to be protected.

An'kle Com-press'or. (*Surgical.*) An application of the nature of a bandage, consisting of a rubber sac around the joint, with tubes, by which hot or cold water can be passed through. — *Dr. Sayre.*

An'kle-joint Ap'pa-ra'tus. (*Surgical.*) An apparatus for maintaining the leg, foot, and ankle in proper and unvarying adjustment, for treatment of the ankle. — *Sayre.*

Sayre's Ankle-joint apparatus, Fig. 98, p. 52.
Andrews' Extension bandage for inflamed ankle, Fig. 186, p. 121.
Weak ankle support, Fig. 60, p. 27.
Talipes equinus apparatus, Fig. 62, p. 28.
Talipes varus apparatus, Fig. 63, p. 29.
Ball and socket club-foot shoe, Fig. 64, p. 30.
Talipes valgus apparatus, Fig. 65, p. 31.
Talipes calcaneus apparatus, Fig. 67, p. 31.
All in *Tiemann's* "*Armamentarium Chirurgicum*," Part IV.

An'kle Shack'le. A manacle for the ankles; sometimes furnished with chain and ball.

An-neal'ing. (*Glass.*) A process the reverse of tempering. See Tempered Glass.

(*Metals.*) In annealing cast-iron the malleable iron castings are put into iron boxes inclosed in pounded iron-stone or lime. The boxes are luted, rolled into a furnace or oven, heated for five days, and allowed to cool gradually in the furnace.

Slow cooling of bronze produces hardness.

See the following: —

Annealing Castings, Process for.
Robinson . . . . . * "*Iron Age*," xx., July 5, p. 7.
Annealing Furnaces, Construction of.
* "*Iron Age*," xxi., March 28, p. 7.
Annealing Furnaces.
Chess . . . . . . * "*Iron Age*," xxi., Nov. 29, p. 5.
Ives . . . . . . * "*Iron Age*," xx., Nov. 22, p. 5.
Annealing Oven, Iron . * "*Iron Age*," xxi., March 7, p. 7.
Annealing Oven, Glass.
Siemens . . . . . * "*Scientific American Sup.*," 4078.
Annealing by Electricity, Machine for.
Warrington . . . . * "*Scientific American Sup.*," 129.

An-neal'ing Lamp. An alcohol lamp and hot plate used by dentists for softening gold foil by heat, in order to render it adhesive when used in plugging teeth. The plate keeps it warm during the operation.

Fig. 90.

White's Annealing Lamp.

An'nu-lar Fur'nace. Fletcher's annular melting furnace (British) for crucible work is shown in "*Iron Age*," * xxii., November 21, p. 1; also in "*Engineering*," * xxvi., 140.

An'nu-lar Pis'ton En'gine. An engine with a ring-shaped piston, moving in the space between two concentric cylinders.

See Annular Cylinder Engine, pp. 115, 116, and Figs. 253–255, "*Mech. Dict.*" Also, Fig. 1742, p. 739, *Ibid.*; also, Figs. 4035, 4036, pp. 1830, 1831, *Ibid.*

In *Robertson's* steam-engine the piston reciprocates in the arc of a circle.

"*Scientific American Supplement*," * 1232.

Borsig, of Berlin, has introduced a compound 45 horse-power steam-engine with peculiar valve gear, and with annular pistons. It is shown and described in "*Iron Age*," * xxv., February 26, p. 1.

Young's annular cylinder marine engine (British), is shown in "*Engineer*," * xlii. 407, 412.

An'ode. (*Electricity.*) The positive pole or "upway," so named by Faraday.

The wire or plate connected to the copper or other *negative* plate of the battery, and which leads the *positive* current to the object.

Wenzel's Nickel Anode, * "*Sc. American*," xxxix. 150.

An'te-ri-or Cur'va-ture Tib'i-a Ap'pa-ra'tus. (*Surgical.*) The instrument consists of two upright steel stems fastening below to a shoe, and above to a calf band. A leathern band passes forward over the arc of the curvature, and around the stems, so as to constantly afford a backward pressure upon the deformity of the tibia.

An'te-ri-or Splint. (*Surgical.*) A frame of stout wire suspended above a fractured limb, the latter being fastened to and suspended from the splint by rollers. The limb lies in a cradle of wire gauze.

See Smith's anterior splint and Byrd's wire gauze supporter, Figs. 102, 103 *a*, 103 *b*, pp. 50, 54, Part IV., *Tiemann's* "*Armamentarium Chirurgicum*."

An'the-mi-on. An ornament in classic architectural decoration, derived from various floral forms, but especially the honeysuckle.

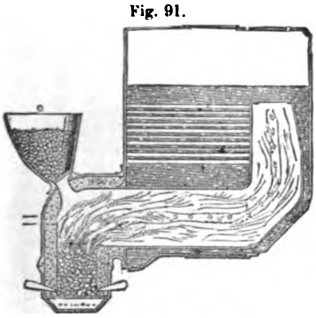
Wornum's "*Analysis of Ornament.*"

An'thra-cene. A product of coal tar.

Anthracene Manufacture, *Fenner*, * "*Sc. Am.*," xxxiv. 226.
See U. S. Patent, *Perkin*, No. 127,426, June 1, 1872.

An'thra-cite Coke Fur'nace. The anthracite coke furnace of Penrose & Richards, of Swansea, Wales, has a gas generator, not immediately in contact with the boiler, composed of iron rings, keyed and luted and lined with fire-brick. The carbonic acid, formed at the interior part of the furnace, is reduced to carbonic oxide in passing through the incandescent fuel, and the requisite oxygen for its consumption is furnished by a pipe, shown in dotted lines, which has orifices through which the heated air under pressure reaches the interior of the furnace.

Fig. 91.



Penrose and Richards' Anthracite Coke Furnace.

c is the supply hopper.

An'thra-cite Dust Fur'nace. A furnace for burning the dust or slack of anthracite coal. This accumulates by millions of tons in the anthracite regions of Pennsylvania and Wales, and is a material addition to the cost and waste of mining operations in those regions. See Waste Coal Burning Locomotive, for description of J. E. Wooten's locomotive.

An'ti-clink'er Grate. A stove grate placed below the fire-pot so as to leave an annular opening between the two through which the clinkers can be raked out from the fire.

An'ti-fric'tion-ate. A name given by the inventors to a combination of materials welded into a solid mass, for machinery bearings, or bearing linings. Patents July 6, and July 27, 1875.

An'ti-fric'tion Bear'ing. This subject has been considered under many heads: —

Anti-friction bearing.	Anti-friction pulley.
Palier glissant.	Anti-friction step.
Anti-friction box.	Anti-friction wheel, etc.
Anti-friction metals.	

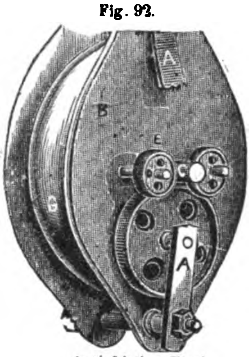
See pp. 118, 119, etc., "*Mech. Dict.*"
Avery's anti-friction has a circle of partially imbedded rollers in the journal. "*Scientific American*," * xl., 278; article "*Rouleaux*," * *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," iv., ed. 1877, where *Chauffour's* and *Brussaut's* (*) systems are described.

An'ti-fric'tion Block. One with roller bearings.

Such are seen in the "Climax" door-hanger, and in Fig. 263, p. 119, "*Mech. Dict.*"

In the illustration, Fig. 92, the pin *C* is keyed fast into the hub of the sheave *G*, and rests and turns on the roller bearings, one on each side of the block. The sheave *G* turns 5 times while *H* turns once. The smaller rollers, *E*, *F*, are to keep the axis *C* in place. The strap *A* is broken, to expose the parts.

Fig. 92.



Anti-friction Block.

An'ti-fric'tion Met'al. Belgian anti-friction metal is composed of —

Copper	20
Tin	4
Antimony	0.5
Lead	0.25

Mix all the other ingredients before adding the copper.
Doubleday's consists of cast-iron, copper, glass, antimony, tin, spelter, and lead. U. S. Patent, 178,841.
Coline. (*French*) Asbestos and graphite in equal parts; mix, and reduce to a paste by addition of silicate of soda or potash. Pressed to shape in a hydraulic press, or pressed to a block and turned to shape when solid. When the bearing is shaped, steep in hot melted paraffine or wax; in solution of paraffine, benzole, or other mineral oil.
See U. S. Patents: —

189,684	*Behrens*	April 17, 1877.
162,065	*Harrington*	April 13, 1875.
157,509	*Guile*	December 8, 1874.
154,317	*Campbell*	August 25, 1874.
136,163	*Hunt*	February 25, 1873.
234,482	*Hunt*	November 16, 1880
175,841	*Doubleday*	June 20, 1876
217,946	*Jackson*	July 29, 1879.
153,154	*Campbell.*	

An'ti-fric'tion Plow. One with rollers on sole, land side, or mold-board, to avoid friction of the passing soil. A doubtful expedient.

Such were shown at the Centennial by two Swedish exhibitors: Catherineholm's Foundry, and L. P. Eklundh.

It is, however, an old device. See *d*, *e*, *f*, Fig. 3823, p. 1745, "*Mech. Dict.*" Wilkie's plow of this class dates from 1825.

An'ti-in-crus'ta-tor. A material, process, or device to prevent the incrustation of steam boilers resulting from the adherence of a scale of salts of lime, etc. See list on p. 1177, "*Mech. Dict.*"

Vigier Process	"*Manufacturer and Builder*," x. 124.
Zinc	"*Scientific American*," xxxv. 158.
	"*Scientific American Supplement*," 518.
Morehouse	"*Scientific American*," xlii. 374.
Holden's Alloy	"*Scientific American Supplement*," 468.

An'ti-mo-ny Pho'to-graph. A process invented by F. Jones (Br.).

The process is based upon the reaction which takes place between sulphur and antimoniated hydrogen or stibine in the presence of light, by which sulphide of antimony results as the product of decomposition. "*British Journal of Photography*," 1876. Reproduced in "*Scientific American Supplement*," 352.

An-tique' Bronz'ing. A process designed to give the *patina* or surface effect seen on ancient bronze, and due to exposure and the effect of time. Also known as ORUGO, which see.

The repeated applications on copper or brass of alternate washes of dilute acetic acid, and exposure to the fumes of ammonia, will give a very antique-looking green bronze, but a quick mode of producing a similar appearance is often desirable. To this end the articles may be immersed in a solution of one part of perchloride of iron in two parts of water. The tone assumed darkens with the length of immersion.

Or, the articles may be boiled in a strong solution of nitrate of copper.

Or, they may be immersed in a solution of two ounces nitrate of iron, and two ounces hyposulphite of soda in one pint of water. Washing, drying, and burnishing complete the process. See also BRONZE COLORING.

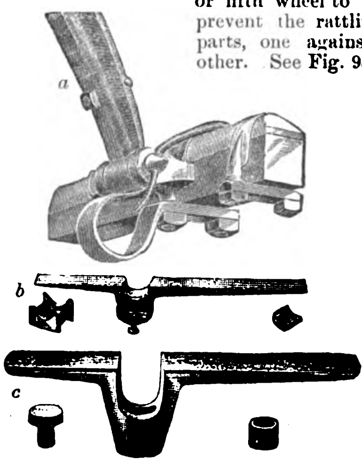
An'ti-ra'cer. A governor for propeller engines to prevent the *racing* of the screw when the ship pitches and throws the propeller out of the water.

Durham, Br. . "*Engineer*" . . . . * 1878.
"*Scientific American Supplement*" * 2397.

See MARINE ENGINE GOVERNOR.

An'ti-rat'tler. An attachment to a carriage coupling or fifth wheel to prevent the rattling of parts, one against the other. See Fig. 93.

Fig. 93.



Anti-rattlers.

a. Represents Ladd's anti-rattler for shaft or pole couplings. A spring presses against the thimble to keep it from chattering on the bolt.
b. Is a fifth wheel anti-rattler. A caoutchouc pad rests in the bearing.
c. Wilcox's fifth wheel anti-rattler. A rubber sleeve is placed in the recess, and the rivet fastens down upon it.

Fig. 94.

Antiseptic Spray Apparatus.

An'ti-sep'tic Spray Ap'pa-ra'tus. (*Surgical.*) An atomizing apparatus for suffus atmosphere with vapor of an antiseptic solı the vicinity of a wound while being dres upon a cut surface during an operation. M ter is the principal authority in the matter, practice is most observed.

The apparatus is generally a steam atomi alcohol lamp making a jet of steam which c the antiseptic liquid into spray. The appara *Hank*, *Weir*, *Head*, *Little*, and *Tiemann*, are in *Tiemann's* "*Armamentarium Chirurgicum*," I., Figs. 408–412, pp. 119–123.

Figure 94 shows that of Dr. Weir, of New See "*New York Medical Journal*," December,

A somewhat similar apparatus is that o Louis Sass, of New York, described in "*Sci. American Supplement*," * 1164.

An'trum Tre-phine'. A small crown used by dentists when it is desired to ente antrum through a tooth socket.

Antrum Drill, *Pope's*, Fig. 50, p. 12, Part I., *Tien* "*Armamentarium Chirurgi*

An'vil. A plate or cup inside the head

Fig. 95.

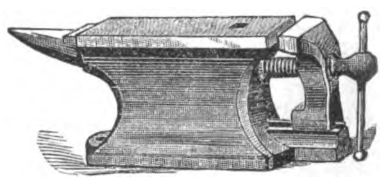
Antrum Trephine.

cartridge to strengthen it. See CUP ANVIL; I ANVIL.

Anvil for Paper Cartridge Shells, *Saget*, * "*Sc. Americ* xxxv. 53

An'vil Cup'per. (*Cartridge.*) A machine making the inside cup or case of the cartri which holds the fulminate; the stamp cuts tl out, and by a die working inside the stamp, dr them to the required length.

Fig. 96.

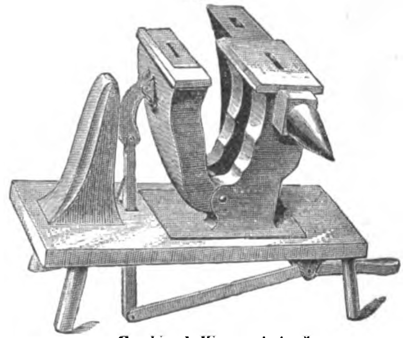


Anvil and Vise Combined.

An'vil Vise. A compound tool in which tl anvil forms one jaw of the vise.

Two forms are shown, in Figs. 96 and 97. On has a screw jaw at the square end of the anvil, an

Fig. 97.



Combined Vise and Anvil.

the other has a long jaw worked by treadle against the side of the anvil.

Ap'a-re'jo. A pack-saddle, or the whole apparatus necessary for loading pack animals. It is one of a number of terms such as "sinch" (Spanish *cincho*, a girth) and "cabresto" (Sp. *cabestro*, a halter), which are working into our language from our Mexico-Spanish frontier.

Ap'er-ture Sight. (*Rifle.*) Another name for the *open bead sight.*

See Bead Sight.

A'pex. (*Mining.*) The top or highest point of the mineral.

Aph'lo-gis'tic Lamp. A flameless lamp; one with platinum sponge and glass wick-holders. Also known as the *Dobereiner lamp*, and *Hydrogen lamp*.

A-phon'go-scope. See Megascope.

Ap'la-nat'ic Search'er. (*Optics.*) Another name for the amplifying lens. See Amplifier. That of Dr. Royston Pigott is described in "*Microscopic Journal.*"

A-plat'is-seur. A name from the French. A grain-flattening mill. Used for the rough crushing of grain for feeding stock. It has a pair of rollers between which the grain is fed from a hopper.

See Grain-crusher.

Ap'o-neu'ro-tome. (*Surgical.*) A blunt pointed curved knife, the blade on the concave edge, used in supra-pubic lithotomy in cutting the tendinous membranes, *aponeuroses.*

Fig. 155, p. 42, Part III., *Tiemann's* "*Armamentarium Chirurgicum.*"

Ap-par'i-tor Au'ris. A species of ear-cornet in which the canal is elongated and overbridged so

Fig. 99.

Apple Corer and Slicer.

Fig. 98.

Apparitor Auris.

that sound entering the aperture A (Fig. 98), cannot diffuse, but is conducted within the tunnel through the meatus auditorius B to the tympanum.

The instrument is of silver, with flesh-colored enamel, is so shaped as to be worn within the concha, and is sold in pairs, one for each ear.

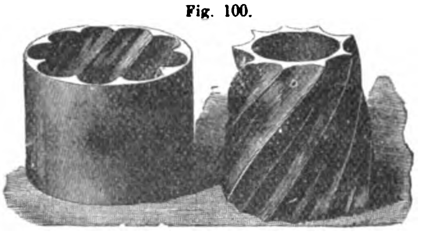
Ap'ple Co'rer and Sli'cer. An implement, Fig. 99, which acts by a simple downward thrust, removing a cylinder of apple containing the core, and cutting the apple into eight pieces.

Ap'ple Gra'ter. The Boomer & Boschert apple grater has an iron cylinder with planed grooves to receive the knives (8) which are adjustable by set screws above and below at each end, and held in their places by a heavy wrought iron band shrunk on at each end of the cylinder. The concaves consist of five iron levers with movable weights.

"*Scientific American*," * xlii. 242.

Ap'ple Grin'der. A mill for grinding apples previous to pressing the pomace.

Fig. 100.



Nut of the Apple Grinder.

Fig. 100 shows the galvanized cast iron nut and concave of the "Peekskill" apple grinder.

Fig. 101.

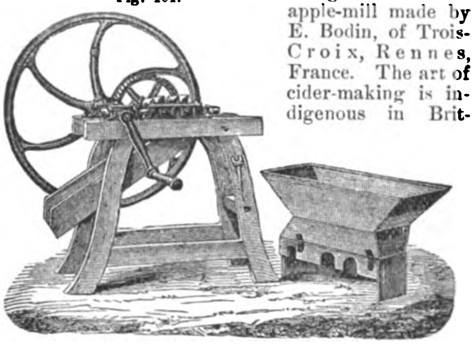


Fig. 101 shows an apple-mill made by E. Bodin, of Trois-Croix, Rennes, France. The art of cider-making is indigenous in Brit-

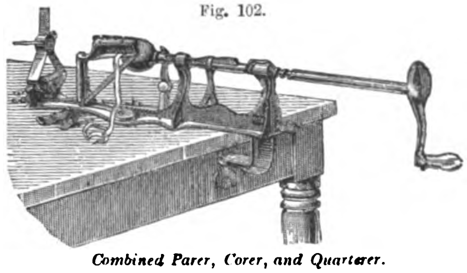
Bodin's Apple Grinder, Rennes, France.

tany, and it is considered that the crushing-mill is superior to the grater, giving a pomace which affords a clearer juice, with less pulp, and consequently less tendency to ferment. The *nuts*, or toothed cylinders, have six teeth, and can be approached or parted by means of two screws.

The duty is from 175 to 200 gallons per hour, by the moderate work of two men.

Ap'ple Par'er. The "Missouri" combined apple parer, corer, and slicer, works by a horizontal motion, the circular movement of the shaft rotating the apple, and the endwise movement of the shaft giving the sweep to the knife; after which a simple thrust delivers the apple to the corer and quarterer, the quarters dropping to the table while the fork withdraws with the core. See Fig. 102.

Fig. 102.



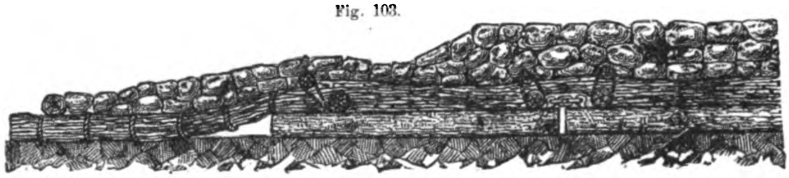
Combined Parer, Corer, and Quarterer.

Ap'pli-ca'tor. (*Surgical.*) Uterine and urethral applicators, for introducing medicaments, caustic, sponge tents, etc.; pp. 21, 65, 73, 77, 82, 83, Part III., *Tiemann's "Armamentarium Chirurgicum."*

Ap-plique'. 1. (*Fine Art Metal Working.*) Ornaments produced by affixing portions to the surface of the object. The metal is previously rolled or stamped into figures, scrolls, braids, etc., and these are soldered on to the object to be ornamented. The result resembles *repoussé*, which is, however, produced by indenting the metal from the interior.

2. In cloth work, also known as *opus consutum*, or cut cloth work, the patterns are cut out and then sewed on.

Fig. 103.



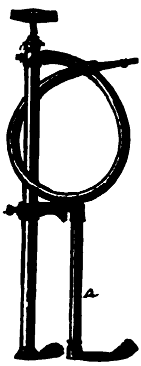
Apron.

A'pron. (*Hydraulic Engineering.*) A protecting surface of logs and brush anchored by rip-rap (or similar contrivances), to protect or to form revetment for river sides, or to form a jetty.

See instance of apron in Charleston Harbor improvements. "*Report of Chief of Engineers U. S. Army,*" 1879, * i. 734.

Savannah River. *Ibid.*, * i. 742.

Fig. 104.



Douglass' Aquapult.

Fig. 103 shows a portion of a cross-section of an apron. It consists of rip-rap, lying on brush anchored by poles and founded on logs.

A'pron Fas'ten-er. A species of catch, resembling a buckle, used for fastening the apron cover on the dash-board of a vehicle. It consists of an apron hook and an apron ring.

A'qua-me'ter. A name for the pulsometer, a vacuum steam-pump. See AQUOMETER.

A'qua-pult'. A portable force-pump. The foot of the barrel stands in a bucket of water and the foot of the operator is on the step of the post *a*, Fig. 104. The pump being thus steadied, the handle is worked up and down, and the stream of water may be directed upon plants, fire, carriage, or what not.

A-qua'ri-um. The aquarium of Brighton is described in some detail, on p. 127, "*Mech. Dict.,*" and reference made to parlor aquaria.

The late Exposition at Paris has furnished a most admirable work of the kind, shown in Plate II.

The aquarium is upon the hill of the Trocadéro, and is for fresh-water fish only. The site was quarried out of the hill, the natural rock being left to form the sides of the tanks and galleries. It covers a surface of 3,200 square meters.

The surface of the water is exposed to the rays of the sun, and light is admitted through the water to the grotto.

These tanks, 24 in number, are connected with each other in a gradually descending series, and the water overflowing each in succession is received into the one next below, the whole presenting, when viewed above ground, the pleasing appearance of a rivulet spanned by numerous rustic bridges and skirted by artistically planned and well-arranged walks. From these walks the visitor can observe the motions of the fish in the tanks below him, but a more accurate survey and closer observation can be had from the interior and lower level, where the fish are rendered plainly visible by reason of the effects of the light passing through the water.

The area of the walks on either side of the tanks is sufficient for the accommodation of 2,000 visitors at a time. The basins which contain the water are formed by the original excavations and artificial rock-work, made to imitate stalactites. These sustain the frames holding the glass plates, which are $\frac{86}{100}''$ in thickness, and number about 250 in all. The water used is the same as that supplied to the city of Paris, from the headwaters of the Vanne, and has a temperature during the summer of from 12° to 15° C. A supply can also be obtained from the Seine if necessary.

As the water is obtained very near the source of the river, it is deficient in oxygen, and in order to supply this element, so essential to the existence of the fish, an apparatus for aërating the water was introduced, the invention of M. Gauckler, chief engineer of roads and bridges, who was, in fact, the author of the original plan of the aquarium.

Some of the basins are 15′ in depth, and the total capacity of the tanks is about 2,000 cubic yards. Forty-six different species and varieties of fish are contained in the tanks, and one peculiarly interesting operation was performed in this aquarium in 1878: the hatching of 35,000 eggs of California salmon, sent by Prof. Spencer F. Baird to the French *Société d'Acclimatation*. Twenty-six thousand were hatched under the care of M. Carbonnier.

When it is remembered that the eggs were taken (artificially) from fish caught on the McCloud River, California, and thence transported across the American continent by rail, and across the Atlantic Ocean by steamship, the loss of only 10,000 eggs was a great triumph for American and French fish culture. The young fish were distributed as follows: —

To the Sarthe	5,000
To the Vienne	5,000
To the Yonne	5,000
To the Adour	5,000
To the Gave de Pau	5,000

The remaining 1,000 were placed in Tank No. 18 of the aquarium. The safe deposit of these fish in the above-named streams was a matter of great rejoicing to the French.

The cost of the aquarium was 50,000 francs.

The London Crystal Palace aquarium is 400′ long and 70′ broad, and the total capacity of all the tanks is 200,000 gallons of water, weighing 1,000,000 pounds. Of sea-anemones alone there are already in the aquarium over 3,000 specimens. These flower-like animals, being deprived in their captivity of the ocean currents which bring them their food, have to be fed at frequent intervals, each having given to it a morsel of food suited to its size.

See the following notices of aquaria: —

AQUARIA:	"*Scientific American.*"
At Paris	* xxxvi. 7; xxxv. 407; * xxxvi. 7.
At Brighton	* xl. 23.
At New York	* xxxv. 305.
At Westminster . . .	* xxxiv. 200.
At Centennial . . .	* xxxiv. 401.
Parlor, Directions for .	xlii. 395.
Emptying	* xxxiv. 34.
Marine	* xxxv. 135; xxxvii. 202, 236.
Cement	xxxvi. 251; xxxviii. 250; xli. 59.

"*Scientific American Supplement.*"

At Paris	* 2116.
At Berlin Expos. . . .	* 3751.

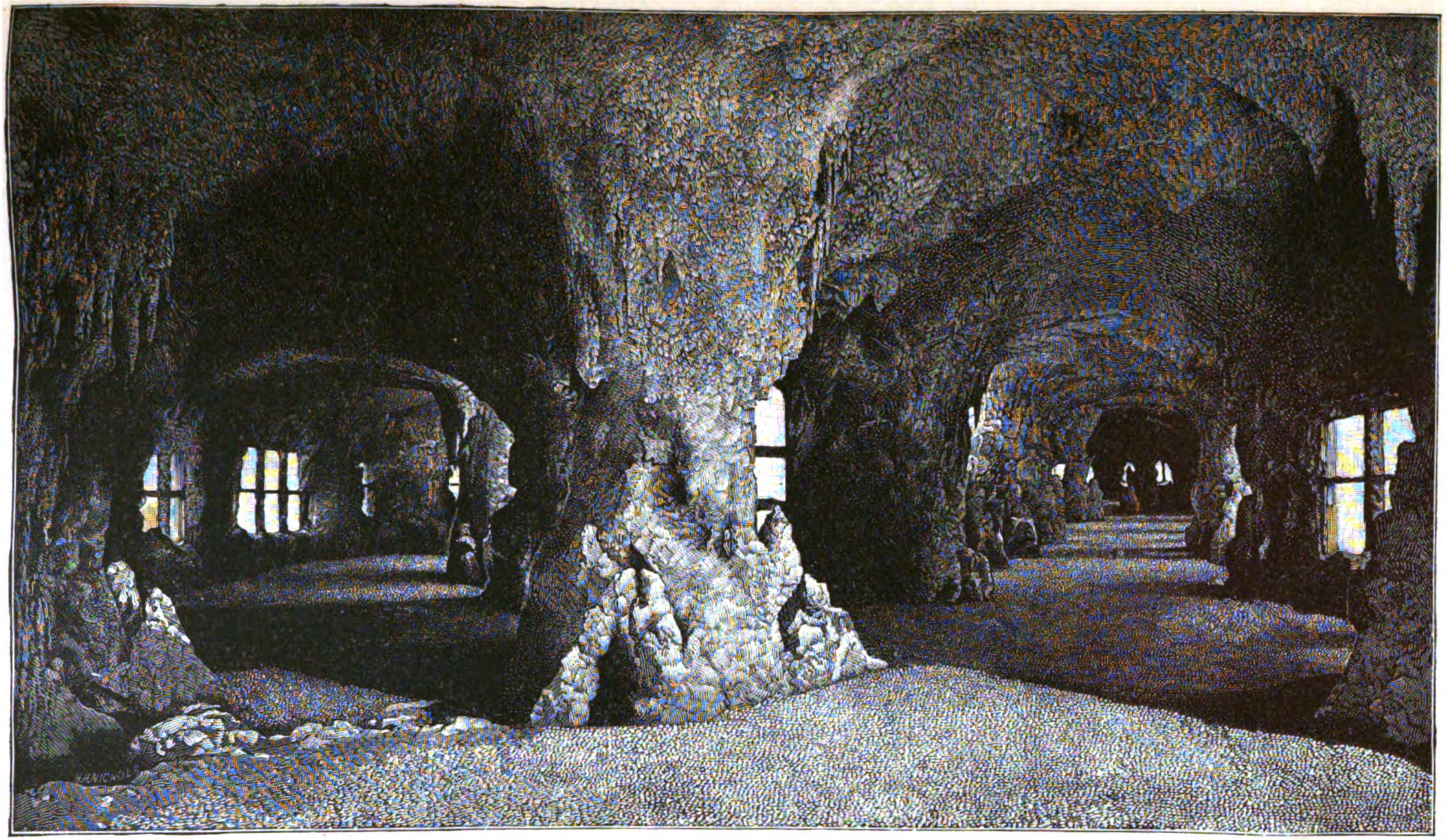


PLATE II.

GROTTO AND AQUARIUM OF THE TROCADÉRO.
PARIS, 1878.

See page 44.

At Westminster	* 216.
At Birmingham, Eng. . .	* 3008.
At Tynemouth	* 2374.
"Agriculturist."	
Parlor	* xxxv. 145.
"Engineering."	
At Paris	* xxv. 42, 85.
"Paris Exposition Reports."	
At Paris	* v. 449.
"Iron Age."	
At New York	xvii. June 1, p. 17.
"Mining and Scientific Press."	
Ornamental	xxxv. 46, 60, 337.
With Bird-cage	xxxvi. 113.
"Manufacturer and Builder."	
Parlor	x. 163.
"English Mechanic."	
Construction	xxiii. 45, 361, 387.
Construction and Suggestions	xxv. 212, 248, 266, 315, 345, 371, 391, 516.
Cement for	xxv. 319, 345, 368.
Marine, Notes on	xxvi. 257
Rockwork	xxvi. 100; xxvii. 275, 557.
"Appleton's Journal."	
At Brighton	* xi. 1-5.

UNITED STATES PATENTS ON AQUARIA.

21,719	*Chilcott et al.*	Securing glass to corner posts.
22,019	*Davis* . . .	Mirror on rear plate.
31,040	*Shlarbaum* .	Suspended against a wall.
31,657	*J. A. Cutting*	Air forced into the tank.
46,801	*A. Ivers* . .	Flow and overflow pipes.
143,456	*J. Moore* . .	Flow and overflow pipes.
164,074	*J. Chase* . .	Aquarium, fernery, and bird-cage.
165,639	*Wenmacker*	Water-space inclosing an apartment.
188,941	*Peltier et al.*	Aquarium fountain and flower-stand.
192,595	*Paten et al.*	Arched-shaped water-chamber.

A'quo-me'ter. Prall & Burr's aquometer steam-pump acts by the direct pressure of the steam upon the water. It has two working chambers, and an intermediate pressure chamber. A double acting balanced valve alternately admits the steam to each working chamber where its pressure closes the water induction valve, opens the water eduction valve on that side, and forces the water contained in the chamber out into the discharge pipe. During this time the induction valve of the other chamber being open, and the eduction valve closed, that chamber becomes filled with water. The steam having expelled all the water from the other chamber, through the rapidity of its exhaust and condensation, a vacuum is formed in the chamber, the unequal pressure on the ends of the steam valve shifts that valve so that the steam passes into the other chamber which has now been filled with water by atmospheric pressure, and at the same time, the water valves in the one chamber are thrown into their proper positions to admit and retain the water ascending through the suction tube, and in the other to permit the water to be expelled therefrom by the steam pressure.

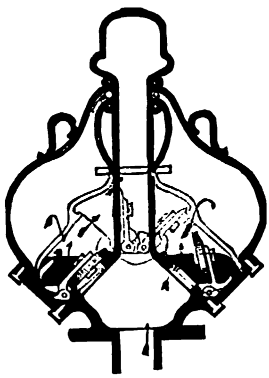
Fig. 105.

Aquometer. (*Elevation.*)

Burdon's vacuum steam-pump has been described under that caption on p. 2687, *"Mech. Dict."* See also early forms, page 2336, *Ibid.*

Van Dusen's and Nye's are also forms of the same kind of apparatus.

Fig. 106.

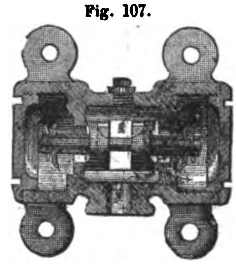


Aquometer. (*Vertical Section.*)

Ar'bor, Ex-pand'-ing. A mandrel having a wedge-shaped feather, capable of being slipped so as to grip interiorly the hollow of a piece of work, or of a circular cutter.

In Fig. 108, *C* is the steel mandrel; *B B* are two of the three keys that are drawn up and pushed down by the nut; a groove is turned inside the nut *A*, which catches the heads of the keys *B*, and thus draws them up to tighten the work; in the outside of the nut *A* is a taper hole which the pin *D* fits, and which answers for a wrench. *F* represents the tool operating on a piece of work.

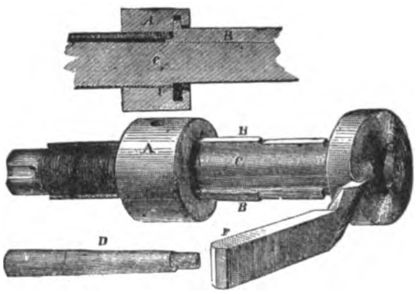
Fig. 107.



Aquometer Valve. (*Section.*)

Arch. (*Add.*) 2. (*Mining.*) A piece of ground left unworked near a shaft.

Fig. 108.



Expanding Mandrel.

3. The fire-chamber of a furnace. The term is used especially in glass-furnaces.

4. The front opening of the ash pit beneath a furnace grate.

Arch Bar. 1. A bar forming a lintel to the mouth of an ash-pit; taking the place of the ordinary brick arch.

Fire-place arch bar, *Wickersham,* * *"Scientific American,"* xxxv. 22.

2. The curved upper member of a round-topped truss.

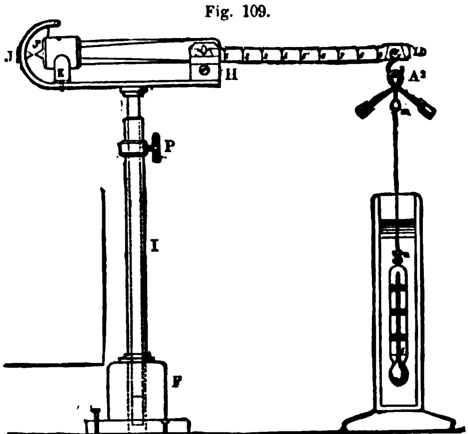
3. A curved bar in a frame depending upon its camber for its stiffness.

Arch Screw Press. One in which the punch and its slide are supported on a frame arched above the die-bed; in contradistinction to one with an over-hang arm or bracket support for the punch-slide.

A're-o-therm'ic Bal'ance. An invention of M. Blondeau for determining the density of liquids. Its advantages are the facility with which the operations may be performed, and the readings taken, the approximation of the specific weight up to the fourth decimal, and its adaptation to liquids either heavier or lighter than water.

The instrument has a base, *F*, and leveling screw, *G*, and a hollow column, *I*, in which the stem of the upper part, *K H*, moves up and down, being held at any vertical adjustment by the binding screw *P*. *H* is a bearing for the knife edges that

Fig. 109.



Blondeau's Areothermic Balance.

support the beam; *K*, the scale-beam guide; *J J'* points to show the equilibrium of the beam. *A 2*, a weight which is suspended from the hook of the 10th division when the specific weight of a liquid heavier than water is sought. *M n*, hooks for suspension of the plunger with its thermometer, from the hook of the balance so that it may dip into the liquid whose density is sought, and which contains the test-glass. One of the arms of the beam carries at its extremity a cylindrical counterpoise, in the center of which is the point, *J'*; and the other is divided into ten equal parts, numbered from 1 to 10. At each division there is an angular notch for receiving a weight. The method of regulating and using is described in a French paper translated and reproduced in "*Scientific American Supplement*," * 3773.

Ar'gen-tif'er-ous. (*Mining.*) Containing silver.

Ar'gen-ti'na. (*Ceramics.*) A name given by M. Hausen, of Stockholm, to his method of covering unglazed porcelain with a coating of gold, silver, or copper. The process is supposed to be as follows: The porcelain articles are dipped in a solution of the metal, similar to that used for electro-plating, and then, by a peculiar process of reduction (perhaps by means of phosphorus vapors), the salt is decomposed, and the metal is deposited within the pores of the earthenware. Articles covered with a metallic coating according to this process, present every appearance of being entirely composed of the metal.

Ar'ith-mom'e-ter. A calculating machine. A number of forms are shown in Figs. 325–329, pp. 143, 144, "*Mech. Dict.*"

Staffel's arithmometer is provided with an attachment, which, if an impossible operation, such as dividing a number by another larger than itself be attempted, stops the machine and rings a bell.

Ar'ith-mo-pla-nim'e-ter. An invention of M. Lalanne; an extension of the principles of the planimeter for calculating certain formulas.

Reference is made at page 1728, "*Mech. Dict.*," to the planimeter of Oppikoffer, and the polar planimeter of Amsler is shown there in Fig. 3794.

The conical planimeter of Lalanne is furnished with longitudinal and transverse scales for calculations, and is shown in Fig. 353, Article "*Calculer*," tome i., *Laboulaye's* "*Dictionnaire des Arts*," etc., edition 1877.

Arm. (*Surgical.*) A dry cupping chamber, inclosing the arm. See DEPURATOR, p. 687, "*Mech. Dict.*"

The apparatus is known as "*Junod's Arm*," from the name of the introducer in Parisian medical practice, about 1855; but it was patented in England by Smith, in 1802. It is a metallic receiver with an elastic band, to exclude access of air, the atmosphere being exhausted from the interior by an air-pump.

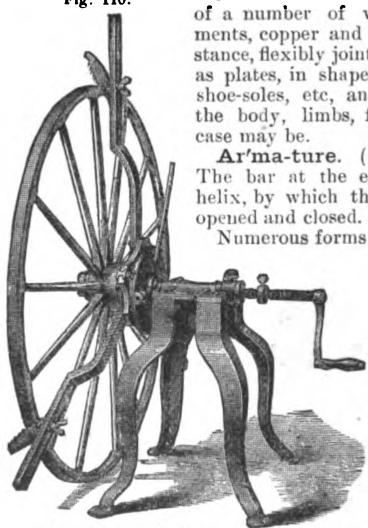
See, also, AËROTHERAPY APPARATUS.

Ar'ma-dil'lo. An electro-magnetic remedy for nervous diseases. It consists of a number of voltaic elements, copper and zinc for instance, flexibly jointed together as plates, in shapes for belts, shoe-soles, etc, and worn on the body, limbs, feet, as the case may be.

Ar'ma-ture. (*Electricity.*) The bar at the end of the helix, by which the circuit is opened and closed.

Numerous forms are shown in treatises on electricity. A compend is given in "*Scientific American Supplement*," * 2,900. See, also DYNAMO-ELECTRIC MACHINE, and list under ELECTRICITY.

Fig. 110.



Arm Boxing Machine.

Arm Box'ing Ma-chine'. A machine for boring the hubs of wheels for the reception of the box for the arm of the axle. The wheel is held, chucked as it were, by three equidistant points on the rim, and the boring device thus presented at the exact center, at right angles to the plane of the wheel.

Ar'mor Com'pound. Ship's armor, having a steel face and iron backing. Made under English Patents to Ellis and Wilson, by Messrs. Brown and Cammell, of Sheffield, England, respectively. See "*Iron*," 1879.

The steel does its work in preventing penetration by causing the shot to break up on impact, and the more tenacious and ductile iron performs its part in preventing the destruction of the steel by being shivered.

In making the compound armor, the liquid steel is poured upon the hot iron plate, the heat of the former being in excess of the welding heat of the latter, and a semi-steel is formed between the two by fusion. Steel-faced iron plates are the latest improvement in the art.

The iron plates are placed horizontally in a furnace when a steel plate is to be cast on to a single iron one, but when a steel plate is to be sandwiched between two of wrought iron, the latter are fixed vertically and the steel run in between them. This is Wilson's plan; that of Sir Joseph Whitworth proceeds on quite a different principle, that of plugging a shield of soft steel with pins of harder quality.

Ar'mor Plate. An iron or steel skin for a vessel of war. See Figs. 337–358, and Plate IV., pp. 150–155, "*Mech. Dict.*" See, also: —

Experiments	* "*Sc. Am. Sup.*," 931.
Trial, Shoeburyness	* "*Sc. Am. Sup.*," 2013.
Plates and Projectiles	"*Iron Age*," xx., July 5, p. 15.
Plate Machine, Br.	* "*Engineer*," xlii. 183.
	"*Sc. Am.*," xxxiv. 247.
	"*Sc. Am. Sup.*," 789.
Chilled Cast Iron, Ger., *Gruson*	* "*Engineer*," xlviii. 465, 468.
Compound Eng.	"*Sc. Am. Sup.*," 1732.
Br., *Brown and Cammell*	"*Iron Age*," xxiv., Aug. 14, p. 14.
Compound	* "*Sc. Am. Sup.*," 1789.
Effect of Shot and Shell	* "*Engineering*," xxvii. 70.
Furnace, Br., *Wilson*	* "*Engineer*," xliv. 419.
Wilson	* "*Sc. Am. Sup.*," 1789.
Iron and Steel	"*Nautical Magazine.*"
	"*Van Nostrand's Magazine*," xxi. 28.
Steel, Eng.	"*Sc. Am. Sup.*," 1777.
	"*Sc. Am.*," xl. 312.
Targets, Eng.	* "*Sc. Am. Sup.*," 2357.
Whitworth's	"*Sc. Am. Sup.*," 2145.
Yates	Patent March 13, 1877.
	"*Sc. Am.*," xxxvi. 407.
Gun, *Krupp*	"*Van Nostrand's Mag.*," xvi. 285.

Consult: —

A. L. Holley's "*Treatise on Ordnance and Armor*," 1865.
Ead's "*System of Naval Defences*," 1868.
Reed's "*Our Iron-clad Ships*," London, 1869.
"*Ship-building in Iron and Steel*," 1869.
Dislère's "*La Marine Cuirassée*," Paris, 1873.
King's "*Report on European Ships of War*," Ex. Doc. xxvii., 1877.
Secretary of Navy's "*Report on Armored Vessels*," 1864.
Noble's "*Report on Penetration of Armor Plates*," 1876.

Arm Sling. (*Surgical.*) A wire gauze cradle for a fractured or dislocated arm, supported by a sling over the shoulder.

Tiemann's "*Wire Arm-sling*," Fig. 152, p. 93, Part IV., "*Armamentarium Chirurgicum.*"

Arm Splint. (*Surgical.*) A stiffening bandage apparatus, for holding parts in position rigidly during the junction of the bony parts, in cases of fracture, or the parts in position in cases of luxation.

The splints are various, according to the part and nature of the fracture. Reference to *Tiemann's* "*Armamentarium Chirurgicum*," Part IV.: —

Clavicle	*Levis*	Fig. 123, p. 76.
Clavicle, Scapula, and Humerus	*Richardson*	Fig. 124, p. 76.
Colles's Fracture	*Hewit*	Fig. 128, p. 79.
	Shrady	Fig. 129, p. 79.
Elbow	*Hamilton*	Fig. 148, p. 91.
Neck of Humerus		Fig. 149, p. 92.
Dislocated Clavicle	*Mayor*	Fig. 150, p. 92.
Olecranon	*Clark*	Fig. 153, p. 94.
Ununited Fracture of the Humerus	*Smith*	Fig. 172, p. 109.
Ununited Fracture of the Fore-arm	*Smith*	Fig. 173, p. 110.
Elbow and Wrist	*Andrew*	p. 123.
Contracted Wrist		Fig. 208, p. 135.

Ar'mure. (*Fabric.*) 1. The character of the weave.

The system of harnesses with which the loom is *armed*, or provided, to produce a definite tissue.

There are four fundamental or classical forms, from which all the varieties of simple tissues are derived.

(*a.*) *Taffeta*, having 2 harnesses, forming a single interlacement.

(*b.*) *Twilled*, or *Batavia Weave*, 4 harnesses.

(*c.*) *Serge*, having 3 harnesses.

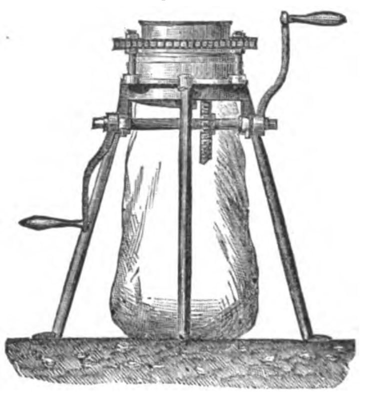
(*d.*) *Satin*, 5 or more harnesses.

See under those heads. See also FABRIC.

2. A silk and wool French dress goods.

Ar'my Mill. A portable mill standing on a tripod, driven by two men at the hand cranks, and grinding into a sack suspended beneath. It is a French invention, costs $40, grinds 44 pounds per

Fig. 111.



Army Mill.

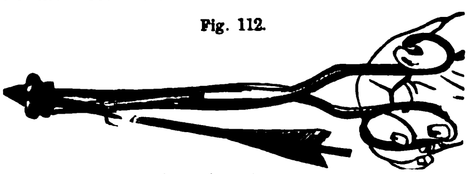
hour, and four of them, packed in two boxes, are a load for a mule on the march.

Ar'my Scales. A portable form of scales which closes up in a box compact for transportation; such scales have a capacity from 600 to 1,200 pounds. When closed, the working parts are entirely protected.

Ar'rage. (*Mining.*) A sharp edge or corner in an adit or drift. — *Arris.*

Ar'row-head For'ceps. (*Surgical.*) An instrument for the extraction of the heads of Indian

Fig. 112.



Arrow-head Forceps.

arrows, which frequently are purposely made to become detached from their shafts.

Ar-te'ri-al Com-press'or. (*Surgical.*) A clamp, to be placed upon an artery to prevent effusion of blood.

Speir's artery constrictor is a species of hook, pulling into a case and clamping the artery. Fig. 87, *Tiemann's* "*Armamentarium Chirurgicum*," Part I.

Billroth's artery clamp is a small screw clamp, holding the artery between curved plates. Fig. 91 *b*, *Ibid.*

Stearns' artery claws are bows of pliable but not flexible metal, pinched upon the artery by forceps. Fig. 89, *Ibid.*

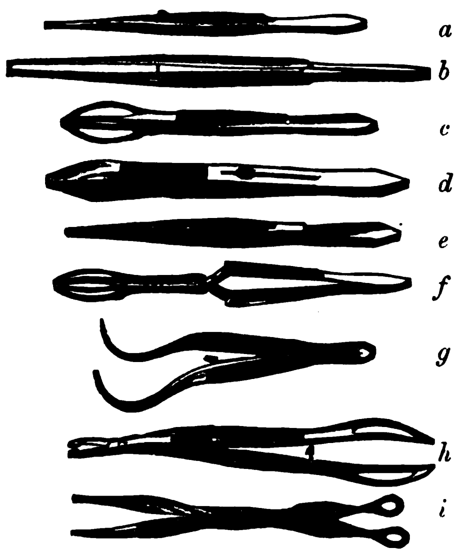
Artery compressors in lieu of tourniquets during amputation.

Erichson's	Fig. 108.	
Buck's	Fig. 109.	
Skeys	Fig. 110.	*Ibid.*, Part I

Ar'te-ry Con-strict'or. (*Surgical.*) A hook-ended instrument capable of being introduced into a wound to grasp and pinch an artery to prevent effusion of blood. See ARTERY COMPRESSOR.

Ar'te-ry For'ceps. An instrument for catching an artery and holding it while being ligated. There are numerous forms, but all are of the nature of tweezers or nippers.

Fig. 113.



Artery Forceps.

a. Spring-catch forceps.
b. Massachusetts General Hospital forceps, with five teeth.
c. Spring-catch fenestrated forceps.
d. *Dugar's* slide-catch forceps.
e. Combined artery and needle forceps.
f. Fenestrated self-holding forceps.
g. *Wight's* curved forceps.
h. *Stohlmann's* combined needle and artery forceps.
i. *Cleborne's* double forceps.

See, also, TORSION FORCEPS.

Ar'te-ry Nee'dle. (*Surgical.*) A curved needle, or thread-carrying hook, for passing a ligature around an artery.

See ANEURISM NEEDLE, Fig. 211, p. 102, "*Mech. Dict.*"

Suture, ligature, and ruptured perineum needles are similarly formed, but have some special characteristics; p. 28, Part I., *Tiemann's* "*Armamentarium Chirurgicum.*"

Ar'te-ry Scis'sors. (*Surgical.*) An instrument having on one blade a prolonged gorget-end to follow the artery. Fig. 149, p. 48, Part I., "*Armamentarium,*" *ut supra.*

Ar-te'sian Well Ma-chine'. Fig. 114 is a boring machine for artesian and other deep wells, operating by means of the diamond rock drill.

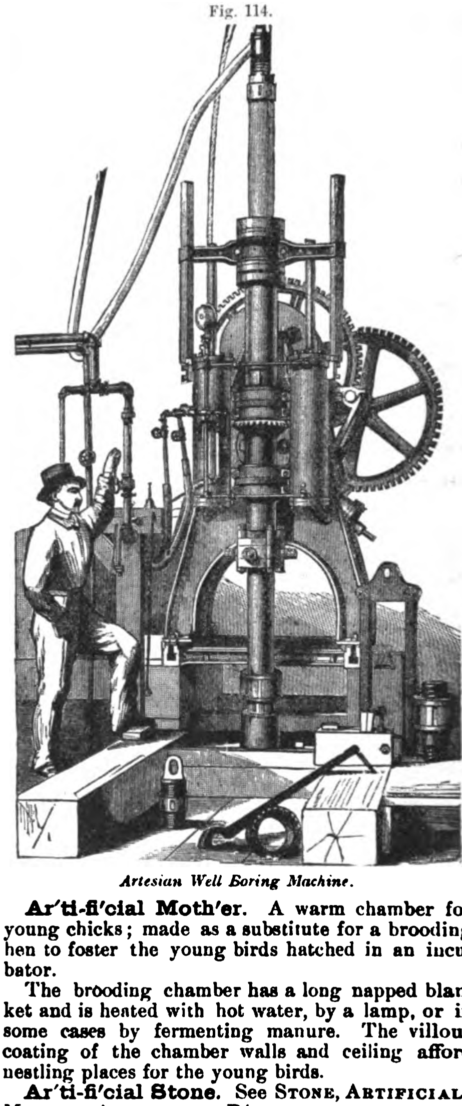
The foot of the drill rod is shod with an annular ring of black diamonds, and the rod is rotated by steam engine and intermediate gearing. The rod is lowered or raised by steam pressure in the pair of vertical cylinders attached to the frame, acting upon a yoke which is clamped to the rod when required. Consult: —

Artesian Well.	
Charleston	"*Sc. Am.*," xxx. 150.
Pesth, Hungary, 8,120', 161° F.	"*Sc. Am. Sup.*," 1972.
Pesth, Hungary	"*Sc. Am.*," xxxviii. 47.
San Francisco	* "*Sc. Am. Sup.*," 2473, 2518.
Vittoria, Spain	"*Sc. Am.*," xxxix. 291.
Boring Tools	* "*Sc. Am. Sup.*," 2526, 2543.

Ar-tic'u-la-ting Tel'e-graph. A name for the telephone.

Ar-tif'i-cer's Knot. A form of knot in which a rope is bent around a spar or handspike so as to jam when pulled taut. It is shown at 8, 9, Fig. 2777, p. 1240, "*Mech. Dict.*"

Fig. 114.



Artesian Well Boring Machine.

Ar'ti-fi'cial Moth'er. A warm chamber for young chicks; made as a substitute for a brooding hen to foster the young birds hatched in an incubator.

The brooding chamber has a long napped blanket and is heated with hot water, by a lamp, or in some cases by fermenting manure. The villous coating of the chamber walls and ceiling afford nestling places for the young birds.

Ar'ti-fi'cial Stone. See STONE, ARTIFICIAL; MARBLE, ARTIFICIAL; BÉTON, etc.

Art, in various materials. See under the following heads: —

Amatorii.
Applique.
Argentina.
Automaton.
Aventurine.
Bat printing.
Bidiri ware.
Black basalt ware.
Black glass.
Blacking.
Bohemian glass.
Bone porcelain.
Bronzed glass
Bronzing.
Cameo cutting.
Cameo glass.
Cameo incrustation.
Carving.
Casing.
Champ-levé.
Chasing.
Checking.
Cire-perdue.
Cloisonné.
Coin.
Colored glass.
Crackle-ware.
Cream-ware.
Crystal.
Damasceening.
Damasking metals.
Decalcomanie.
Deglazing.
Delft ware.

Depolishing.
De-vitrification.
Diamond.
Doubled-glass.
Doulton ware.
Egg-shell ware.
Electro-plating china
Email ink.
Enamel.
Enameled glass.
Encaustic.
Encaustic tile.
Engraved colored glass.
Engraved glass.
Etched enamel.
Etched glass.
Etching on porcelain.
Faience.
Faïence d'Oiron.
Faïence stannifère.
Feathers, artificial.
Filigree glass.
Fine art metal-work.
Flag.
Flashed glass.
Flat chasing.
Flooring tile.
Flowers, artificial.
Fluted glass.
Frosting.
Gem, artificial.
Gem engraving.
Gilding on glass.
Glass carving.
Glass cutting.
Glass enamel.
Glass engraving.
Glass etching.
Glass polishing.
Glass silk.
Glass silver.
Grafito.
Half clear.
Hard paste.
Heliogravure.
Henri-Deux ware.
Hyalithe.
Incrusted work.
Inlaying.
Iridescent glass.
Iridiated glass.
Irisated wire.
Irisation.
Ivory-dyeing.
Ivory porcelain.
Ivory work.
Jasper ware.
Jet.
Jewelry
Kuft work.
Lac work.
Lacquer.
Luster.
Majolica.
Marbleized glass.
Metalized glass.
Metal seal.
Mezza-majolica.
Milling.
Mirror.
Mixed-clay ware.
Modeling clay.
Modeling wax.
Mosaic.
Mosaic glass.
Mousselaine glass.
Mural tile.
Murrhine.
Muslin glass.
Niëllo.
Oïron ware.
Onyx glass.
Opal glass.
Orugo.
Palissy ware.
Parcel gilt.
Parian biscuit.
Pâte changeante.
Pâte-sur-pâte.
Patina.
Pearl.
Pearl inlaying.
Piercing.
Plaque.
Plaster bronzing.
Plaster casts.
Plastic crystal.
Plastilina.
Platinizing glass.
Porcelain.
Porcelain pâte tendre
Pottery.
Rafaëlle ware.
Repoussé.
Rose glass.
Ruby glass.
Satining.
Sculpture.
Seal.
Sèvres porcelain.
Sgraffito.
Silvering glass.
Silver glass.
Snarling.
Soft paste.
Spinning.
Spun glass.
Staining wood.
Stanniferous glaze.
Stoneware, decorated.
Tender porcelain.
Terra-cotta.
Terre-cuite.
Tile.
Tissue glass.
Tortoise-shell ware.
Transfer printing.
Ultramarine.
Under-glaze.
Wax flowers.
Wedgwood.
Zinc decorating.

As-bes'tos. A curious fibrous mineral; a variety of hornblende and pyroxene. It is found in many parts of the world, is of very various qualities, and requires careful preparation for some of the uses to which it is applied. See p. 167, "*Mech. Dict.*"

In the application of asbestos, it is used loose, or is made into sheets, felt, boards, braid, or rope, sometimes with a cementing substance, such as paper pulp, cement, mortar; or as a covering or lining to hair-felt, to prevent the charring of the latter when used as a covering to steam boilers and pipes.

For steam-packing the fibres are covered with braid, and made in coils of convenient length.

As a paint, it is mixed with metallic pigments, and used on wooden structures, roofs, ceilings, and partitions.

The best asbestos is found in Italy. An exhibition of asbestos has recently been held at the Simonetti Palace in Rome; the material in numerous different crude forms being exhibited, as also all the known applications of it in the useful arts. The cabinet of Mr. C. A. Wilson, of Genoa, is said to contain one hundred distinct varieties from the Alps. It is largely exported from Italy to the United States.

See "*Waste Products and Undeveloped Substances*," by Simmons. London, 1876.

The uses of Asbestos are recited on pp. 167, 168, "*Mech. Dict.*": —

Absorbent in lamps.
Boiler covering.
Coffins.
Cremation shrouds.
Electric insulators.
Fire brick and crucibles.
Firemen's clothes.
Flooring cement.
Fuel bed for petroleum.
Ink.
Journal bearings, Ingredient in.
Lamp-wicks.
Molded articles.
Paper.
Piston and rod packing, either in rope or loose form.
Porcelain.
Refrigerators.
Roofing cement.
Ropes.
Safes.
Wrapper for articles to be consumed.
Yarn.

To these may be added: —
Cellar ceilings, to prevent radiation of heat.
Sheathing paper, for walls and ceilings.
Fire-proof boxes, for shelves, etc.
Theatrical scenery.
Converting hydro-carbon into gas fuel.
Packing and lubricant, Jennings', U. S. Patent, 1828.
Mill boards, for steam joints.
Gaskets, for man-hole plates.
Filtering acids.

It is used in the shape of trays of cardboard, for containing molten metals at high temperature.

As a sponge, to contain concentrated sulphuric acid in that form of lighting apparatus known as *oxygénés*, No. 18 of the series of *lighting devices* recited on p. 1315, "*Mech. Dict.*"

Asbestos is used in Italy as a fire-bed in a furnace, petroleum being poured thereon and burned beneath the steam boiler. — *Scientific American*, xxxvi., 217. Modifications of this form the subjects of many patents in England and the United States.

See, also, Asbestos Stove, p. 168, "*Mech. Dict.*"

As a coating for metals in a furnace: —

Fire Clay, Soap-stone, Asbestos } *Nes* . . . . Patent 104,878, June 28, 1870.

British Patents.

No. 145	Lamp-wick, silk and asbestos woven together.
2,647	Plaited and felted asbestos for wicks.
1,413	Asbestos pulp for paper. Boiled; fibres segregated and mixed with alum.
6,555	Safes.
2,048	Lubricant of asbestos, mercury, fat, and oils.
218	Lubricant of asbestos and clay. (*Laubereau.*)
362	Insulator, and non-conductor in electrical apparatus.

United States Patents.

1870. Refrigerators, as a non-conductor. (*F. Hyatt, U. S.*)
1828. Packing for pistons, piston-rods, pump plungers, joints, etc., etc. (*Israel Jennings.*)
August 22, 1865. Lubricant: asbestos, soapstone, and cotton. (*Devlan.*)
March 29, 1870. Cord in a rope packing of asbestos. (*Stevens.*)
October 4, 1874. Loose asbestos packing. (*Botticher.*)
November 8, 1870. Asbestos, graphite, and iron filings. (*Kelly.*)
1868. Made into sheets with felt or pulp. (*Johns.*)
September 18, 1866. In carburetors. (*Bassett.*)
August 14, 1866. In lamps as an absorbent. (*Beschke.*)
Nos. 112,647 and 112,648, Packing. (*Stevens.*)
Nos. 112,649 and 112,650, Mode of treating asbestos. (*Stevens.*)

See under the following references: —

"*Engineering.*"

Faucet Packing, *Dewrance.* xxi. 68.

"*Mining and Scientific Press.*"

Uses	xxxiii. 180, 344, 433; xxxvii. 232, 297, 393.
Felt	xxxvi. 307.

"*Engineering and Mining Journal.*"

Powder	xxi. 347.
California Mines	xxiv. 404; xxix. 86.
At Rome	xxii. 141.
Patents.	xxii. 347; xxiv. 328.
Pipe Covering	xxvi. 448.

Packing	xxvi. 58.
Uses	xxx. 444.

"Scientific American."

At Italian Exposition	xxxv. 79.
Roof and Boiler Covering	* xxxiv. 258; xliii. 857.
Uses and History	xxxv. 392; * xxxiv. 258.
Fire Surface	xxxvi. 217.

"Scientific American Supplement."

Packing	2947.

"Polytechnic Review," August 26, 1876.

"Leffel's Milling and Mechanical News."

Uses	* vi. 31.

"Iron Age."

Uses	xix., Jan. 11, p. 15; xx., Sept. 13, p. 7.
Fire Surface	xix., May 24, p. 1.
Roman Exhibition	xviii., Sept. 28, p. 1.

"Manufacturer and Builder."

Uses	ix. 102, 127; viii. 176; xii. 227; x. 65; xi. 68.
Paint	xi. 236.
Artificial	x. 5.
Roofing	ix. 102; xii. 228.
Boiler Covering	ix. 102; xii. 31.

"American Railroad Journal."

Fire-proofing	liii. 160, 193.
Mineral Wool	liii. 843, 1231.

"Telegraph Journal."

Uses	v. 285.

"English Mechanic."

Fire Surface	xxiv. 440, 531.

"Engineer."

Asbestos and Patents	xlii. 396.
Cardboard	xliii. 352

"American Builder," xiii. 9.

See paper by Mr. Lloyd, *"Philosophical Transactions,"* vol. xiv., p. 823, A. D. 1684. See *"Abridgments,"* vol. ii., pp. 548-554. Several articles.

See, also, *"Munsell on Paper,"* pp. 20, 25, 102.

As-bes'tos Pa'per. *Rosenthal's* method of disintegration of asbestos, for paper-making, is as follows: —

The asbestos is put into wooden tanks lined with lead, covered with water, and chemicals added. Steam is introduced, and it is boiled four to six hours. When disintegrated it is passed through a pair of rolls, the top one covered with rubber, and a rubber apron running on the lower one, by means of which the water is driven from the fiber. It is then dried, and manufactured into board on a special machine.

The Italian asbestos paper costs 40 cents per pound. The paper mills are at Tivoli, where Victoria made his successful attempt to manufacture this paper, which is specially adapted for valuable documents, etc. It has recently undergone most conclusive tests by the Marquis de Bariera at an exhibition of objects made of this substance, held in Rome. Two card-board boxes containing papers, one made of ordinary material and the other of asbestos, were thrown into the fire. The former was entirely consumed, while the latter remained intact, together with the papers it contained. It is also made into theatrical hangings. This is an excellent use of it. — *"La France Nouvelle."*

As-bes'tos Felt. Mr. F. A. Gooch, of Cambridge, Mass., describes a mode of preparing a felt of anhydrous asbestos for filtering material.

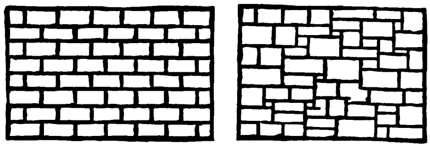
The felt is prepared by scraping white silky asbestos to a fine, short down, boiling it with hydrochloric acid, and washing it by decantation. It is then deposited, by the aid of the Bunsen pump, on the bottom of a platinum crucible perforated with fine holes; or, better, the bottom may be made of fine platinum gauze. The process is described in the proceedings of the American Academy.

As-cen'sion. (*Mining.*) The theory that the matter filling fissures was introduced from below.

Ash'lar. (*Masonry.*) Cut stone masonry.

When regular, it is *ashlar;* but when smaller cut stones break the regularity, it is called *broken ashlar*, as in the right hand illustration.

Fig. 115.



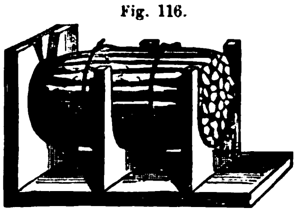
Ashlar.

Small ashlar, when the assizes are less than a foot in height.

Rough ashlar, squared, when the face is only quarry-faced or pitch-faced.

As-par'a-gus Bunch'er. The Sartrouville buncher, shown in Fig. 116, has two U-shaped frames in which the sprouts are laid, the tips symmetrically gathered in the contracted space, and the bunches tied.

Fig. 116.



Asparagus Buncher.

As-phalt' Pave'ment. Asphalt is limestone saturated with bituminous matter. — *Léon Malo.*

The first quarry opened and worked was the famous bed of Val de Travers, on the Neufchâtel Pontarlier Railroad, Switzerland. The bed extends over a distance of six miles, and is 1.75 miles wide. The thickness of the bed varies from 3 to 16 feet, the annual production of the mine fluctuating between 40,000 and 50,000 tons, occasionally exceeding the latter figure. The deposit was first discovered in 1712 by Eirinus, a Grecian physician, who obtained mineral rights from the King of Prussia, at that time in possession of Neufchâtel. Eirinus sold the product obtained by him chiefly as a cement for woodwork, masonry, etc., exposed to water.

Eirinus finally abandoned Val de Travers and went to Alsace, where he opened new mines. After his death the asphalt industry collapsed entirely, other parties who obtained control of the mines using them for distilling oils which were sold as wonderful remedies. It was not till 1802, when asphalt beds were discovered at Seyssel, on the banks of the Rhône, France, that a new impetus was given to an industry which has since steadily grown in importance.

Natural asphalt must contain nothing else but carbonate of lime and bitumen, and the latter must thoroughly impregnate the rock, the grain of which must be as fine as possible. It must not contain less than 7 per cent., and not more than 11 per cent., of bitumen, and the latter itself must not, when warmed for a long time, lose more than 2 per cent. by weight. Greater loss indicates that bitumen is not wholly tarry matter. The following analyses show the composition of the asphalt from the most important mines of the Continent, No. I. being from Val de Travers, No. II. from Seyssel, and No. III. from Lobsann, in Alsace: —

	I.	II.	III.
Water and other substances evaporating below 90° C	0.50	1.90	3.40
Bitumen	10.10	8.00	11.90

Carbonate of lime	87.95	89.55	69.00
Carbonate of magnesia	0.30	0.10	0.30
Mineral matter insoluble in acids	0.45	0.10	3.05
Other substances	0.70	0.35	2.90
Sulphur			5.00
Sulphuret of iron			4.45
Total	100.00	100.00	100.00

The **asphalt rock** is blasted with the aid of powder, dynamite having proved inefficient, probably owing to the elasticity of the rock. It is ground, or, rather, torn to pieces between two rollers rotating at different velocities and provided with steel teeth, a 10 to 12 horse-power mill being capable of reducing to suitable size from 8 to 12 tons of rock per hour. The grinding is completed in a 22 to 25 horse-power Carr disintegrator, running at a speed of 500 revolutions per minute, and turning out 5 tons of powdered rock per hour. The fine asphalt is then melted in a cast-iron semi-cylindrical vessel, provided with a system of mixing knives attached to a shaft. During the operation a varying quantity of mineral pitch is added. For a 3-ton vessel this operation lasts about 3½ hours, the greatest care being taken not to allow the temperature to fall below 175° C., or go above 230° C. The product thus obtained is called "mastic," which possesses the valuable property of rendering the asphalt capable of being melted, while the asphalt rock alone would only be converted into a powder even by the application of the highest temperatures. As soon as the mastic is thoroughly mixed, it is run into molds. For use, the bricks are broken up and melted with a small quantity (from 2 to 3 per cent.) of pure pitch, and from 30 to 40 per cent. of clean gravel.

See Paving.

Asphalt	"*Sc. American Sup.*," 1939.
Asphalt and Wooden Road Construction, On, (10 Figs.) *	"*Engineer*," xlvi. 117.
Asphalt Manufacture	"*Iron Age*," xxi., Jan. 17, 8.
Asphaltum, Manufacture of	"*Sc. American Sup.*," 1176.
Asphaltum Road-making	"*Man. & Build.*," xi. 143.
Asphalt Tiles	"*Sc. American*," xxxvi. 7.
Asphalt Pavements of Paris *	"*Sc. American*," xxxix. 65.

As-phalt′, Ar′ti-fi′cial. The "Lyons" asphalt, introduced by M. Gobin into Belgium, is composed of 15 parts of bitumen, 35 parte of coal slack, 10 parts by weight of coke powder, 130 parts of lime, and 160 parts of fine gravel. The bitumen and coal slack are mixed together in a boiler, and skimmed until the formation of a scum ceases. The coke powder and lime are mixed, heated to about 300° C. in order to dry them, and then they are added to the material in the boiler. The gravel is embodied in the mixture as the last ingredient.—"*Moniteur Industriel.*"

As-phalt′ Tiles. In a Bavarian method of making flooring tiles from asphalt, the drawing of the intended design is first made on coarse, heavy paper. This is then covered with bits of china and glass, so as to form a mosaic. Lastly, a border is made to the sheet, and liquid asphalt is poured upon it. After the whole has been covered, the paper is taken away with cold water, and the tile is finished.

As-phalt′o-type. (*Photography.*) The process of Niepce; producing the image on a plate covered with bitumen of Judea. See pp. 673, 1683, "*Mech. Dict.*"

As-phal′tum. See paper on Petroleum, Bituminous Rocks, Shales, Asphaltum, etc., *Brodhead's* Report of Group I.; *Centennial Report*, vol. iii., including: —

	Page		Page
Petroleum	8	Shales of New South Wales	11
Bituminous rocks in America	10	Albertite	12
Grahamite	14	Coörongite	17
Asphaltum	14	Kauri gum	18
Asphalt	16	Amber	18
Ozocerite	16		

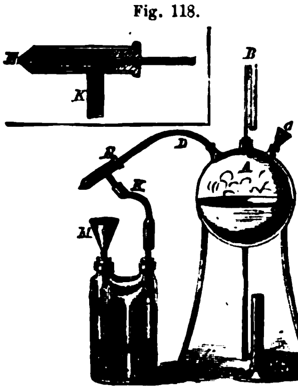
As′pi-ra′ting Fil′ter. One in which the action is expedited by the withdrawal of air from beneath the filtering material.

Fig. 117.

Aspirating Filter.

By compressing the rubber ball in the hand, the slit in the India-rubber tube, which acts as a valve at *B*, closes, and the air it contains is ejected through the valve at *C*. On removing the pressure from the ball, valve *C* closes by atmospheric pressure, leaving a partial vacuum in the ball; air passes from the flask through valve *B* into the ball, to restore the equilibrium, and a partial vacuum is created in the flask which is increased by a second squeezing of the ball. The liquid material in the filter, in consequence, will be rapidly forced into the flask by atmospheric pressure on its surface. — *Partridge.*

Fig. 118.

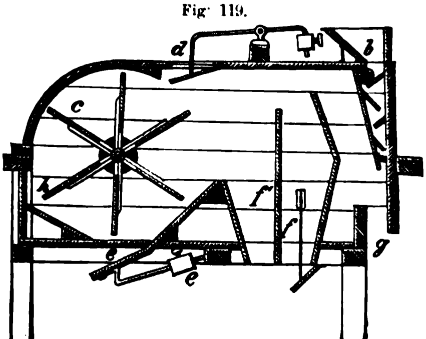


Steam Aspirating Filter.

The aspirating filter apparatus, Fig. 118, operates by steam generated in the globe *A*, which passing by *D* into *E*, issues at the point of the latter, drawing with it through *K* the air from the bottle *L*. *M* is the supply funnel; B, the steam-gage; *C*, water supply.

As′pi-ra′ting Win′now-ing Ma-chine′. One which draws air through the grain instead of blowing it. Action by suction instead of blast. This is very common in the United States in smut mills and machines of that class, but the principle is more commonly adopted with winnowers in France than with us. Fig. 119 is a French machine. The fan *c* draws air in the direction of the arrow. The grain, falling from the hopper *b*, meets the

Fig. 119.

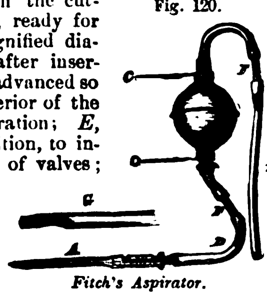


Aspirating Winnower.

blast entering at g, and, according to the comparative levity of the grain, seeds, chaff, dust, etc., each falls or issues at compartments f, f', e h. d is a counterbalanced valve, by which the force of the in-draft is regulated. e is another regulator.

As'pi-ra'tor. An apparatus or instrument for drawing air. In Fig. 120, A represents the dome aspirator-needle, with the cutting point projected, ready for puncture; G, a magnified diagram of the same, after insertion, with the dome advanced so as to protect the interior of the cavity during aspiration; E, bulb in upright position, to insure the best action of valves; C C, valves; D, entrance tube; E, exit tube; F F, bits of glass tubing, through which to observe the presence or absence of fluid. — "*New York Medical Journal*," November, 1877.

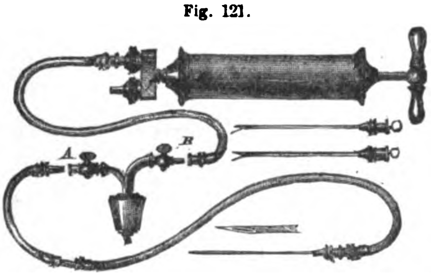
Fig. 120.



Fitch's Aspirator.

Fig. 121 is an aspirator which can also be used as an injector. The instrument consists of three

Fig. 121.



Aspirator.

needles of assorted sizes, a rubber stopper which fits into a jar, and through which passes a double-current tube provided with stop-cocks. This communicates by an elastic hose, at B, with a pump, and at A, by another hose, with the needle or capillary tube to be used.

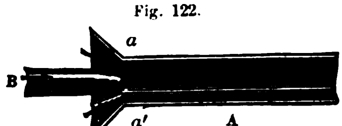
By putting the stopper in the bottle, closing the cock A, opening B, and giving 25 or 30 strokes of the pump, the air is exhausted from the bottle; then close B, and the apparatus is ready for use. The tube is introduced, and cock A being opened, aspiration commences.

To inject with the same instrument, connect the air-tube with the outward flow of the pump; put the desired liquid in the bottle, and, while holding the latter in reversed position, pump air into it. After having obtained the desired pressure in the bottle, close B, and detach the pump; introduce the tube into the object to be injected, and open A.

The rotating aspirator point for use as a trocar is a flat blade twisted. — *Dr. Warren.*

Aspirators are used in trades which produce deleterious dust, also to remove shavings and sawdust from wood-working machinery.

Fig. 122.



Aspirator for Dry Grinding. *Châtellerault.*

Various principles are used. The Sturtevant suction fan is employed. At the works of Châtellerault, in France, the jet of compressed air is used. A is a cylindrical tube, having a length at least five times its diameter. B is a tube throwing a jet of compressed air into the tube, the air at the rear being drawn forcibly through the passage a a^1 by the suction produced.

Another form of aspirator is that used in ventilation; in fact, any exhaust pump or suction fan comes within the definition. Such are used in buildings of importance, hospitals, public buildings, and halls; also in mines.

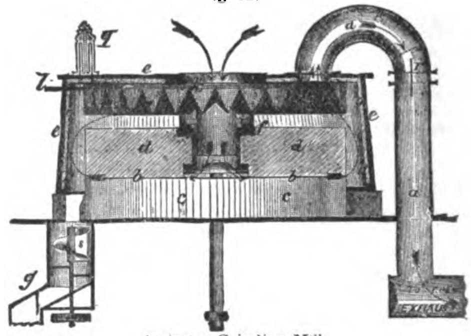
Such machines operate on various principles: the piston, revolving fan, inverted caisson resembling a gas-holder. The former two are shown in Figs. 5, 6, *Laboulaye's* "*Dictionnaire des Arts et Sciences*," tome iii, article "*Ventilation.*"

The hydro-pneumatic aspirator of M. Legat has been applied to paper-making machinery, to replace the air-pumps, which serve to make a vacuum beneath the web, on which the pulp collects to form paper. The effect of the withdrawal of the air from beneath the web is to drain out the water of the pulp, which becomes solidified sufficiently to take off and pass to the calenders.

The hydro-pneumatic aspirator is on the principle of the Giffard injector, and a view and description of it are given in Fig. 3,237, *Laboulaye's* "*Dictionnaire des Arts et Sciences*," tome i., article "*Aspirateur.*"

Fig. 123 shows the aspirating principle applied to grinding-mills, to prevent the accumulation of

Fig. 123.



Aspirator Grinding Mill.

flour dust in the husk. It is the invention of MM. Jaacks and Behrns, of Lubeck, Germany.

A fan exhausts air through the pipe a, from the mill-stone hoop, and fresh air enters with the wheat at the eye of the stone and passes between the buhrs, dd, cc. The hoop is air-tight, and has but the one inlet, k, and two outlets: one at g for the chop, and the other at a, for the warm and damp air. Leakage of air at the eye is prevented by an arrangement of two rings, h, i, one fast to the stone, and the other suspended by a leathern cylinder from the hoop e. The screw s, in the chop tube, presses out the meal, which is sufficiently tightly packed therein to prevent passage of air.

In order to retain the flour-dust within the hoop a cloth of long-haired flannel is stretched and laced up in zig-zag shape over a frame, m, which is suspended by hooks under the top of the curb, and the flannel is tacked loosely, but dust tight, against the top, at the outer and inner diameters of the frame. The flannel detains the flour-dust, but allows the warm air and vapor to pass. The dust gathers on the cloth, and is removed by occasionally striking the pin l, which causes it to drop, and go out with the chop. The valve r governs the force of the air current; q is a vacuum gage; o is a felt non-conducting lining.

The following notices may be consulted: —

With Compressor, *Marangoni*	* "*Scientific Am.*," xliii. 11.
With Trocar, *Dieulafoy* . .	* "*Mech. Dict.*," Fig. 6665, p. 2629.
By Flow of Hydrant Water.	
Richards	* "*Scientific Am. Sup.*," 808.
For Laboratories, *Hanks* . .	* "*Scientific Am. Sup.*," 101.

As-say′. (*Mining.*) To test ores by chemical or blow-pipe examination.

Assaying Outfit .	* "*Eng. and Min. Journal*," xxv. 443.
Assay Office Model	"*Scientific American Supplement*," 211.

UNITED STATES PATENTS.

181,304,	*Berge*	Furnace and Muffle.
94,508,	*Phillips*	Automatic Assay Apparatus.
227,852,	*Snow and Seamans*	Burner for Crucible Furnace.
220,895,	*Wight*	Cupel Furnace.

Consult: —

Lieber's "*Assayers' Guide.*"
Mitchell's "*Manual of Practical Assaying.*" London, 1868.
Bodemann and Kerl's "*Treatise on Assaying*" (Transl.). New York, 1865.
Budge's "*Practical Miners' Guide.*" London, 1866.
Byland's "*Assay of Gold and Silver Wares.*"
Kerl's "*Practical Treatise on Metallurgy.*"
Overman's "*Practical Mineralogy, Assaying and Mining.*" Philadelphia, 1863.
North's "*Practical Assayer.*" London, 1874.
Rickett's "*Mints and Assay Offices of Europe.*"
Knapp's "*Chemical Technology.*"

As-sem′bling. For account of the parts and methods used in the manufacture of fire-arms on this principle, see RIFLE.

As-tat′ic Gal′va-nom′e-ter. One the magnetized needle of which is balanced so as to make it normally quiescescent in any position.

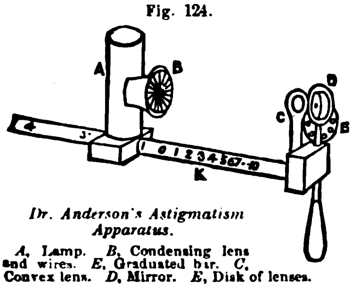
"*Manufacturer and Builder*," * xi. 276.

A-stig′ma-tism Ap′pa-ra′tus.

"Astigmatism is that condition of the eye in which the refraction is different in different meridians of the eye, owing to the refractive media not being perfectly symmetrical. An eye with a cornea shaped like the bowl of a spoon, instead of like a portion of a sphere, would be astigmatic. Dr. Anderson's instrument was exhibited at the meeting of the British Association at Swansea. In it the observations and measurements are made by the observer, and are entirely independent of the patient's sensations. The image thrown on the retina being used as an object, the error arising from the vessels or optic nerve being before or behind the retina is avoided. The refraction and accommodation of the observer does not affect the result: it is only necessary that he should be able to see whether certain lines are sharply defined.

"A lamp (A, in the engraving) is provided with a condensing lens, which has a screen of radiating wires, B, across its front, thus giving a bright field with black lines. This slides on a graduated bar, K, at the other end of which is a convex lens, C. It is better to have two of these of different powers, *4* and *10* dioptrics being convenient. Close to the lens, and at an angle of 45° to it, is a plane silvered mirror D, which reflects the rays at right angles to their former path. The instrument is held so that this pencil of rays enters the observed eye and when the screen is at the proper distance an image of it is formed on the retina. The mirror has its center left unsilvered, and has an ordinary disk of lenses, E, behind it to render the retina and the image on it visible to the observer by the ordinary direct method. The bar is so graduated that when an image of the whole or part of the screen is sharp on the retina, the figure opposite the screen expresses the refractive error of the meridian by which the image is produced. Hence, if the image of the whole screen is seen to be equally sharp, the eye is known to be not astigmatic, and the graduation gives the number of dioptrics by which it is myopic or hypermetropic. If the lines be not all sharp at once, then the most distant point at which any of them is distinct gives the refraction of the meridian of minimum refraction, and the point at which that at right angles to the former is distinct, gives that of maximum refraction. The least of these gives the spherical element of the correcting spectacle required, and their difference that of the cylindrical element. The meridian of maximum refraction is that in which the line appears distinct when the screen is at the greatest distance. If the cylindrical lens be convex its axis must be in this meridian; if concave, then at right angles to it. The makers are Cook & Sons, York. — *Lancet.*

Fig. 124.



Dr. Anderson's Astigmatism Apparatus.

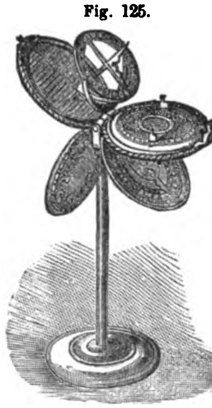
A, Lamp. *B*, Condensing lens and wires. *E*, Graduated bar. *C*, Convex lens. *D*, Mirror. *E*, Disk of lenses.

The ametrometer is also capable of being used to detect the existence or extent of astigmatism. See AMETROMETER, pp. 28, 29.

Referring to the ametrometer, it may be stated that when astigmatism is suspected, the patient should be directed to observe whether the flames are longer in one direction than the other, and if so, by the rotation of the bar on a pivot opposite to the fixed light, the two lights being placed some distance apart so that they do not appear to touch, the apparatus affords one of the most accurate means of ascertaining the meridians of greatest and least refraction, since it will become easy for the patient to say when two elongated points or ovals of light are placed so as to have the same direction; and when this has been fixed, the pointer on the instrument will indicate on the half-circle the exact angle at which the lights are placed, and hence the position of the meridian of greatest ametropia.

On bringing the flames into contact at this angle, the real distance of the lights apart will indicate the degree of ametropia, and having thus found one meridian, the lights can be placed at right angles to it, and the refraction of the second be ascertained.

Fig. 125.

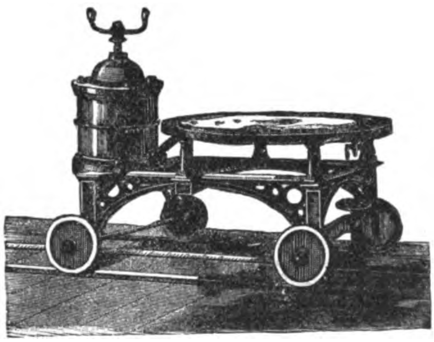


Astrolabe of Sir Francis Drake.

As′tro-labe. Several astrolabes of antiquity, and of the fifteenth and sixteenth centuries, are referred to on p. 172, "*Mech. Dict.*" The astrolabe of Sir Francis Drake is shown in Fig. 125. It was recently shown at a loan collection. It was constructed for him previous to his first expedition to the West Indies, in 1570, and was preserved in the Stanhope family till 1783, when it was presented to the Duke of Clarence, who, in 1833, deposited it in Greenwich Hospital. It is about 9″ high.

As′tro-nom′i-cal Mir′ror. An instrument devised by M. Collin to obtain a fresh reflecting surface of mercury to reflect the image of stars under observation. To obviate the necessity of removing the film from the surface of the mercury, the metal becomes cleaned during its escape from the reservoir in which it is kept hermetically inclosed. It is thus always pure and brilliant. The reservoir shown on the left is a pump cylinder, in which a piston is operated by means of the screw represented above. This forces the metal out upon a large circular shallow vessel through a connecting tube. In order to operate the apparatus conveniently, it is mounted on a carriage on rails. Between the latter is a graduated scale, so that the mirror can be readjusted at any desired point. The vertical screw shown on the right serves to fix it in place.

Fig. 126.



Astronomical Mirror.

As'tro-nom'i-cal Time Mark'er. An instrument for indicating fractions of a second by means of a sliding vernier attached to a graduated scale, which it traverses second by second. A species of metronome.

Invented by E. K. Horn, and shown in the "*Engineer,*" 1876. Reproduced in "*Scientific American Supplement,*" * 204.

As'tro-pho-tom'e-ter. An instrument designed by Zollner to measure the *brightness* of the stars by comparing them with an artificial star of standard brightness.

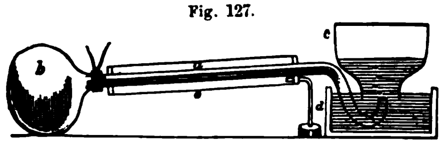
"The telescope is directed to the natural star, and the light of the artificial star is introduced through a lateral tube. A petroleum lamp serves for this object, the lateral tube carrying a diaphragm with a minute perforation in the center. In the interior of the principal tube, a plane glass mirror with parallel surfaces, placed at an angle of forty-five degrees, reflects the light of the artificial star to the eye; and as the mirror has a sensible thickness, two images are perceived with a small space intervening between them. The image of the natural star is brought to occupy this intermediate space. The lateral tube contains a polarization apparatus, by means of which the light of the artificial star may be modified both for color and for brilliancy. The first adjustment is for color. By rotating the polarization system the tint which corresponds to that of the real star observed is easily obtained, as in the saccharimeter. Then by turning one of the prisms of the system, the brightness of the artificial star, which is always at first superior to that of the real object, is gradually subdued until the two intensities are sensibly equal. As the image reflected from the first surface of the mirror is necessarily the brighter of the two, this one is selected as the standard of comparison. The other serves as a lower limit, and between the two the determination can be very accurately made." — *Barnard.*

Ath'a-nor. The alchemist's base-burning furnace. It is described on p. 175, "*Mech. Dict.,*" and is to be found in —

Hebert's "*Engineer's Encyclopedia,*" London, 1850, vol. i., p. 109.
Francis's "*Dictionary of Arts.*"
Partington's "*Dictionary,*" 2 vols.
Weale's "*Dictionary of Terms in Art.*"

At'mo-ly'zer. (*Gas.*) An instrument for illustrating the separation of gases.

Fig. 127.



Atmolyzer.

In the figure, the bag of impure gases communicates by a porous earthen pipe with the receiver. The pipe has an envolving sheath, the interior of which connects with an aspirator, so that a partial vacuum is maintained around the porous pipe. Gases ejected by the bag are separated by the passage of the lighter gas through the pores of the pipe to the aspirator.

At'mos-pher'ic Brake. (*Railway.*) A brake operated by pressure of air; an air brake. The term is properly applied to that form of air-brake in which, the air being exhausted, the pressure of the atmosphere becomes the moving agent. A *vacuum brake.*

At'mos-pher'ic En'gine. The engine of Newcomen, Fig. 5658, p. 2337, "*Mech. Dict.*"

See, also, AIR ENGINE; CALORIC ENGINE; COMPRESSED-AIR ENGINE; HOT-AIR ENGINE, etc.

Atmospheric Engine, Br.
Newcomen (1712) . . . . * "*Engineer,*" xlviii. 400.
Coalbrookdale (1776) . . . * "*Engineer,*" xlix. 84.

At'mos-pher'ic Gas'-en'gine. A name given in England to the Otto and Langen gas engine, in which coal-gas is exploded in atmospheric air in a cylinder. See GAS ENGINE.

At'mos-pher'ic Ham'mer. A power hammer driven by the force of compressed air.

Butterfield's "*Scientific American Supplement,*" * 689.

At'mos-pher'ic Re-cor'der. An apparatus for registering the various meteorological phenomena. The force and direction of the wind, the height of the barometer, the temperature, amount of rain-fall, humidity and electrical condition of the air, are all recorded upon an endless paper band, moved by clock-work mechanism.

See ANEMOMETROGRAPH, METEOROGRAPH.

At'om-i-zer. Fig. 128 shows a number of atomizers all involving the same principle, the spraying of a fluid by a blast of air or steam.

Atomizer and Volatilizer.
*Wells and Dulucc,** '*Journal Materia Medica,*' Feb., 1877.
Antiseptic Atomizer.
Hanks . . . . "*Medical Record,*" January 13, 1877.
Atomizer and Eye Douche.
Burrall . . . . "*Medical Record,*" August 25, 1877.

At-tri'tion Mill. One operating by impact and mutual attrition of the material under treatment. A flouring mill in New York working on this principle has a wheel of some 3′ in diameter and 3″ thick, inclosed in a box of about 4′ in diameter and 8″ thick. The wheel makes 2,000 revolutions per minute, receives the wheat in its center, and whirls it around with such violence that by rolling friction against the sides, but especially by mutual friction or attrition, it becomes pulverized.

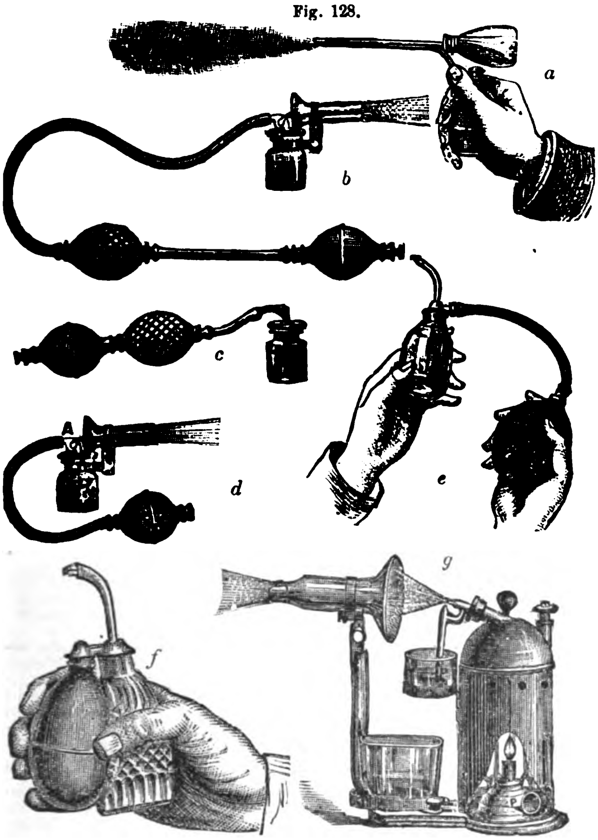
A *disintegrator.* See Fig. 1565, p. 707, "*Mech. Dict.*" Cited in "*Manufacturer and Builder,*" May, 1877.

At'wood Steel. (*Metallurgy.*) Steel made by a process in which iodide of potassium is used to take up the phosphorus existing in the iron.

Van Nostrand's "*Engineering Magazine,*" xvi. 280.

Au'di-om'e-ter. An instrument invented by Professor Hughes. It is a combination of the telephone, a new form of microphonic key, and a Leclanché battery. By its means the power of hearing sounds can be accurately gaged and recorded on a suitable arbitrary scale. The one in use is divided into 200 degrees, the zero being the point of positive silence, the absence of recognizable sound produced by the instrument through the telephone, and the maximum being audible to every one not actually deaf. The first point ob-

Fig. 128.



Atomizers.

a. Dr. *Knight's* atomizer. The vial is connected with the tube by a metallic cup, which is screwed on, and may be so turned as to nearly exclude air and render the spray exceedingly fine.
b. Dr. *Clark's* atomizer, with the addition of a shield.
c. The "Constant" atomizer.
d. The Boston atomizer, with single bulb.
e, f. Other forms.
g. Steam atomizer. It has a brass boiler, steam outlet tube, rubber packing, through which the atomizing tube passes; a safety valve; a suspended medicine-cup; a flaring face shield, and the waste cup to catch the drops.

served with the instrument is that the power of hearing sound is very sharply defined. The sound is abruptly lost within a range of one hundredth part of the entire scale, both when the person can hear audibly and when he is more or less deaf. If the sound be suddenly moved from 15° to 5° on the scale, the weaker sound is inaudible, though if the scale had been gradually moved the sound at 5° would have been easily heard. Filling the chest and holding the breath increases the capacity for hearing for a few seconds. Holding the breath with the chest not full does not produce the same result. Most persons hear better with the right ear than with the left, but physicians who have accustomed themselves to use the stethoscope with the left ear hear better with it than with the right; and four persons who habitually listened to public discourses from the left side also heard better with the left ear. See also SPHYGMOPHONE.

"*Telegraphic Journal*"	vii. 213.
"*Scientific American Sup.*" . . .	2960.

Au'di-phone. An instrument accredited to R. S. Rhodes, of Chicago, for conveying sound through the medium of the teeth.

The instrument is simply a thin plate of vulcanized rubber shaped like a Japanese fan. When in use, it is curved to give it the requisite tension by means of cords attached to the outer edge of the fan and fastened at the junction of the handle. When the top of the fan is placed against the upper teeth the impinging sound waves create a sensible vibration which is conveyed through the teeth and the bones of the face (or possibly by the dental nerves) to the auditory nerve. With a little practice, the sounds thus received are interpreted the same as if they reached the nerves of hearing through the ear; and thus the deaf are made to hear more or less distinctly, provided, of course, that the auditory nerve itself is not defective.

Newspapers, pamphlets, card-board, answer the same purpose in certain degrees.

A rod of wood, with its ends placed against the teeth or bony structure of the heads of the speaker and hearer respectively, has been used, and is a natural suggestion from Wheatstone's contrivance, mentioned on p. 2515, "*Mech. Dict.*"

The writer recollects as a boy, trading two pocket musical boxes to an old and deaf naval officer, turned portrait-painter, and watching the pleasure he derived from hearing them play when placed against his teeth.

Resting the head against the piano or harpsichord is as old as the instruments.

The head of the violinist, or of the harper, resting against his instrument, conveys the musical vibration through the bony structure to the brain. The old Egyptian who swept the strings of his standing harp in the time of Rameses the Great, laid his head against the instrument, as the paintings discovered by Bruce clearly show. See *c*, Fig. 2404, "*Mech. Dict.*"

"*Scientific American*" .	xli. 342, 377; xlii. 240.
"*Sc. Am. Supplement*" .	2081, 3887.
"*Min. and Sc. Press*" .	xl. 151, 172.
"*Eng. and Min. Journal*"	xxix. 67.
"*Manufac. and Builder*"	xii. 7, 125.
"*Iron Age*"	xxiv. Nov. 27, p. 1: xxvi. Jan. 22, p. 5; April 22, p. 16.

Au'ral In'stru-ments. (*Surgical.*) These include those for exploration, diagnosis, prothesis, operation: for the external meatus, the membrana tympani, the Eustachian canal. The list includes the following: —

Air bag.	Eyelet forceps.
Angular forceps.	Forceps.
Basin.	Furuncle knife.
Bistoury.	Gorgeret.
Catheter.	Gouge.
Catheter holder.	Hook.
Caustic holder.	Inhaler.
Conversation tube.	Manometer.
Cotton holder.	Maryngotome.
Curette.	Mastoid process knife.
Diagnostic tube.	Meatus knife.
Director.	Mirror.
Douche.	Otoscope.
Drill.	Polypus forceps.
Eustachian canal inflator.	Polypus knife
Explorer.	Polypus snare.

Port-acid glass.	Spout.
Probe.	Spray apparatus.
Rongeur.	Syringe.
Scissors.	Tensor-tympani instrument.
Scoop.	Trumpet.
Screw hook.	Tuning fork.
Speculum.	Tympanum, artificial.
Spoon.	Tympanum, perforator.

Au-rif'e-rous. (*Mining.*) Containing gold.

Au-ro'ra Tube. A tube, of uranium glass preferably, through which discharges from an induction coil are transmitted to produce the optical effect of aurora.

Au'ro-type. (*Photography.*) Hunt's process upon paper, produced by a preparation of gold.

Aus'cul-ta'tor. (*Surgical.*) An instrument for diagnosis of diseases of the chest by listening to the sounds within the thorax. The *stethoscope* is the principal instrument; see STETHOSCOPE. The word is from the act of listening, but the diagnosis by *pleximeter* and *percussor* is not held to be strictly within the term.

Camann's cylindrical and intercostal auscultators, Figs. 254, 255, p. 82, Part I., *Tiemann's "Armamentarium Chirurgicum."*

Aus-tra'li-an Crape. (*Fabric.*) A cotton and wool French goods.

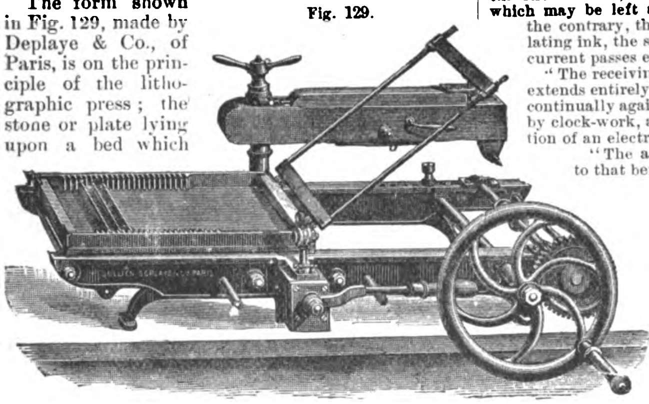
Au-tog'e-nous Sol'der-ing. Soldering by melting the adjacent surfaces of the material itself, without the intervention of solder.

The application of autogenous soldering to the making of perfect platinum stills for sulphuric acid, by Johnson, Matthey & Co, of London, is described in Professor Jenkins' Report on Chemical Industries, "*Paris Exposition* (1878) *Reports*," vol. iv., p. 65.

Au'to-graph'ic Press. A press for making copies of autographic documents, letters, etc., either upon stone or a bichromated-gelatine pad.

The form shown in Fig. 129, made by Deplaye & Co., of Paris, is on the principle of the lithographic press; the stone or plate lying upon a bed which travels beneath a pressure bar, the latter being shown in the cut as detached and swung aside.

Fig. 129.



Autographic Press.

The press is intended for lithography and chromolithography, as well as phototypy, and some other gelatine processes of reproduction.

Au'to-graph'ic Pro'cess. A mode by which a manuscript or drawing made with a peculiar ink may be transferred to stone and then printed.

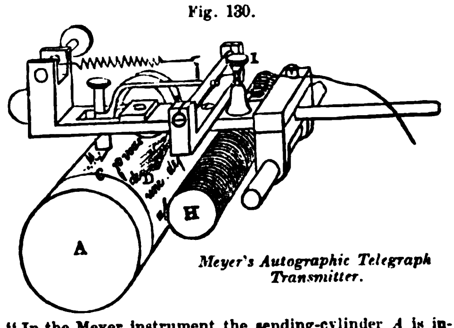
The definition may be somewhat extended, now that a variety of processes operating with gelatine, with gelatine films, bichromated gelatine, etc., have been devised. As mechanical copying processes, the HECTOGRAPH, COPYGRAPH, etc., are familiar.

Two autographic litho-processes may be mentioned: —

Hannot, Belgium .	"*Scientific American*," xxxvii. 259.
Sars, Norway . . .	"*Scientific American*," xxxvii. 326.

Au'to-graph'ic Tel'e-graph. The *Meyer* apparatus has substituted the Caselli on the French lines served by that form of apparatus. The Caselli system is described on p. 191, "*Mech. Dict.*"

Fig. 130.



Meyer's Autographic Telegraph Transmitter.

"In the Meyer instrument the sending-cylinder *A* is insulated, and upon it is wound the message written with an insulating ink upon a sheet of metallic paper. An endless screw, *H*, is moved by clock-work, and carries a car armed with a brush of metallic wires, *D*, and a metallic point, *C*. The brush and point are insulated from each other, and rub constantly against the surface of the paper.

"For each turn of the cylinder *A*, the car moves forward one thread of the screw, or a distance of ¼ millimeter, so that each point of the surface of the cylinder is brought successively in contact with the point *C*. This point is connected permanently with the ground.

"At the transmitting station, the positive pole of the battery is connected constantly on the one hand with the brush *D*, and on the other with the line-wire. The battery is therefore continually in action, but the distribution of its current depends upon the position of the stylus *C*. When the latter touches the metallic surface of the paper, the circuit is closed by the way of the brush *D*, the paper, the stylus, and the ground. Almost the entire current passes into this short circuit, and the line receives only a small portion, which may be left altogether out of account. When, on the contrary, the stylus *C* touches a part of the insulating ink, the short circuit is broken, and the battery current passes entirely over the line.

"The receiving cylinder carries a spiral thread which extends entirely around the cylinder. This thread rubs continually against an ink-roller. The paper is unrolled by clock-work, and brought up to the spiral by the action of an electro-magnet

"The apparatus for synchronism is also similar to that before described.

"If the circuit is closed and the paper is brought in contact with the spiral during a whole turn of the latter, a straight line is drawn across it: at the commencement of another turn a new line is begun, and so on. It will thus be seen that whenever the transmitting stylus touches the ink, permitting a current to pass over the line, the paper receives an impression corresponding to the length of the emission. The writing on the metallic paper is thus reproduced at the receiving end." — *Lines.*

See "*Report on Vienna Exposition*," vol. ii., Section I., pp. 37, 40.

D'Arlincourt's automatic telegraph is described in Lines' "*Report on Vienna Exposition*," vol. ii., Section 1., * p. 40.

"*Telegraphic Journal*"	* vi. 495.
	* vii. 28.
"*Scientific American Supplement*"	* 2433, * 2645.

Sawyer's autographic telegraph, or *Pantelegraph*, is described in "*Telegrapher*," * 1876. Reproduced in "*Scientific American Supplement*," * 302.

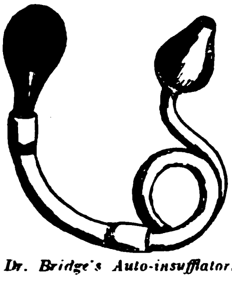
Au'to-in-suf-fla'tor. An instrument for the self-administration of medicine in the form of powder. Figure 131.

Au'to-ki-net'ic Tel'e-graph. (*Electricity.*) An English name for a form of municipal telegraph for fire-alarms, police, etc.

See "*Teleg. Journal*"	* iv. 241.
"*Engineering*"	* xxiii. 402.

Au'to-la-ryn'go-scope. An instrument by which one may inspect his own larynx. See "*Treatise on the Laryngoscope,*" by Dr. Sieveking, "*Lancet,*" April 8, 1865, p. 360.

Fig. 131.



Dr. Bridge's Auto-insufflator.

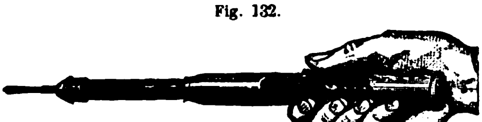
Au'to-mat'ic Air'-brake. (*Railway.*) *Westinghouse.* The air is compressed by a steam-pump on the engine, and is stored in tanks on the engine, and under the tender and cars, connection being made by pipes and flexible hose.

"When the brakes are to be applied, compressed air is admitted from the tank on the engine to a valve called a *triple valve* under each car, which releases the compressed air stored up in the tank under that car and admits it to a cylinder provided with a piston which is connected with a system of brake-levers, and the pressure of the air is thus transmitted to the brake-shoes. In this brake the air for operating the brakes on each car is stored up in a tank on that car, whereas in other systems of air-brakes the compressed air to operate the pistons under each car must all flow from the tank on the engine, and in vacuum-brakes the air from the appliances on the car used to operate the brakes must flow forward to the engine before the brakes can be applied. This consumes an appreciable amount of time, whereas the application of the automatic brake is almost instantaneous. The triple-valve is so arranged that the brakes can be applied from each car by pulling a cord, and they will also be applied to the rear part of a train in case it should break in two parts, if one or more cars should be separated from the rest of the train." — *Forney.*

See Figs. 655–745, "*Car-Builders' Dictionary.*"
"*Engineering,*" * xxv. 203.

Au'to-mat'ic Bor'ing Tool. An instrument on the principle of what is known as the Persian drill. See Fig. 3650, p. 1671, "*Mech. Dict.*"

Fig. 132.



Automatic Boring Tool.

A spiral on the stem is rotated by endwise pressure on the handle, and when the pressure is withdrawn the case is restored by a spring to its former position. Used for small drilling, such as dentists' and jewelers' work, etc.

Au'to-mat'ic Car'-brake. See RAILWAY CAR-BRAKE.

Au'to-mat'ic Clock. One that will continually or recurrently wind itself. Such have frequently been suggested. Two are mentioned on p. 576, "*Mech. Dict.*" Another is described in the "*Journal of German Engineers,*" as the invention of F. Hellig.

The power winding it up is change of temperature, which expands or contracts glycerine contained in a cylinder and supporting a piston; the piston-rod is connected by means of a toothed rack to ratchet wheels, so arranged that the motion of the piston will wind up the clock whether this motion is upward or downward. The clock may have a weight or a spring. It is evident that such a clock must not be placed in a room where the temperature is equal, but will act best when exposed to extremes, such as are found on the top of meteorological observatories, for which the inventor especially recommends it.

Au'to-mat'ic Cut'-off En'gine. One self-operating, cutting off steam at such portion of the stroke as shall maintain a regular rate of motion. The cut-off device is usually operated through the governor. See CUT-OFF.

Au'to-mat'ic Print'ing Tel'e-graph. An instrument or system which transmits a message, previously prepared, on a paper strip, which is simply drawn through the instrument. The message is usually punched in the strip, the dots or dashes signifying letters.

It is used in connection with a *printer*, which, in ordinary cases, is a puncher.

*Edison's, Phelps', Meyer's,** described by Lines, in his "*Report from the Vienna Exposition,*" 1873, p. 37 *et seq.*

Little's Automatic Telegraph, * *Lines'* "*Report on Vienna Exposition*" of 1873, vol. ii., Section I.

Au'to-mat'ic Re-peat'er. (*Electricity.*) One which is thrown into action by the current itself.

Au'to-mat'ic Sig'nal Tel'e-graph. One set in action by an original impulse derived from —

A thermostat, in case of fire.

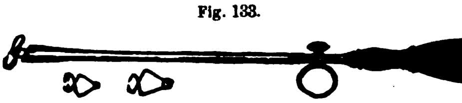
Tampering with a safe, for instance, by a robber.

The turning of a handle, as that of a fire-alarm box, etc.

Au'to-mat'ic Steam En'gine. One having a cut-off self-adjusted from the governor. See CUT-OFF.

Au'to-mat'ic Su'ture. A spring claw, for

Fig. 133.



Hoff's Automatic Suture.

holding together the lips of a wound. Used in vesico-vaginal operations, etc. The clasp is held on the end of an applicator, and thus applied, a slide pin releases it, and it is then self-holding.

Au'to-mat'ic Switch. 1. (*Electricity.*) A device used in many forms of electric apparatus to turn the current in another direction, to reverse it, etc.

An automatic device, to reverse the current in the electric candle of the Jablochkoff light. See "*Scientific American Sup.,*" * 2574.

2. (*Railways.*) A self-setting switch, or one operated by agencies set in motion by the train, for instance.

Au'to-mat'ic Ven'ti-la'tor. (*Railway.*) A car ventilator arranged so as to be self-adjusted, according to the direction in which the car is moving.

Au-tom'a-ton.

"Psycho," Eng.	* "*Scientific American Sup.,*" 1684.
	"*Scientific American,*" xxxiv. 342.
	"*Iron Age,*" xix., June 28, p. 24.
Cornet Player, etc.	"*Scientific American Sup.,*" 2482.
Houdin's, etc.	"*Iron Age,*" xxvii., April 6, p. 7.

Au'to-oph-thal'mo-scope. An instrument by which one may inspect the interior of his own eye. Fig. 3403, p. 1563, "*Mech. Dict.*"

See "*Treatise on the Use of the Ophthalmoscope,*" by Dr. Hutchinson, "*Clinical Reports of the London Hospital,*" 1867, 1868, p. 182.

Au'to-phone. An accordeon or organ, in which a music-sheet of Bristol board, perforated for the notes, is passed through the instrument; the notes sounded are as air passing through the respective perforations is admitted to the appropriate reeds or pipes.

Invented by Merritt Gally. See —

"*Manufac. and Builder*" * xi. 124.
"*Scientific American*" . * xl. 351; xli. 342.

Au'to-pol'y-graph. An autographic printing process. See *Hectograph*, etc.

Bauer's Process, "*English Mechanic*," xxvi. 46, 74.

A-ven'tu-rine. (*Glass.*) 1. *Aventurinus lapis.* A variety of translucent quartz or feldspar spangled throughout with scales of yellow mica. — Dana.

2. A precious quartz spangled with crystals or flakes of gold, giving it a brilliant appearance.

3. *Artificial aventurine* is an imitation of the natural, and consists of glass intermingled with little flakes of copper which look like grains of gold. — *Gold-stone.*

Menage says that the mode of making artificial aventurine being discovered by *accident* among the Murano glass-workers, the stone was called *avventurino*, that is, *pierre d'aventure*, and that this name was eventually applied to the natural stone, which the artificial gem resembles.

Artificial aventurine is made in Murano, Venice, by a secret process. It is yellow, and in the mass are to be seen imbedded numerous small brilliant crystals of copper, or, according to some chemists, of silicate of protoxide of copper. When polished, this glass affords a brilliant object for mounting by jewelers.

It is evident that the crystals are produced in the body of the glass while the latter is in a state of fusion. Among the elements which compose the glass are found the oxides of iron and tin, and M. Peligot deems it probable that it is due to the reduction of the bioxide of copper by these metals that the production of the crystals of copper is to be attributed.

M. Hautefeuille has made aventurine, the recipe for the ingredients being as follows: —

Glass (St. Gobain)	2,000 gr.
Nitre	200 gr.
Flakes of copper	125 gr.
Peroxide of iron	60 gr.

When the glass is completely melted, and while yet in the crucible, add 86 gr. of fine iron turnings wrapped in paper, and mix by means of a red-hot iron rod. The glass becomes blood-colored, opaque, and at the same time doughy and bubbly. Stop the draft of the furnace, put the cover on the crucible and cover with cinders; allow the furnace and crucible to cool very slowly. The following day break the crucible and the glass will be found permeated with crystals, regularly disseminated in parts, in others stratified and irregular, according to the success in mixing the materials.

It has been suggested to add the filings to the pounded glass or frit, in order to obtain more complete dissemination.

Green aventurine or *aventurine de chrome*, as termed by its inventor, M. Pelouze, is compounded of the following: —

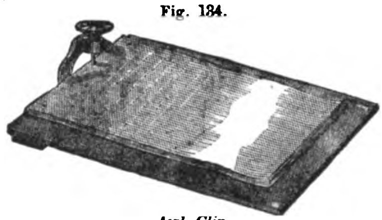
Sand	250 gr.
Carbonate of soda	100 gr.
Carbonate of lime	50 gr.
Bichromate of potassa	40 gr.

The glass which results from this combination contains from 6 to 7 per cent. of oxide of chrome, of which about half is combined with the glass, and the remainder assumes the form of brilliant crystals or flakes.

The color of the *aventurine de chrome* is that of the third yellow-green, the thirteenth tone in the chromatic circle of M. Chevreul. It is very brilliant and its radiant power is stated by M. Pelouze to be second to the diamond only. It is harder than window glass, which it cuts easily, and is much harder than the aventurine of Venice.

Awl Clip. A board and clip pin, to hold blanks, message, or memorandum paper, etc. The pin penetrates the pile of papers, which are removed from time to time with a slight tear in the edge.

Fig. 134.



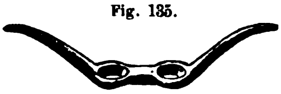
Awl Clip.

Awn'ing Block. A small wooden block for suspending or stretching an awning over the quarter-deck, or elsewhere.

Made plain or rope strapped, and with an eye.

Awn'ing Cleat. A small becket on which to belay an awning rope.

Fig. 135.



Curved Horn Awning Cleat.

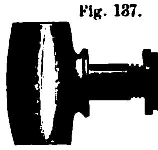
Awn'ing Hinge. One to which an awning rod is journaled. See Fig. 136.

Awn'ing Slide. A holder with a tube through which the rod of the awning slides.

Fig. 136.

Awning Hinge.

Fig. 137.



Awning Slide.

Axe. The poll is formed from a solid bar of iron by a machine that operates two punches simultaneously to form the eye for the reception of the handle. The heated bar is placed under shears that cut off a piece sufficient for the poll, which piece is placed in the machine, the two punches working from either edge, a supplementary punch finishing the eye and a set of dies forming the sides, when the poll drops, still red hot, ready to receive the bit. The after insertion of the steel bit and shaping the axe are done by ordinary forging.

The axes are then sent to the hardening and tempering room, which is partially darkened. The hardening ovens are circular, having a vertical shaft in the center to which are attached rotating tables, on which the axes are laid with the bits toward the outside. The table turns slowly but continually, bringing the axes over furnaces of anthracite coal alternating with spaces. When brought to the proper redness by heat, the axes are hung on hooks on a revolving frame, the bits dipping into a tank of brine, which is kept in constant circulation by a pump. When cool, the axes are tempered, which is done by heating them in a rotary oven like that used for the hardening, except that the fuel used is charcoal. One of the batch of perhaps 200 which are tempered, or drawn, at one time is brightened, and serves as a test of all the others, the rotary action of the shelves insuring equal heating. When the brightened axe shows the right color, the entire batch is removed, and the axes are then ready for the subsequent finishing operations of grinding and polishing.

Several kinds of axes are used among fishermen and whalemen.

Boat hatchet: For cutting the harpoon line at the bow, if it become tangled in "paying out."

Head axe: For cutting off the head of the whale; opening the skull to obtain the spermaceti; cutting off the baleen, etc.

See also SPADE.

Rollins's axe, with detachable bits, is described in "*Scientific American*," * xxxvi. 355.

(*Stone Working.*) Stone axes are of several kinds; their distinguishing peculiarity is having an edge, while the *hammer* has a *face* and a *pick* has a point.

The *cavil* has a face at one end and a point at the other.

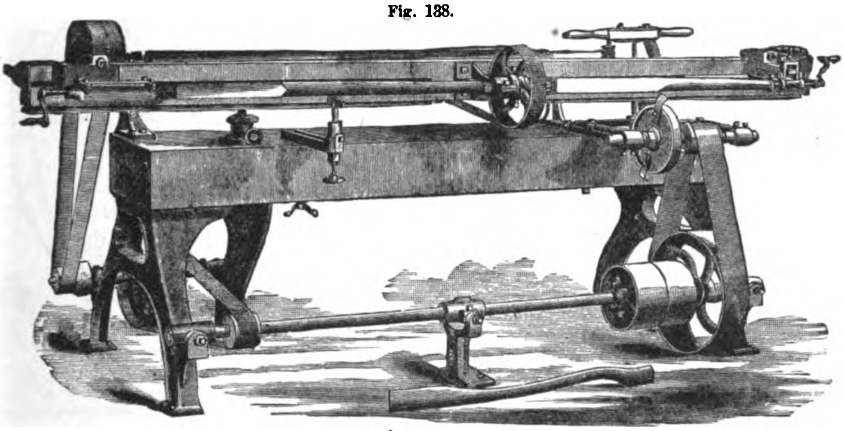
See list under HAMMERS AND STRIKING TOOLS.

Axe Wedge. A small iron wedge driven into the end of the axe-handle, within the eye, in order to expand the wood, and prevent the head flying from the helve.

Axe-han'dle Lathe. This is a machine on the Blanchard spoke-lathe principle, and is adapted to work by pattern. It is shown, Fig. 138, as making a spoke. The pattern spoke is at the left, and rotates against a guide-piece, so that the swinging frame in which the pattern spoke and the blank are chucked moves back and forth as the pattern traverses against the guide. The frame has a motion endwise, and the revolving cutter dresses the blank in accordance with the governing piece against the pattern.

It will turn out 20 to 25 dozen 3 feet axe-handles, or 150 to 300 spokes per day, according to size. The machine feeds itself after the work is in, working by a pattern, and is so arranged that the same pattern will make several sizes, and stops feeding when the end of the stick is reached by the cutter. It is also arranged with adjusting screws to level up the tilting frame for different sizes of work.

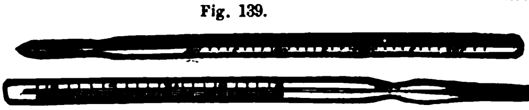
Fig. 138.



Axe-handle Lathe.

Ax-il'la Ther-mom'e-ter. A thermometer, so named from the axilla affording a convenient place for the instrument in the observation of personal temperature. See also CLINICAL THERMOMETER.

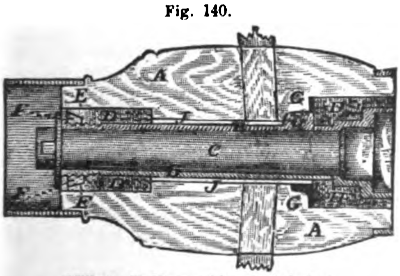
Fig. 139.



Axilla Thermometer.

Ax'le. The rubber-cushioned carriage axle is shown in the hub, Fig. 140, and detached, but with the cushions in place, in Fig. 141.

Fig. 140.



Miller's Rubber-cushioned Axle-box.

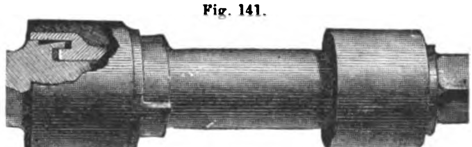
A, Hub. *B*, Axle-box. *C*, Axle arm. *D*, Rubber cushions. *E*, Compression nut. *F*, Cavities in compression nut admitting points of the wrench when compressing cushions. *G*, Slotted retaining sleeve. *H*, Spur on axle-box. *J*, Space between axle-box and hub.

It consists of a vulcanized rubber cushion in the form of a thick band interposed between the axle-box and the wood of the hub, as shown by Fig. 140, giving a sectional view of an ordinary hub, to which the cushioned axle is applied.

Adjustable axles to regulate height, are common in reapers, and their adjustment at the divider, on the grain end of the cutter bar, is one of the points of regulation in fitting the machine to cut to a certain height of stubble.

The axles of wheeled cultivators have also an adjustability to raise or lower the machines, according to the required depth of tillage.

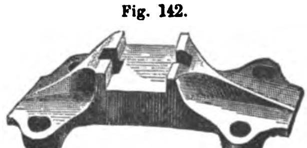
Fig. 141.



Rubber-cushioned Axle.

Lincoln's Patent Axle, * "*Mining & Sc. Press*," xxxviii. 289.
Axle centering machine, * "*Railroad Gazette*," xxvi. 59.

Fig. 142.



Spring and Axle Block.

Ax'le Block. A block bolted to a vehicle axle to form a seat for the spring. See Fig. 142.

Ax'le Box. (*Railway.*) A cast-iron box inclosing the end of the axle, its bearing brasses, the key or saddle, and the receptacle for grease or oil and waste.

The accompanying cut, Fig. 143, is from *Forney's "Car-builders' Dictionary"*: —

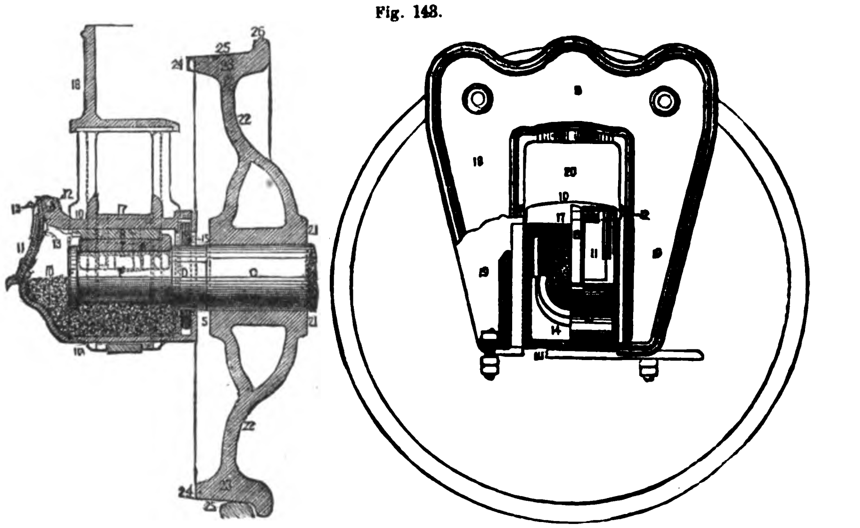
The following may be consulted: —

Axle, Austrian .	*Paget, Becker,*	* "*R. R. Gaz.,*" xxii. 569.
Axle, Br. . . .	*Attock* . .	* "*Engineering,*" xxix. 280.
Axle, Self-oiling,	*Tomlinson* .	* "*Sc. Amer.,*" xxxvi. 54.
	Tomlinson .	* "*Sc. Amer. Sup.,*" 1876.
Axle, Radial . .	*Windmark* .	* "*Engineer,*" xliv. 333.

Ax'le Box Met'al.

Lining Metal for Axle Boxes:	Tin	24
	Copper	4
	Antimony	8
Melt and then add tin		24
		60

Fig. 143.



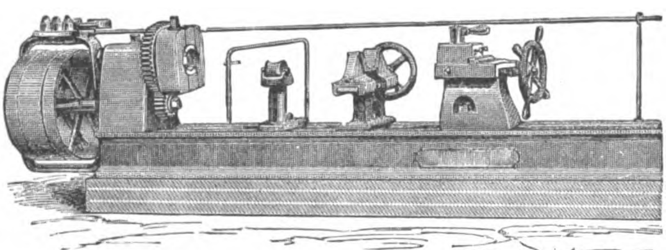
Axle, Wheel, and Axle Box

A. Center of axle.
B. Neck of axle.
C. Wheel-seat.
D. Dust-guard bearing.
E. Journal.
F. Axle collar.
3. Stop-plate.
7. Journal bearing.
8. Journal bearing key.
9. Stop-key journal-bearing.
10. Journal box.
11. Journal-box cover.
12. Journal-box cover hinge-pin.
13. Journal-box cover spring.
14. Journal-packing.
15. Dust guard and chamber.
16. Dust collar.
17. Equalizing-bar seat.
18. Pedestal.
19. Pedestal horns.
20. Pedestal jaw.
21. Hub of wheel.
22. Wheel-plate.
23. Rim of wheel.
24. Face of rim.
25. Tread of wheel, or wheel tread.
26. Wheel-flange.
27. Journal-bearing stop-key.
28. Oil cellar.
29. Stop journal-bearing.

Ax'le Box Guides. (*Railway.*) Slips on the inner faces of the pedestals of a railway truck, to guide the axle brasses as they move up and down.

Ax'le Cen'ter-ing and Siz'ing Ma-chine. A machine tool, to be used in connection with an axle lathe, to center the rough axle, and after it has been turned to size in its journals and rough-turned in the *fit*, to finish this part accurately, and to dress off the ends as well as to re-center. This machine is provided with a powerful chuck lined with brass to clamp the axle by its outer collar. It is arranged with fast and slow motions on the driving gear.

Fig. 144.



Axle Centering and Sizing Machine.

The axle rests in an adjustable V-guide at its end farthest away from the driving head; a squaring-up tool finishes the end of the axle, and at the same time re-centers it. The *fit* part of the axle is brought to size by a hollow reamer provided with adjustable cutting blades.

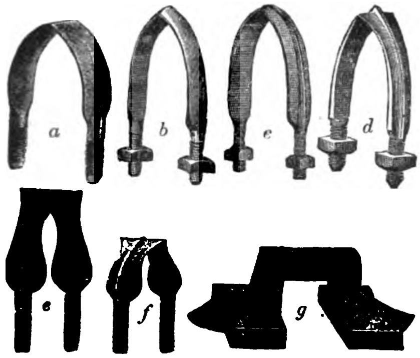
Ax'le Clip. A saddle-shaped clamp which binds a spring to its axle, a spring bar to its spring, etc., etc. Various forms of axle clips are shown in Fig. 145.

Ax'le Col'lar. An enlargement on an axle to form a butting ring, that is, to receive a thrust.

The collar is ordinarily on the shoulder of the axle arm in road vehicles, but is also placed on the outer end in car axles. Examples of each are given on pp. 198–203, and Figs. 1091–1093, p. 459, "*Mech. Dict.*"

Ax'le Lathe. 1. A lathe, Fig. 146, for turning car axles. The shears or bed is in the form of a continuous cylinder of requisite strength, with flat surfaces added to the cylinder for attachment of heads and bearing of slide-rest. The live-head or driving-head is simple and powerful. The face plate is fitted with the Clement driver, which insures rotation of the axle with no lateral strain on the centers. The back-head has a very large spindle

Fig. 145.

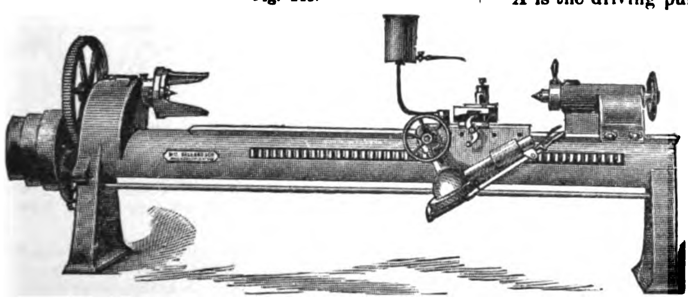


Axle Clips.

a. Flat, sharp center bent axle clip.
b. Sharp center bent axle clip for spring bars.
c. Sharp center-ribbed, bent axle clip for spring bars.
d. Sharp, wide center, ribbed, bent axle clip for spring bars.
e. Sharp center, O. G., bent axle clip for spring bars.
f. New pattern, sharp center, O. G., bent axle clip for buggy perch-plates and sleigh work.
g. Coach axle clip.

with large center, and a clamping arrangement, which insures the spindle being held central and at the point nearest to the work. It has a rack-

Fig. 146.

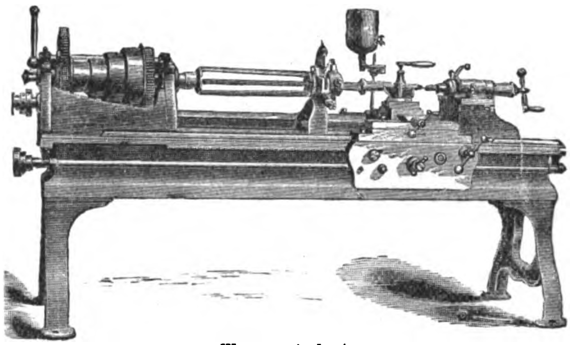


Car-axle Lathe.

feed with quick hand traverse to bottom rest; patent adjustable tool holders, automatic feed motion, which can be started instantly; rate of feed, 15 to the inch.

2. A machine, Fig. 147, for turning the spindles of wagon and carriage axles. It swings over ways

Fig. 147.



Wagon-axle Lathe.

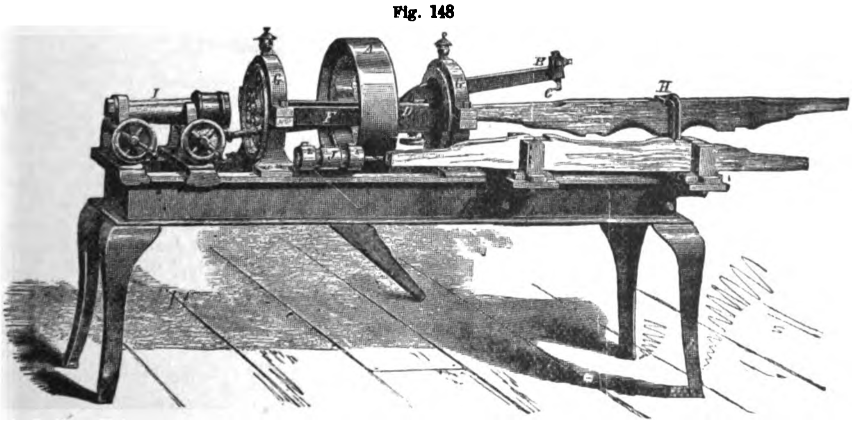
18″; the bed is 8′ long; with plain head, especially adapted for turning wagon axles, with taper attachment to carriage. This lathe can also be used for turning any regular tapers or irregular shapes, by guide or pattern, which can be fastened to a rail on back side of the bed-piece.

3. A machine for turning spindles of wooden axles for the reception of thimble-skeins. The machine, Fig. 148, turns the axle to a pattern, making the wooden spindle fit any inequality in the thimble skein, filling it throughout.

A is the driving pulley, which rotates the mechanism supporting the knife in the standard *G*. *B* is a curved cutter bar, to the outer end of which is secured the knife *C*, and which enters the sliding block *D*, as a fulcrum. Block *D* travels in the ways *F*, and is actuated therein by the feed gearing shown at *E*. At *H* is the clamp which holds the axle while it is operated upon, and at *I* is the pattern, just below which is shown the end of the bar *B*, projecting, which, terminating in a friction roller, enters the skein, and is held against the inside surface of the same, thereby guiding the knife in its revolution, thus necessarily causing the axle to be turned to an accurate fit.

Fetu & Deliège, Liège . . * "*Engineering*," xxix. 418.
Axle-lathe Hoist. *Thomas*. * "*Railroad Gazette*," viii. 289.

Fig. 148



Axle-turning Machine.

Ax′le Lu′bri-ca′tor. Eggleston's axle lubricator has a cap-piece inserted into the upper side

Fig. 149.

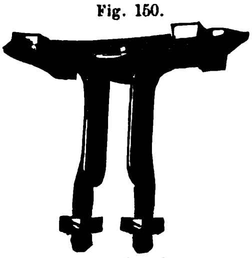
Axle Lubricator.

of the arm, and wick protruding up through it, and extending downward into an oil reservoir. See, also, AXLE-BOX, "*Mech. Dict.*"

Ax′le Pack′ing. (*Railway.*) A dust guard around a car axle, to prevent access of dirt to the interior of the axle-box. Figs. 1091, 1092, p. 459, "*Mech. Dict.*"

Ax′le Sad′dle. A saddle-shaped clip, for securing a spring to an axle. A plate or yoke slips over the screwed ends, and is secured by burs.

Fig. 150.



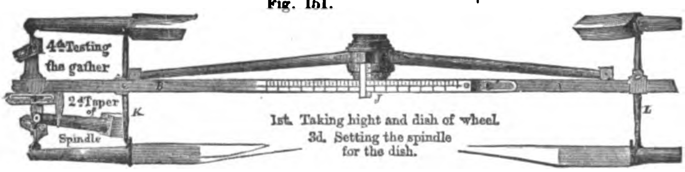
Axle Saddle.

Ax′le Seat. (*Railway.*) The opening in a wheel, fitted to receive the axle arm.

Ax′le Set and Gage. An apparatus, Fig. 151, for enabling the wheelwright to get the height and dish of wheel: the taper of spindle: to set the spindle for the dish: to obtain the gather.

The apparatus consists of a steel bar, *A*, 6′ 3″ long, and an index and gage bar, *B*, 3′ 9″ long, which slides against the former, and has a scale cut upon it to adapt the apparatus to any sized wheel. The bar *B* is attached to the main bar, 13″ from the end, by a straight standard, *K*, projecting 4″ from one edge and 3″ from the other. A screw, passing through the center of this standard, serves as a pivot for the index and gage-bar *B*. A

Fig. 151.



Carleton's Axle Set and Gage.

vertical sliding rule, *J*, on the bar *B*, is designed to show the dish, while the graduated scale on the bar shows the height of wheel. A movable arm-rest, *L*, is attached to the bar *A*, to support the gage horizontally over the center of the axle, the rest *L* and standard *K* resting on opposite shoulders of the spindles, while the taper-taker is placed over the end of the spindle to be set. The taper-taker, or graduated double caliper, is fitted with a movable arm, scale, and graduated sliding gage. It is moved on the index bar *B*, through a socket, and held in place by a set screw. The short caliper, and the short ends of standards, 3″ long each, are placed on the opposite ends of the bar *A*, on the "gather side."

Bex's axle setter, patented December 21, 1875, is for straightening bent axle arms. It is of the type of Fig. 507, p. 200, "*Mech. Dict.*"

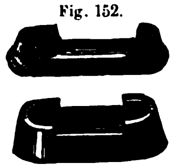
See "*Scientific American*" . . . . * xxxv. 18.
"*Mining and Scientific Press*" . . . * xxiv. 289.

Ax′le Stop′-key. (*Railway.*) A plate abutting upon the end of the car-axle, to resist excessive lateral motion and take the wear.

Ax′le-turn′ing Ma-chine′. See AXLE LATHE.

Ax′le Yoke. A plate beneath the axle; a cross-bar through which the ends of the spring saddle clip are passed, and beneath which they are secured by nuts. Fig. 152.

Fig. 152.

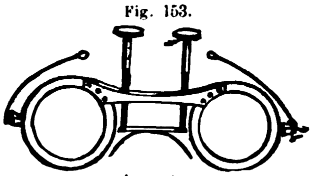


Axle Yokes.

Ax-om′e-ter. An instrument to determine the proper height of the bridge of the spectacles, in order that the lenses may be properly centered vertically with regard to the pupils. Fig. 153.

The patient having put on the spectacles, the movable bridge of the instrument is raised or lowered until the pupils are seen in the center of the circle. This done, the axometer is placed on a sheet of paper, and the bridge, along with the lower half circles, is traced thereon with a pencil.

Fig. 153.



Axometer.

Az′i-muth In′stru-ment. Sir William Thomson's instrument for taking azimuths, which he terms the "azimuth mirror," was patented Nov. 19, 1878, No. 210,068.

In it the axis, on which the mirror is pivoted, is above the plane of the lens, which is contained within the inclined tubular leg, which arrangement allows of the interval of no vision between mirror and lens to be reduced to a minimum, by reason of the inner straight edge of the mirror cutting out of sight with a sharp or fine line that portion of the lens which it hides, whereby the image of the object is seen distinctly on the degree scale of the compass-card.

The azimuth, circle and azimuth compass are considered on pages 203, 204, "*Mech. Dict.*" The brass azimuth of Benares, India, is shown in Fig. 571, page 204, *Ibid.* It was built by Jay-Singh, Rajah of Jayanagar, in the 17th century. The equatorial and equinoctial dials of the same holy city of the Ganges are shown on page 692, Figures 1624, 1625, *Ibid.* The subject is discussed in Dr. Hooker's "*Himalayan Journals,*" "*Transactions American Oriental Society,*" vol. vi., Dr. Hooker's "*Notes on Bengal, Nepaul, etc.*"

Az′o-tine. An explosive: Saltpeter, 69.05; carbon, 15.23; sulphur, 11.43; petroleum, 4.29 per cent.

B.

Bab'bit-ing La'dle. An iron ladle for holding and pouring the melted alloy known as babbit-metal, and used for bearings.

Ba-biche'. (*Fishing.*) Properly *barbiche.* A common name in France for the *nigelle de Damas;* called also *araignée* (spider), *barbe de capucin,* and *cheveux de Venus.* Used in net-making.

Back Band. (*Manége.*) That portion of the harness attached to the gig-saddle under the jockey, and used as a support for the shaft-tug.

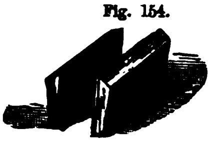
Back Board. (*Boat.*) The board across the stern-sheets of a boat for supporting the backs of the passengers.

Back Cyl'in-der-head. (*Steam.*) That head of a cylinder through which the piston-rod passes.

Back End. (*Mining.*) That part of a judd (an undermined mass of coal) which is left after the lump is brought down.

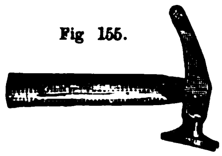
Back'ing Boards. A pair of wooden jaws, Fig. 154, to grip a book in the book-binder's vise.

Fig. 154.



Backing Boards.

Fig 155.

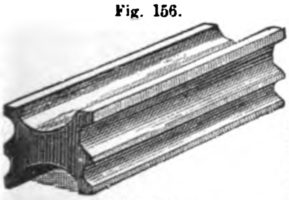


Backing Hammer.

Back'ing Deals. (*Mining.*) Timbers placed behind cribs to keep back loose strata.

Back'ing Ham'mer. (*Bookbinding.*) The hammer, Fig. 155, used in beating the backs of books in condensing and rounding them.

Fig. 156.

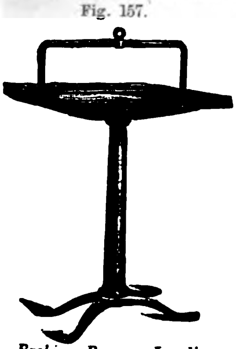


Backing Iron

Back'ing I'ron. (*Bookbinding.*) An appliance used in giving the rounded shape to the backs of books. On its face it has depressions of varying depth and width.

Back'ing Ma-chine'. (*Bookbinding.*) A machine used in rounding the backs of books. That shown in Fig. 160 is adapted to back blank books from ½″ to 4″ wide, and 30″ long and under. The revolving backing-iron is hollow, and is heated from the center by gas or steam. On the right of the cylinder is the adjusting screw, and at the same end is the device which secures the cylinder on the groove desired.

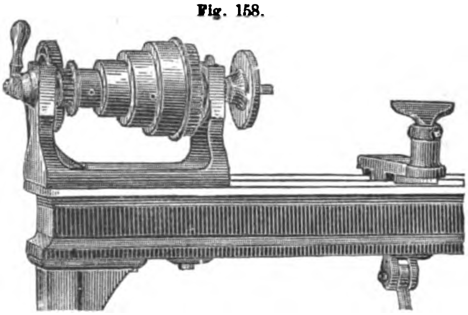
Fig. 157.



Backing Pan on Leveling Stand.

Back'ing Pan. (*Stereotyping.*) A pan, Fig. 157, in which the electrotype shell is placed, face downward, while the melted metal is poured on its back. The table being perfectly level, the stand is secured to the floor by its feet. The pan is swung on to the stand, and the metal poured on to

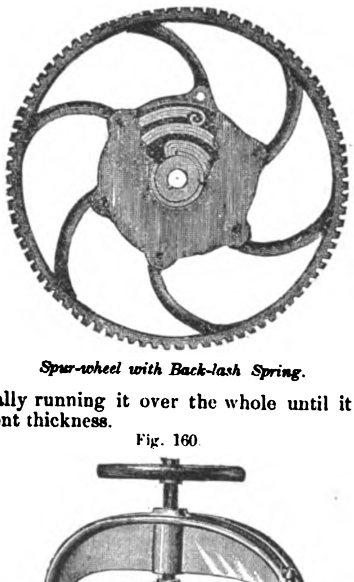
Fig. 158.



Back-geared Lathe-head.

the shell, commencing at one of the corners and

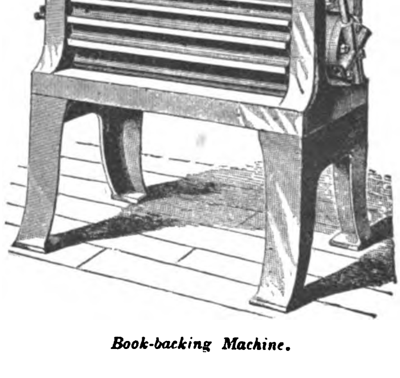
Fig. 159.



Spur-wheel with Back-lash Spring.

gradually running it over the whole until it is of sufficient thickness.

Fig. 160.



Book-backing Machine.

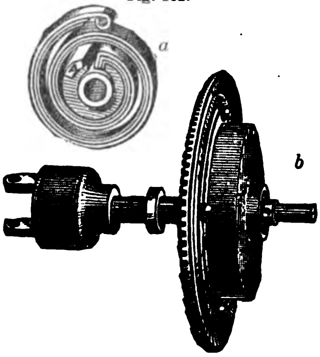
Back′-geared Lathe. One having a set of variable gears in the head-stock.

Back′-lash Spring. A spring interposed between an engine or horse-power and the machinery driven, to prevent a jerking motion in transmission. The spring is wound upon the shaft, its ends connected to the driver and driven portion respectively, so as to absorb a sudden jerk.

Fig. 159 represents the spur-wheel of a thresher, with a casing for the spring cast in its center.

Fig. 161, *a*, represents a spring and hub detached

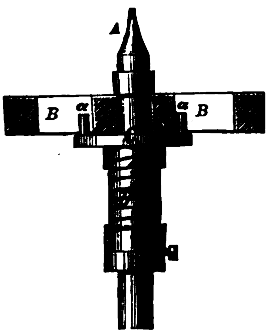
Fig. 161.



Heffner's Back-lash Springs.

from the casing. The hub is keyed to the shaft; the inner end of the spring is connected to the hub, and the outer end to the wheel. Fig. 161, *b*, is a bevel-wheel of a side-gear, forming a casing for the spring.

Fig. 162.

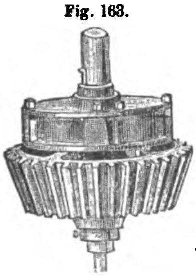


Alsop's Back-lash Spring.

Fig. 162 is Alsop's spring wound upon the shaft, and having a similar function to the above described.

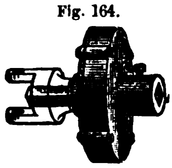
In Fig. 162, *A* is a mill-spindle; *D* the spiral spring, one end clamped to the spindle, and the other end to the driver *C*, which presses by its pins *a a* upon the spokes of the pinion *B*.

Fig. 163.



Back-lash Spring.

Fig. 164.



Back-lash Spring, applied to Tumbling-rod Coupling.

Fig. 163 shows a bevel-wheel with spring in a case.

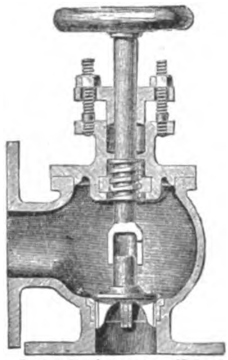
Fig. 164 shows a spring in a case to form part of line-shaft of a horse-power.

See also BACK-LASH, p. 206, "*Mech. Dict.*"

Back′-log. A casting or a work in earthenware in semblance of a back-log or pile of wood, and hollow to admit gas from the service-pipe. The surface of the back-log has minute perforations at which gas is emitted and burned, resembling a log on fire.

Back-press′ure Valve. A valve which is free in the normal direction of the flow, but closes automatically against back-pressure.

Fig. 165.



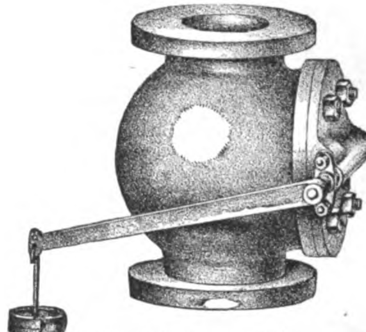
Globe Back-pressure Valve.

In the sectional view, Fig. 165, the valve can be screwed down tightly, but normally yields to upward flow, and is closed at any time against downward flow.

In Fig. 166 the valve is normally closed by a weighted lever, but yields to direct pressure of a given tension while always opposed to any return current.

Back Saw. One with a stiffening bar at the back. That shown in Fig. 167 has a back less than the full length of the saw, and has a recess in the handle for the thumb.

Fig. 166.



Weighted Back-pressure Valve.

Back Skin. (*Mining.*) A leathern covering worn by miners when working in wet places.

Back Spring. (*Vehicle.*) A spring at the rear of a vehicle body, but more especially a C-spring which rides up in the rear of the carriage, and from the forward pendent end of which the body is suspended. A pair of C-springs is shown in Fig. 1541, page 655, "*Mech. Dict.*"

Fig. 167.

Back-saw.

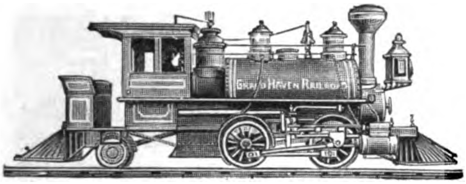
Back Stay. In a carriage: (1), one of the rods extending from the reach or perch to the outer end of the hind axle. The *stay-end* is the end-piece, which is fitted to the axle, and is sometimes sold separately as a piece of carriage hardware, the lengthening-rod being added by the blacksmith.

2. One of the standing flaps on the back of the carriage-top, on each side of the curtain.

Back Strap. (*Manège.*) A broad strap used instead of a pad on common harness. In some sections of the country the strap that extends from the hames back to the hip-straps is more generally known as the *turn-back*.

Back′-truck Lo′co-mo′tive. One having a truck with a pair of wheels under the rear of the locomotive, as distinct from the usual truck in front of the drivers. The engine is intended to run equally well in either direction, being, in fact, a double-ender, adapted for sharp curves and steep grades. The 9 × 16 and 10 × 16 engines of this style are well adapted to suburban roads and special service on wide or narrow-gage roads, and light shifting on wide gage.

Fig. 168.



H. K. Porter & Co.'s Back-truck Locomotive.

A 4-wheel truck is sometimes substituted for the 2-wheel, the tank being placed over the rear truck.

Baf'fle Plate. (*Steam.*) A plate in a steam-furnace, to direct or divert the course of flame and gases. Placed in a space traversed by water-tubes, it will determine the course of the heated gases toward portions of the boiler which would not otherwise be as fully exposed to the heated current.

Bag. (*Fishing.*) The middle portion of a large haul-seine, the last to come ashore. The portions on each side of the bag are the *wings*.

Ba-gasse' Dry'er. An apparatus for drying the refuse cane-stalk from the mill. Page 208, "*Mech. Dict.*"

Berry, Br. . . . . . * "*Engineering*," xxix. 204.
* "*Engineering*," xxx. 482.

Bag Ear-syr'inge. An ear douche, with elastic rubber bag for ejecting the liquid.

Bag Fill'er. A funnel used in filling bags. See also Bag-holding Truck. Machines on a larger scale for filling flour-bags of various dimensions are shown under Flour Packer.

Fig. 169.

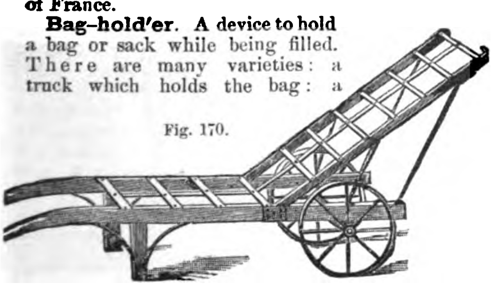
Bag Filler.

Bag'gage Bar'row. A two-wheel hand-vehicle for conveying trunks. See Fig. 170.

Bag'gage Truck. A hand-truck adapted to receive trunks. Fig. 171 shows the pattern used on the Eastern Railway of France.

Bag-hold'er. A device to hold a bag or sack while being filled. There are many varieties: a truck which holds the bag: a

Fig. 170.



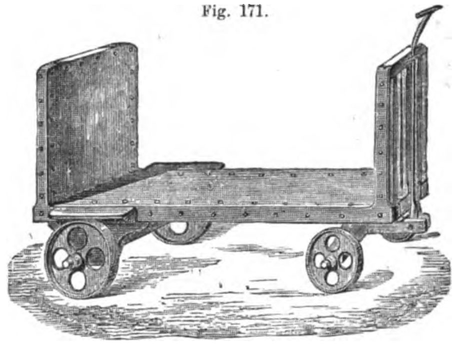
Baggage Barrow.

funnel held upon a tripod, or on the end of a weighing beam, etc. See Bag-holding Truck; Sack Lifter; Sack Filler, etc.

Fairchild's bag-holder has a metallic funnel attached to a standard, and to the funnel are attached four steel hooks which hold the mouth of the bag distended while being filled.

Mosher's bag-holder has two telescopic standards, with curved flanges to hold the bag.

Fig. 171.



Baggage Truck.

Bag-hold'ing Truck. The bag-holding truck of Bodin of Rennes, France, is shown in Fig. 172. It has a slanting frame, supported by a strut, and a clip-ring at top to hold the distended mouth of the bag.

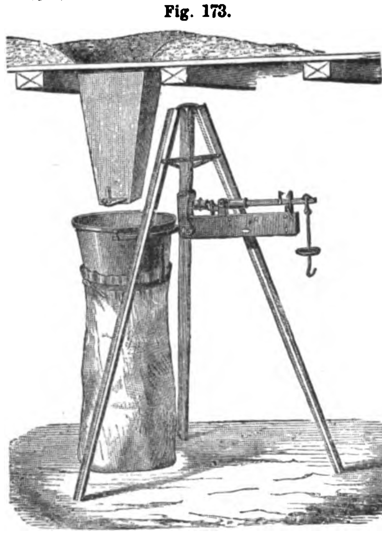
A similar device is made by Pitner of Chicago.

Fig. 172.

Bag-holding Truck.

Bag'-net. (*Fishing.*) A purse-shaped net, or part of a net. In some cases a sort of dip net, like Fig. 3318, p. 1522, "*Mech. Dict.*;" sometimes a portion of a net into which fish collected by the wings are driven or led. See list under Net.

Fig. 173.



Romaine's Sack-filler and Weigher.

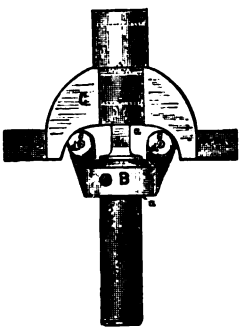
Ba-gra'tion Bat'te-ry. (*Electricity.*) One in which the zinc and copper elements are immersed in a jar filled with earth, sprinkled with chloride of ammonium. — *De la Rive.*

Bag Weigh'er. Fig. 173 shows a French device.

A tripod supporting a scale-beam, on one end of which is a funnel to which the open mouth of a bag is clamped. The bag hangs beneath a spout, and when a prescribed weight of grain has passed from the spout into the sack, the shutter is closed, the bag removed and tied, and an empty sack substituted. The bag is clipped by a ring to the funnel, which is suspended by a notch on the end of the weigh-beam. The scale is centessimal, — the scale-weight being one-hundredth of the weight of grain which makes its equipoise.

Bail. (*Milling.*) The arch-shaped support of a mill-stone. The *balance-rynd.*

Fig. 174.



Bacon's Cushioned Bail and Driver.

In the figure, *C* is the bail resting upon the cock-head *a* of the spindle. *B* is the driver, with two cushioned horns, *c d,* which in the figure are exposed to view by the lifting of the bail out of place, but in operation occupy recesses in the bail.

The cushions, being yielding, allow the stone to be self-balancing.

Bain-Ma'rie. A water-bath; used in perfumery manufacture. See for particulars p. 398, vol. vii., "*Chambers' Encyclopedia,*" article "*Perfumery,*" where is given an interesting account of the flower-farms and processes of the Var, France.

"*Art of Perfumery,*" *Septimus Presse.* London, 1855.
"*British Perfumer,*" *C. Lilly.* London, 1822.
"*Libraire Roret,*" *Mme. Celnart.* Translated by Morfit of Philadelphia.
"*Treatise on Perfumery,*" *Pradal & Malepeyre.* Translated by Dussauce.
"*A Practical Guide for the Perfumer,*" *Dussauce.*

Bait, Ar'ti-fic'ial. (*Fishing.*) Tin minnows, roach, dace, and gudgeon.

Gutta-percha minnows.

Tin blue-fish squids.

White bone blue-fish squids.

Insects: Imitations of grasshoppers, hornets, beetles, spiders, wasps, May-grubs, grubs, etc.

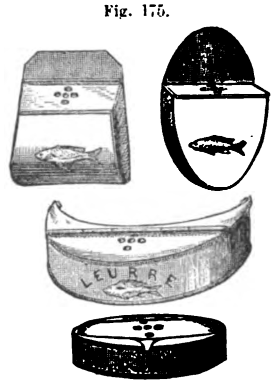
Kellogg's patent, No. 74,378, is for an ice-chest for bait, for fishing-vessels.

Burnham, No. 84,855, uses a saturated solution of lime to preserve bait.

Thorp's fish-bait, No. 96,288, is a baked cracker, made of equal parts of coarsely-ground wheat, oats, rye, and corn.

Goodman, No. 135,-113, uses to make bait more attractive, oils of anise, asafœtida, and cardamons; black root and buzzard-flesh (!) a few drops on the bait.

Fig. 175.



Bait Boxes.

Bait Box. 1. The cistern or tank in which bait of fish or clams is carried to the fishing-grounds.

2. On a smaller scale, the angler's bait-can for worms or what-not.

Kepner's can for live bait, No. 163,498, has a perforated false bottom and openings at the sides, to allow circulation of water when the can is set therein.

Hitchcock's bait-kettle, No. 181,844, has ice-cooler, minnow-bucket, and trays.

Lasater, No 194,258, has a combined minnow-trap and can.

Bait Cut'ter. A bait-cutting machine. See Bait Mill.

Bait Mill. A grinding mill to mince bait, frequently on the principle of a sausage-cutter.

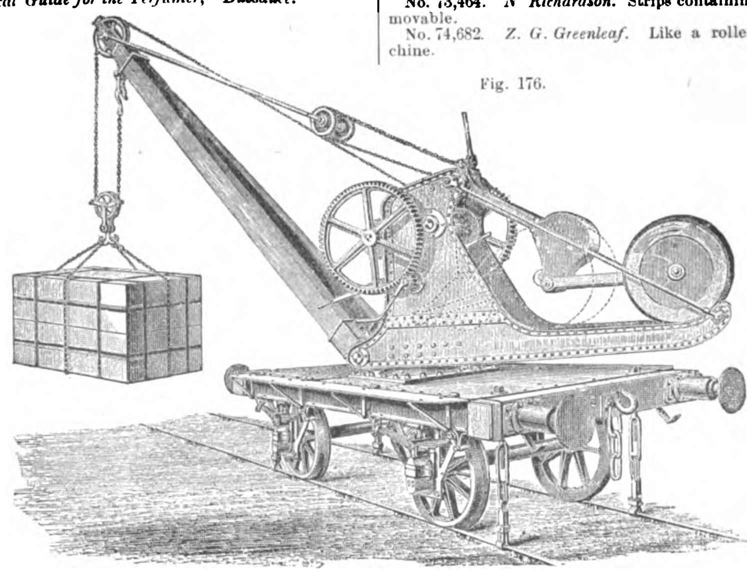
UNITED STATES PATENTS.

No. 35,472. *N. Richardson.* Triangular teeth on each of two rollers, working together.

No. 73,464. *N Richardson.* Strips containing teeth are removable.

No. 74,682. *Z. G. Greenleaf.* Like a roller sausage-machine.

Fig. 176.



Self-acting Balance Permanent-way Crane.

No. 83,048. *V. Doane.* Roller-knives and stationary blades.
No. 101,260. *S. Hamblin.* Knives spirally arranged on roller.
No. 129,576. *W. M'Kay.* Circular saws on roller.
No. 172,777. *N. Richardson.* A roller cutter-mill.
Voss, 1876. Like a sausage-cutter.

Bal. (*Mining.*) Cornish — a mine.

Balance Crane. One in which the load is in part or entirely balanced by a counterpoise on the crane-frame extension.

The manner in which the load on the lifting-chain acts on the counter-balance weights will be readily understood from the engraving, Fig. 176. The rigid rods which tie the jib-head to the side-frames in ordinary railway-track cranes are here replaced by two short tie-rods, each with a chain-sheave at its lower end. One end of each of the chains passing over these sheaves is attached to a chain-barrel fitted with worm and wheel-gear, while the other ends are coupled to the short arms of two bell-crank levers, having a fulcrum in the top of the side-frames; the lower ends of the long limbs of the bell-crank levers are fitted with weights connected by strong wrought-iron links to the axis of a cylindrical balance weight, which is free to roll on the tail-pieces of the crane framing. When the load is being lifted the strain due to the weight of the load passes through the tie-bars and chains to the short arms of the bell-cranks, and the strain thus applied causes the long arms and weights to rise out of the vertical position and to draw the cylindrical weights into the position shown, or until they are at a distance from the center sufficient to counterbalance the load being lifted. When the load is released, the levers resume the vertical position shown in the dotted lines.

The action is therefore entirely automatic, there are few parts, none of them liable to derangement, and all so strong and simple in construction that these cranes have never been known to fail in securing the safety and certainty which they were designed to afford.

The chain-barrel is fitted with a tangent wheel and worm which serve to adjust the jib to any angle or radius required, as well as to lower it down for traveling.

The under carriage and side-frames are of wrought iron.

Bal'anced Draw'bridge. A counter-weighted bascule or lifting drawbridge. Instances are to be found in the drawbridges of fortifications, of counterpoising by means of suspended weights from chains passing over pulleys.

Burdon's drawbridge balanced by hydraulic pressure is shown in

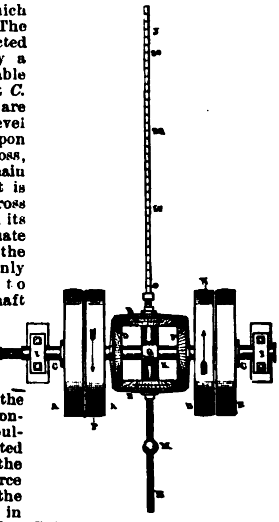
"*Manufacturer and Builder*," * xi. 29.

Bal'ance Dy'na-mom'e-ter. An invention of Samuel Batchelder of Boston. It is placed in the line of communication between the motor and the machinery to be moved, the power exerted on the machinery being measured by the steelyard and weight which form a part of the machine.

A A and *B B* are two pairs of belt pulleys, each pair consisting of a fast and loose pulley. *A* is driven by a belt from the prime motor, and a belt from *B* communicates motion to the machine to be driven.

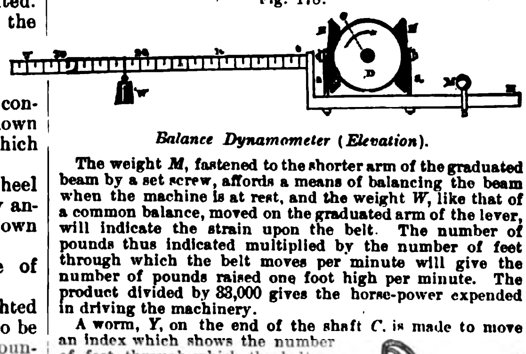
The first pulley, *A*, and the bevel wheel *D*, are fast upon the shaft *C*, which revolves in bearings *I*. The bevel wheel *F* is connected with the pulley *B* by a sleeve, *K*, which is capable of turning on the shaft *C*. The bevel wheels *D F* are geared together by the bevel wheels *E E*, which run upon a cross shaft having a boss, *G*, through which the main shaft passes freely. It is evident that if this cross shaft is not retained in its place by some adequate force, the motion of the bevel wheel *D* will only cause the cross-shaft to move round upon the shaft *C*, and the wheels *E* will roll upon the wheel *F*, without communicating motion to it or to the pulley *B*; but if the wheels *E* and the cross-shaft are held stationary, the motion of the pulley *A* will be communicated to the pulley *B* through the bevel wheels, and the force there applied to retain the shaft *G* and wheels *E* in place will indicate the power transmitted through the dynamometer. The amount of power is ascertained by means of a graduated scale beam, *H J*, connected with the shaft of the wheels *E* by straps, *a*.

Fig. 177.



Balance Dynamometer (Plan.)

Fig. 178.

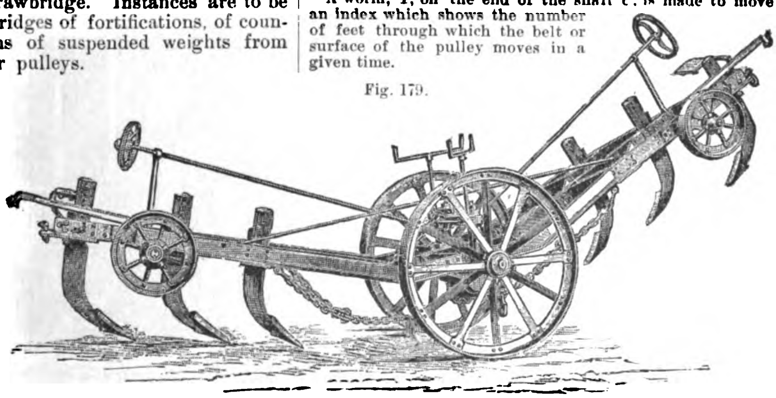


Balance Dynamometer (Elevation).

The weight *M*, fastened to the shorter arm of the graduated beam by a set screw, affords a means of balancing the beam when the machine is at rest, and the weight *W*, like that of a common balance, moved on the graduated arm of the lever, will indicate the strain upon the belt. The number of pounds thus indicated multiplied by the number of feet through which the belt moves per minute will give the number of pounds raised one foot high per minute. The product divided by 33,000 gives the horse-power expended in driving the machinery.

A worm, *Y*, on the end of the shaft *C*, is made to move an index which shows the number of feet through which the belt or surface of the pulley moves in a given time.

Fig. 179.



Balance Plow.

Bal'ance En'gine. A name applied to a form of steam-engine which has two pistons acting in opposite directions in the same cylinder. For instance: —

Wells . . "*Engineer*," * xlvii. 332.
"*Scientific American*," xxxv. 281.
"*Engineering and Mining Journal*," xxvii. 237.

Bal'ance Plow. A plow used in steam culture. The ends are duplicates, one balancing the other, as shown in Fig. 179. The implement is drawn across the field, back and forth, without being turned at the ends. When it reaches the end of its course the plows are lifted from the ground and the other set lowered to do the plowing on the return trip. See STEAM PLOW, pp. 2354–2356, "*Mech. Dict.*," *et infra*, for installation and method of working.

Bal'ance-wheel Turn'ing Ma-chine'. A machine-tool for the automatic turning of the circular rims of balance wheels, such as are used upon sewing-machines and other light machinery. The work is performed by two tools operating upon opposite sides of the wheel at the same time. These tools are automatically revolved in a horizontal plane, about the rim of the wheel, in opposite directions, so that one-quarter revolution of each tool-post completes the half-circle, and then both spindle and tool-posts cease revolving.

The centers around which the tool-posts revolve are adjustable, and allow a variation in the size of wheel to be turned, of from 6″ to 7″ in diameter. This adjustment is made by simply turning a screw. The feed-works are inclosed in the base of the machine, and are readily accessible for oiling, etc. The cone has two speeds.

See "*Scientific American*," * xxxviii. 271.

Balance-wheel adjusting apparatus.
Ide . . . . . . * "*Scientific American*," xlii. 307.

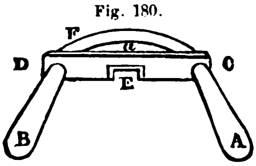
Ba-la'ta. The gum of the *Achras dissecta* of the family Sapoteæ (Mex. Zapotl) found in Guiana, and having properties similar to gutta percha. It may be vulcanized by digesting with sulphur.

Bald'win Bit. (*Manége.*) A bit having two mouth-pieces, the inner one working on levers; claimed to possess superior advantages over others for driving horses that are hard to control or have bad or vicious habits.

Ba-leen'. Views and diagrams showing the manner in which the baleen (whalebone) is arranged in the head of the whale (*Balæna mysticetus*) were given in "*Land and Water*," 1877, and republished in "*Scientific American*," xxxviii. 88.

The house of Meyer, in Hamburg, is probably the largest manufacturer of whalebone wares and walking-sticks in the world. The value of the produce of the former in 1871 was £362,000, and the number of sticks and whips was 175,000 dozen, valued at £65,000.

Fig. 180.



Baleen Splitting-knife.

Ba-leen' Knife. A knife used in splitting the baleen into rods of the required size.

The baleen is held in a bench-vise and split in the direction of its fibers. The knife, Fig. 180, has a curved blade, *F*, in a metallic plate, *C D*, with handles *A B*. The knife-edge is parallel with the upper edge of the directing notch *E*.

Bale Hooks. 1. Large lifting-hooks suspended in pairs from the chain of a crane or winch. See Fig. 181.

2. Small hand-hooks, Fig. 182, used by 'longshoremen in handling bales.

Fig. 181.

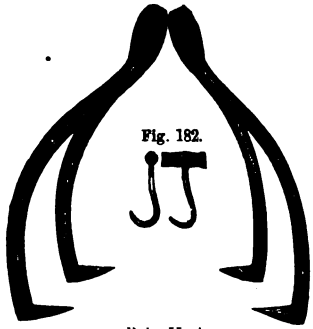


Fig. 182.

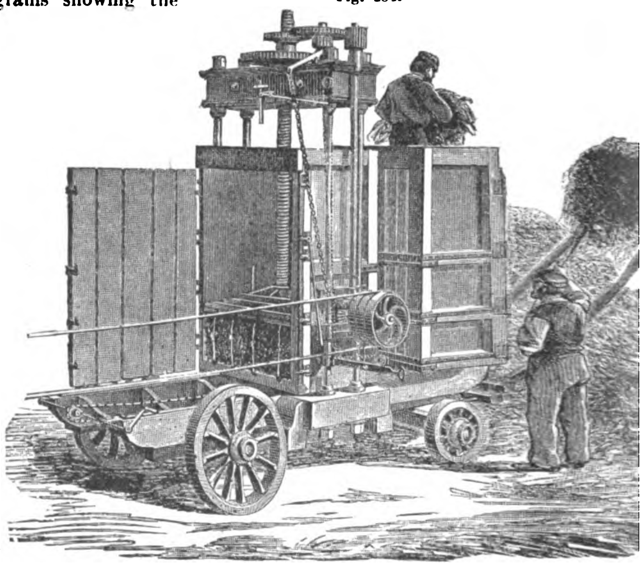
Bale Hooks.

Bal'ing Press. Two continuous baling press took high honors in Paris in 1878, — those of De erick and Dodge.

The former has a plunger or piston in connection wit reciprocating feeder, which drives a bunch of hay wit the range of the plunger before each stroke of the lat A certain quantity being thus compressed into a comp ment at the end of the chamber, is tied with wire dropped from the machine.

In the Dodge machine the hay is thrown loosely on feed-table or troughs in front of the press, whence teeth carry it right into the open mouth of the mac when it is seized by the revolving cones in the head- and drawn in from the feed-table in two continuous str and built up into a bale 26″ in diameter. The diamet the bale is never increased, but the bale grows long layer after layer is built up. In doing this the dens the bale is regulated by the friction-clutch, which has previously made tight. After the bale is built such

Fig. 183.



Mabille Frères' Hay Press.

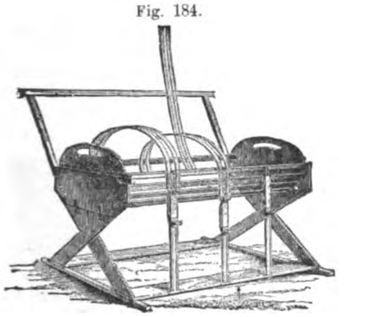
as desired, the action of the compress-screw is b play by simply shifting one cog-wheel, and in a the bale is compressed endwise and shortened about one-fourth or one-fifth its length without increasing its diameter. While the compression is going on, the man attending the press is passing around and fastening the two wires. When this is done, the pressure is released, the bale dropped out, and the press set for another bale.

Fig. 183 represents a baling press, made by Mabille Frères of Amboise, and worked by horse-power. The rotation of the band-wheel is transferred by bevel gearing to the vertical shaft, and that by spur pinion to the system of gearing on top of the machine, which is of different speeds and powers for rapid work at the first of the pressing, followed by slower and more powerful condensation as the truss approaches its final dimensions.

A multitude of small baling presses are used in France, both for packing rations for cavalry and for stowing away in convenient form for handling, the straw or hay of a farm.

One of the smaller kind is that made by Guitton of Corbeil, France. It has three pliable steel bands, which are

Fig. 184.



Guitton's Ration Press.

laid back against the bar (one is shown in this position) while the crate is being filled. The bands are then laid over, the ends brought down in front, and secured to hooks. These are forcibly drawn down by pressing the foot on the treadle, each band being in turn attached, a catch holding each firmly until the encircling cord is placed and tied. Each steel band being then released, the bundle is thrown out.

The machines make bundles from 30″ to 40″ long. A larger size, made on the same principle, but mounted on wheels, makes bundles of from 60 to 80 lbs. weight.

See baling presses, etc.: —

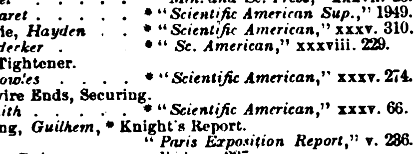
Ertel . . . . . * "*Min. and Sc. Press*," xxxvii. 25.
Albaret . . . . . * "*Scientific American Sup.*," 1949.
Bale Tie, *Hayden* . . * "*Scientific American*," xxxv. 310.
Roderker . * "*Sc. American*," xxxviii. 229.
Hoop Tightener.
Knowles . . . . * "*Scientific American*," xxxv. 274.
Bale-wire Ends, Securing.
Smith . . . . . * "*Scientific American*," xxxv. 66.
Trussing, *Guilhem*, * Knight's Report.
"*Paris Exposition Report*," v. 286.
Ration, *Guitton* . . . *Ibid.*, v. 237.

Balk. (*Agriculture.*) The space between rows of plants in a field, as of corn or cotton.

Bal'land. (*Mining.*) Derbyshire: Dusty lead ore.

Ball and Sock'et Coup'ling. A coupling which, by affording a joint, permits flexure.

Fig. 185.



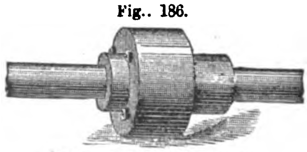
Ball and Socket Coupling. (Parts Detached.)

Figs. 185, 186, show a ball and socket coupling for line shafting, — a more compact device than the gimbal joint of the tumbling shaft.

It has not a perfect ball, but the leaves are the equivalent, and operate against plates in the case. The rounded edges of the leaves allow flexure without cramping. A divergence from the straight of 5″ in 12′ is readily permitted.

Ball and Sock'et Hang'er. One the axis of the opening in which is adjustable so as to be capable of being brought in line with a shaft.

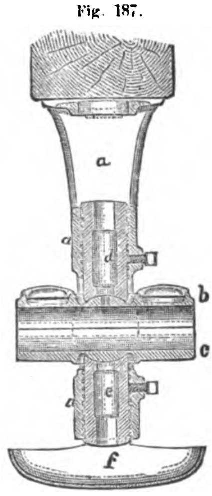
Fig.. 186.



Ball and Socket Coupling. (Parts Connected.)

In Fig. 187, *a* is the frame or hanger; *b*, the upper, and *c*, the lower portion of the box. This box is provided, top and bottom, with spherical surfaces, so placed as to be, in reality, portions of a sphere which has its center in the center of the axis of the box; *d* and *e* are what are called the plungers. These are screwed into the frame, and are provided with cup-shaped ends to clasp the spherical parts of the box. The box can rock to a limited extent in every direction in these cup-shaped ends. The plungers serve a double purpose: 1st, of providing the socket for the sphere to roll in; 2d, to permit of a vertical adjustment of the entire box to bring them in line one with another; *f* is an oil dish to catch the drippings from the box.

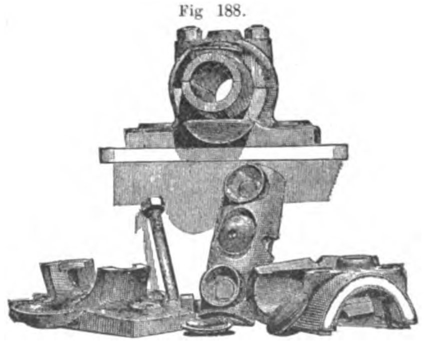
Fig. 187.



Ball and Socket Hanger.

Ball and Sock'et Pil'low-block. One which is capable, within certain limits, of accommodating itself to the line of direction of the shafting.

Fig 188.

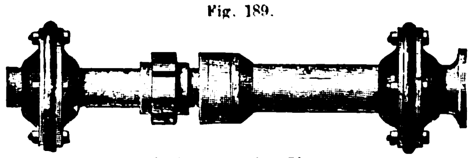


Ball and Socket Pillow-block.

Fig. 188 shows a ball and socket pillow-block, and beneath it are all the parts, detached.

Ball and Sock'et Pipe. One having a flexible joint which permits the sections to be laid out of mutual line.

Fig. 189.



Ball and Socket Pipe.

The illustration shows a pipe with two such joints, each inclosed with casing plates bolted together. The ball at the end of one section rolls in a spherical cavity in the other, as shown in section in Fig. 541, p. 219, "*Mech. Dict.*"; but in the present, each section is tubular.

Ball and Sock'et Truss. (*Surgical.*) One, the pad of which is attached to the strap by a ball and socket joint which allows the pad to adjust itself to the surface of the body.

Bal'last Ham'mer. A track-layer's hammer, having two rounded faces, and used in packing the ballast beneath ties, and also, on occasion, in driving spikes.

Fig. 190.

Ballast Hammer.

Ball-cock.

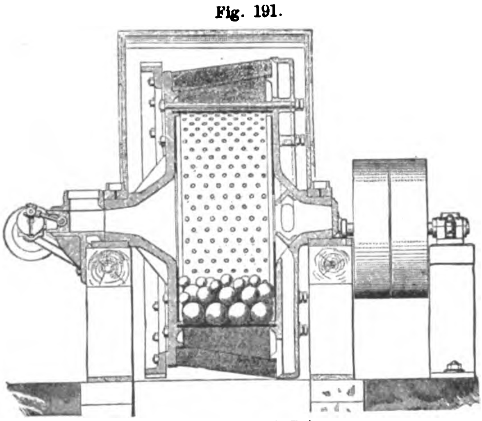
1. One in which a globular valve takes the place of a disk, spigot, sliding plate, etc., which are other forms of devices for closing an aperture in a pipe.

2. One opened or closed by a lever attached to a floating ball. See Fig. 234. See also p. 220, "*Mech. Dict.*"

Ball valve, Br. *Jefferies* . . . * "*Engineer,*" xlvi. 377.

Ball Grind'er. A pulverizer for minerals. It depends upon the attrition of spheres rolling inside a rotating cylinder, the periphery of which is provided with a cast-steel ring, perforated with

Fig. 191.



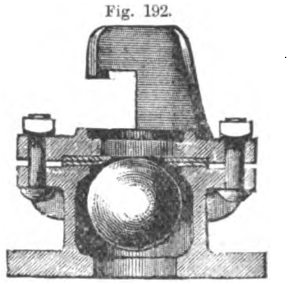
Brueckner's Ball Grinder.

small holes. The heads of the cylinder are made of heavy cast iron, lined with steel. It is filled with steel balls from 2″ to 5″ in diameter, in quantities of 1,000 to 1,200 lbs for a 48″ cylinder. The steel ring is the crushing plate upon which the balls, by a combined stamping and grinding action, break up the material to a size varying from a powder to the size of the holes of the ring. The broken material which has passed through the holes of the steel plate, is sorted by the first wire-screen, all that are larger than the mesh being returned to the grinding chamber by the passage shown on the right hand. This process is repeated on the second outer screen, which regulates the size of the final product, all stuff not coming up to the required degree of comminution also being returned to the grinding chamber.

"*Iron Age,*" February 20, * xxiii., p. 1.

Ball Hy'drant. One having a metallic box containing a self-acting globular valve of gutta-percha or material relatively lighter than water, so as to be normally closed against its seat by its levity, and more firmly by the pressure beneath it. The top of the box has two L lugs so as to form a bayonet-joint with the portable stand-pipe to which it is attached.

Fig. 192.

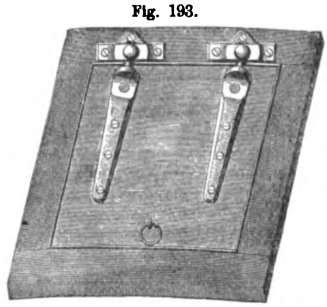


Ball Hydrant.

Ball'-joint Hinge. One having a flexible knuckle. In the form illustrated it is a hinge for a stern-post shutter; when made on this principle each can be adjusted, in fixing, to the bevel of the post, so that hinges from one pattern will answer for all the different rakes and bevels of the various posts. See Fig. 193.

Ball Mount'ing. (*Manége.*) A pattern of harness mountings having a ball at the point where the ring is attached to the base.

Fig. 193.



Ball-joint Hinge.

Bal-loon'. *Hartness's* sectional balloon, the parts resembling the lobes of an orange, was patented May, 1874. This is a substitute for the gores of which the balloon is ordinarily made, and prevents the puncturing of a section from being fatal to the whole. It is like making a ship's hull or a life-preserver in compartments.

See the following notices: —

Balloons . . . . . "*Scientific American Sup.,*" 792.
Giffard's Captive Paris, 1878. . * "*Scientific American,*" xxxix. 180, 154.
* "*Engineering,*" xxvi. 106, 231, 127, 214.
* "*Scientific American Sup.,*" * 726, 2021, * 2820.
"*La Presse Illustrée,*" ix., No. 539.
Captive "Pioneer" . "*Scientific American,*" xli. 32.
Captive, *Badgley* . * "*Scientific American,*" xii. 18.
Military, Eng. . . "*Scientific American,*" xxxix. 326.
Military, sectional . "*Iron Age,*" xxiv., July 31, 1.
Voyage to North Pole, proposed, Eng.
* "*Scientific American,*" xxxvii. 375.
* "*Scientific American,*" xli. 183.
On Aëronautics, *Gerner* "*Van Nostrand's Mag.,*" xix. 439.

Bal-loon' Bat'te-ry. (*Electricity.*) A form of Daniell's or Meidinger's battery in which an inverted flask forms a reservoir of crystals and liquid, the mouth of the flask being below the surface of the liquid in the cell.

Niaudet. American translation, * 101.

Bal-loon' Mus'ket. One for perforating balloons of observation. As specially made by Krupp for the German army it was designed to pick off the postal balloons from Paris during the siege of that city. It was a heavy rifle swiveled on a standard upon an artillery wagon. — "*La Nature.*" Its range enabled it at times to pick off balloons at 3,200 feet elevation.

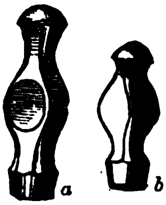
"*Scientific American Supplement,*" * 638.

Bal-loon' Tor-pe'do. A torpedo elevated and floated over an enemy by a balloon, and dropped by time arrangement (fuse or clockwork), or by means of electric connection through wire reaching from the point of dispatch.

" *Scientific American*," xxxvi. 404.

Ball'-peen Ham'mer. One whose peen is round, or ball-shaped. See PEEN, "*Mech. Dict.*"

Fig. 194.



Ball-peen Hammer.
a. Hand-hammer.
b. Riveting Hammer.

Ball Probe. (*Surgical.*) A urethral sound; a slight staff with a ball on the end. The *olivary bougie* or *bougie à boule* are of similar character but different proportions. Page ii., Part III., *Tiemann's Armamentarium Chirurgicum.*"

Ball Seat'er. A tool used in loading metallic shells, to place the axis of the ball accurately in line in its seat in the shell. See RELOADING TOOLS.

Ball Trim'mer. (*Cartridge-making.*) The balls after they come from the bullet machine are trimmed both side and end by this machine, working on the principle of the lathe.

Bal'us-ter Lathe. A lathe for turning articles of wood which have to be frequently repeated, such as ornamental stair-balusters, the legs of tables or chairs, bed-posts, etc. Between the headstocks a sliding-frame is arranged and fixed to suit the dimensions; this slide contains two knives, both the entire length of the article, the one knife to rough-out nearly to size in advance of the one to finish; both are set on the skew in order to take the work in detail; the first blade merely brings the piece of wood approximately to form, while the other blade is cut out exactly to pattern with all the irregularities of the required article. One passage of the slide with its two instruments in moving past the revolving article finishes the work.

Bam-boo'. A plant of the grass family. The tubular stem is of great use in the mechanic arts, and the splits therefrom are used in making mats, baskets, etc.

Bamboo, uses of . . " *Scientific American*," xl. 279.
" *Scientific American*," xlii. 240.

Band. The metallic cap on the outside of the hub or nave of a vehicle. Made of many fancy patterns for carriages of luxury.

Ban'dage. (*Surgical.*) A wrapping, support, or dressing of various kinds and uses. For instance (the figures refer to " *Tiemann's Armamentarium Chirurgicum*," Part IV.): —

Abdominal bandage, for supporting the abdomen after parturition, etc. Figs. 40–44.

Suspensory, for the scrotum. Fig. 46.

Umbilical, a truss for the umbilicus. Fig. 16.

Fracture, various in kind, material, and mode of application. Figs. 122, 123, 125–127.

Esmarch's tourniquet. Fig. 184.

Rubber, vulcanized gum cloth.

Roller, cloth in strips.

Plaster-of-Paris, cloth saturated with a thin paste of gypsum, placed on a part of the body to harden *in situ*.

Carbolized, saturated with solution of carbolic acid. See also p. 225, "*Mech. Dict.*"

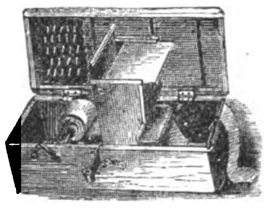
Ban'dage Shears. Curved-tip shears for trimming and cutting bandage cloth; or in cutting away portions of a plaster-of-Paris fracture bandage for inspection.

Figs. 165, 189, 202, 203, 204, Part IV., *Tiemann's* "*Armamentarium Chirurgicum.*"

Ban'dages, Plas'ter Spread'er for. The device, Fig. 195, is for simply rolling bandages, or to apply silicate of soda, dextrine, or plaster simultaneously with the winding process.

" *Medical Record*," October 13, 1877.

Fig. 195.



Dr. Greene's Bandage Winder and Plaster Spreader.

Band Cut'ter. A tool for cutting the bands of sheaves, when feeding to the threshing machine.

In the latest practice the band is of wire or string.

Graham and Haines . * "*Iron Age*," xxv., April 8, 9.
Chadbourne . . . . * "*Iron Age*," xxii., July 11, 20.

In some British threshing machines, the band is cut by a revolving knife in the floor of the hopper down which the sheaf slides into the throat of the threshing concave.

Ban'de-role. The flag formerly known by that name was a company color.

Band'ing Ma-chine'. (*Hat Making.*) A form of hat-body blocking machine specially adapted to make the *band*, the term used in the trade for the sharp angle at the junction of the side-crown and brim. See BLOCKING MACHINE.

Band'ing Ring. (*Hat Making.*) The circular band which grips the hat at the band; the angle formed by the side-crown and brim. It is used in hat-blocking machines.

Band In'stru-ments. See report on band instruments by *H. K. Oliver* on Group XXV., in vol. vii., " *Centennial Exhibition Reports*," p. 50.

Band Mount'ing. (*Manége.*) A pattern of harness the ring of which is broad and flat, with square edges.

Ban'do-leer'. A case containing a musket charge and fastened to the shoulder belt.

Band and Jig Saw Combined. (*Wood Working.*) A machine by Western & Co., of London, in which are provided alternative band and jig saws, each furnished with its own pulleys fixed and loose. The band is adapted to saw wood up to 10″ thick, and the jig up to 6″.

Band Saw. The band saw, consisting of an endless steel ribbon with serrated edge, is the invention of William Newberry, of London, England, and was patented in 1807.

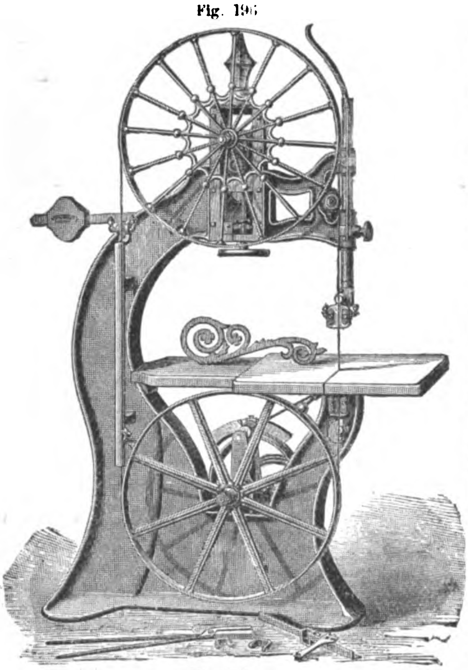
M. J. L. Perin, of Paris, France, overcame the difficulty which long prevented the invention from becoming of general utility, and his celebrated blades are yet unsurpassed.

" Analyzing the peculiar principles of action of the band saw, it may be said to have a blade of superior thinness, capable of tension in varying degrees, moving in right lines through the material, at a speed that is almost unlimited, and capable of exceeding that of circular saws; operating too by machinery consisting only of rotating parts, and of the most simple construction, the sawdust all carried down through the timber, offering no obstruction in following lines.

" Add to this the peculiar adaptation of the band saw to curved lines, and its advantages cannot be over-estimated. The speed of sawing, or the cost of sawing, which is much the same thing as the movement of the teeth, is with the band saw almost unlimited. Its performance, contrasted with reciprocating saws for cutting plain sweeps or scroll work, shows a gain of time, or cost, of three or four to one, with the important advantage of being easier to operate." — *Richards*.

The latest form of band saw is shown in Fig. 196. The machine has a planed iron table pivoted for bevel sawing; a shipper with frictional brake, for arresting the motion of the saw; a vertical guide bar with retracting spring, for instantly adjusting it to the desired height; an elastic steel upper wheel; cast steel shafts, with self-oiling boxes and adjustments to take up the wear; and methods of

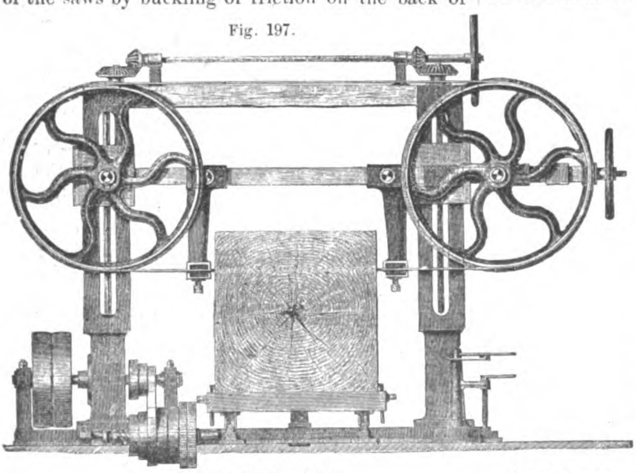
Fig. 196.



Band Saw.

keeping the saw at its proper tension, allowing at the same time flexibility to the parts, to compensate for any sudden impact, and prevent breakage of the saws by buckling or friction on the back or

Fig. 197.



Horizontal Band Saw.

sides. The weighting device gives positiveness to the amount of tension the saw is receiving, at the same time compensating for any variation in the length of the saw by change in temperature, or strain. Friction guide-wheels receive the back thrust of the saw, and wooden guides are provided at the side.

The following references to Band Saws may be consulted: —

Bentel, Margedant & Co. * "*Engineer*," xli. 409.
* "*Man. & Builder*," viii. 129.
Clement . . . . . * "*Man. & Builder*," xi. 184.
Fay & Co. . . . . . * "*Thurston's Vienna Rept.*," iii. 259.
* "*Engineer*," xli. 463.
* "*Sc. American*," xxxvii. 310.
Resawing Machine, *Fay* . * "*Sc. American*," xxxv. 31.
Hand power, *Frank* . . * "*Sc. American*," xliii. 387.
* "*Man. & Builder*," xi. 58.
For timber, *Furness* . . * "*Engineering*," xxvii. 235.
Foot power, *Kimball* . . * "*Iron Age*," xxiii., May 29, 1.
London, Berry & Orton * "*Sc. American*," xl. 1.
Margedant . . . . * "*Sc. American*," xxxiv. 70.
Newberry (1808), Br. . * "*Engineering*," xxix. 43.
Perin, Fr. . . . . . * "*Thurston's Vienna Rept.*," iii. 284.
Perin, Pauchard et Cie. * "*Engineer*," xlvii. 293.
Polyblank, Br. . . . * "*Engineer*," xlvii. 171.
Ransome, Eng. . . . . * "*Thurston's Rept.*," iii. 266.
Richards, London & Kelly * "*Thurston's Rept.*," iii. 254.
Rogers . . . . . . * "*Engineer*," xlvi. 134.
Whitney . . . . . * "*Thurston's Rept.*," iii. 253.
Worssam, Br. . . . * "*Engineer*," l. 245.

Band Saw′-mill. The band saw has been applied to the sawing of logs into boards, and the resawing of timbers. Three illustrations are given of English, French, and American machines respectively.

The horizontal band saw of Western & Co., of London, is shown in Fig. 197. It is shown as splitting into heavy balks a log already squared and mounted on a horizontally moving carriage. The saw wheels are simultaneously adjusted for height by a single wheel: for tension, by adjustment of the right-hand wheel. The saw guides are separately adjustable to the vicinity of the log.

Plate III. shows the band saw-mill of Arbey, of Paris. It has a continuous roller feed, pivotal table for bevel sawing, and the various adjustments for tension of the blade, elevation of the guide, approach of the feed rollers, etc.

Fig. 198 shows by side and end elevations the band-saw mill of Richards, London & Kelly.

It has wrought iron wheels 72″ in diameter, receives blades 45′ long to 5″ wide, and is shown operating upon a small round log. The wheels are covered with wood and faced with leather or gum: the upper one has an adjustment of 18″, the supports resting on springs which equalize the tension of the blades. The Perin saw blades are used. The wheel is carried on a steel shaft 3½″ in diameter, with brass bearings.

The guide stem is 3½″ diameter, of wrought iron, counter-balanced, and supported in iron brackets bolted to the main column. The lower guide is also mounted on an iron bracket, connected to the main column, and has no attachments to the floor. The lower or main shaft is 4½″ diameter, with bearings 12″ long. The tight and loose driving pulleys are 30″ in diameter, 10″ face. Thermatic oilers are applied to the bearings.

Band′-saw Hold′er. An apparatus (Fig. 199) used in brazing band saws. It consists of a holding device and brazing tongs.

File a taper for, say ½″ on each end of the blade, so that when brought together the ends will be of even thickness with the rest of the saw. When adjusted properly, so that the teeth will match, clamp in the scarfing frame, so that the ends will be pressed together. Wash the saw and solder with acid, place a slip of solder between the laps of the saw, heat the welding tongs, grasp the joint, and when the solder is melted allow the saw to cool gradually.

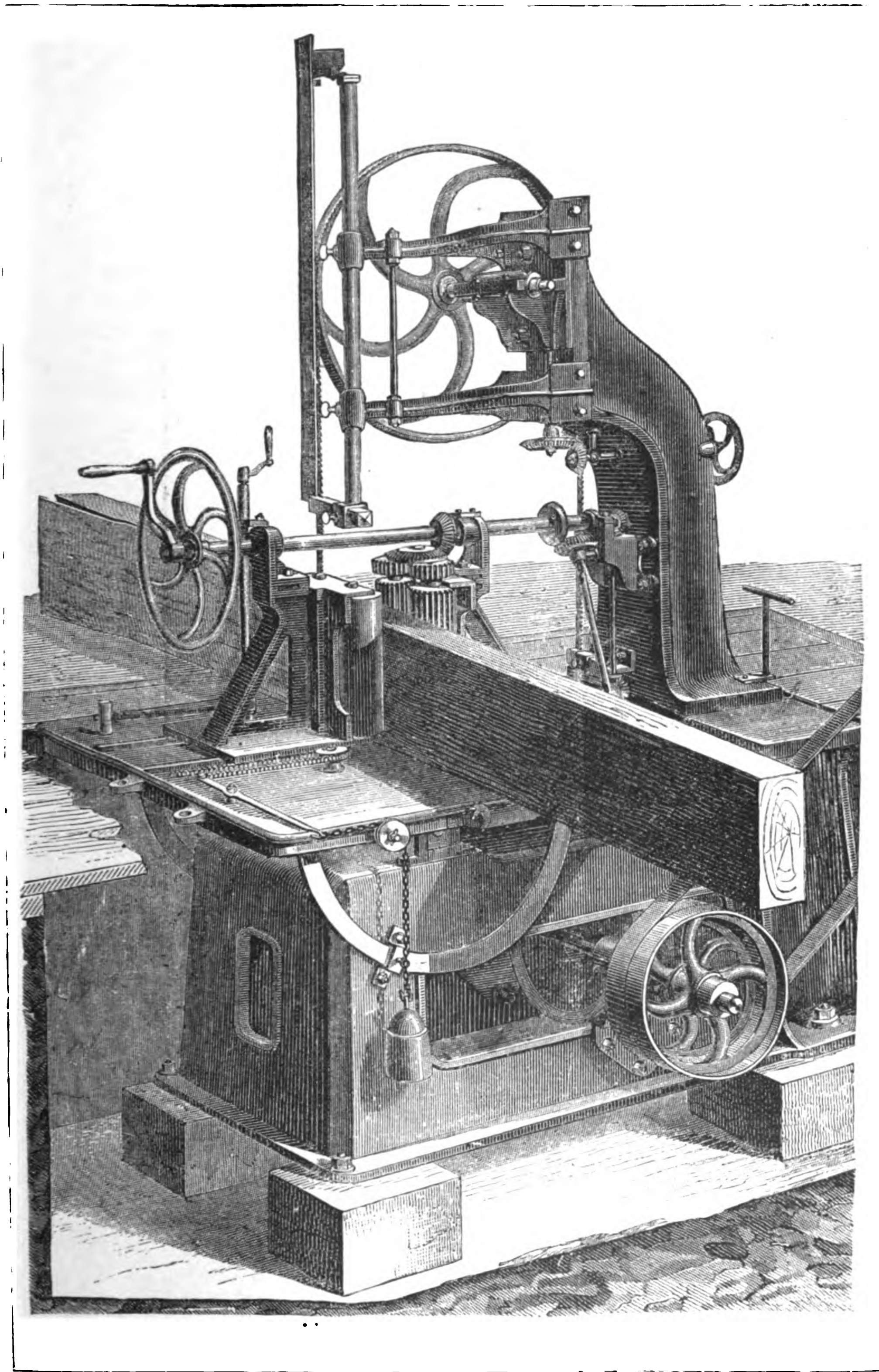
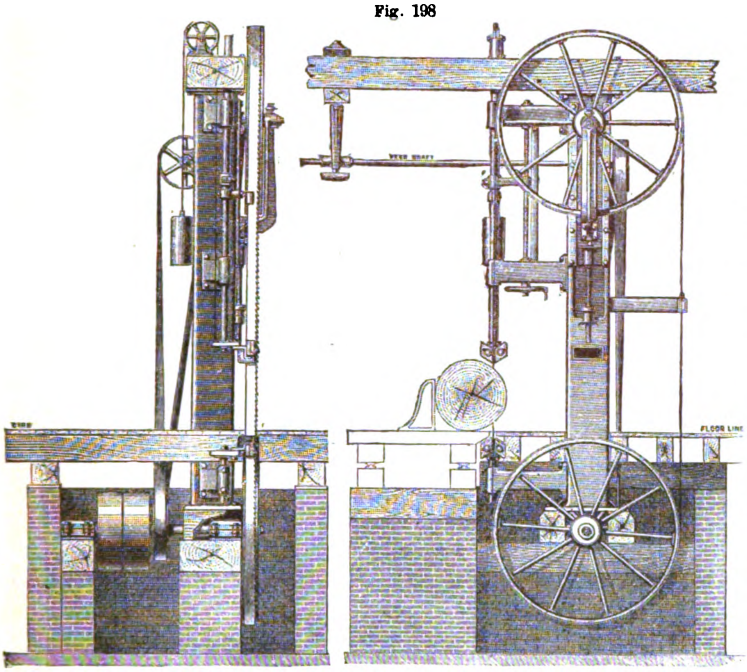


PLATE III. BAND SAW-MILL, BY ARBEY OF PARIS. See page 72.

Fig. 198



Band Saw-mill.

Band'-saw Set'ter. Fig. 200 is Richards' band-saw setting machine and filing frame.

The setting is done by a hammer in the hand of the operator. The saw is strained and passes between two steel blocks, feed is imparted to the saw by a pawl, operated by the hammer handle. Every blow of the hammer sets a tooth, and the setting can be done at the rate of about 6′ per minute. The feed is adjustable to any pitch of tooth in an instant.

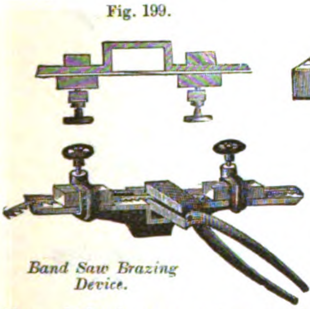
The machine is wholly of metal, except the rims of the wheels. The vise is arranged to close instantly for a length of 24″, by means of cams on the front.

Fay & Co.'s band-saw setter is a machine of similar character, the saw being strained upon the wheels and passing between the jaws of the setting machine. The feed pawl feeds two teeth at a time.

Band'-saw Sharp'en-ing Frame. A frame in which band-saws are stretched, and each portion of the blade clamped in turn, in order that it may be sharpened. When the clamp is slackened, the rotation of the crank brings a new portion of the blade within the loosened jaws of the clamp. See Fig. 201.

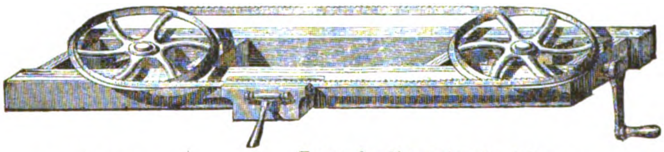
Band'-saw Tongs. A pair of flat-lipped tongs which are heated sufficiently to melt silver solder, and then clasped over the scarfed and matched ends of a band saw, to melt the film of solder placed between the lapping edges. Shown in BAND-SAW HOLDER, Fig. 199.

Fig. 199.



Band Saw Brazing Device.

Fig. 201.



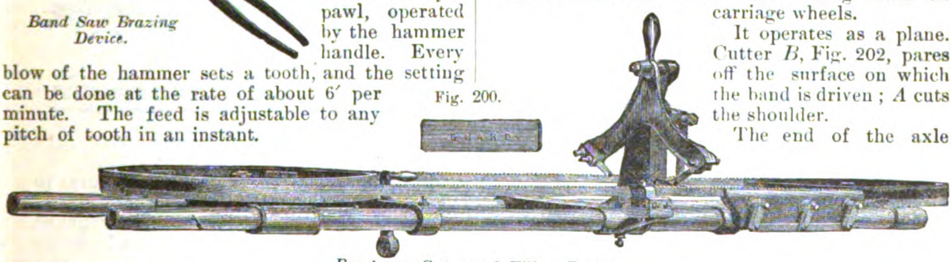
Frame for Sharpening Band Saws.

Band Set'ter. A tool for setting bands on carriage wheels.

It operates as a plane. Cutter *B*, Fig. 202, pares off the surface on which the band is driven; *A* cuts the shoulder.

The end of the axle should be raised so that the wheel can be made to revolve rapidly, and then, while the wheel is in motion, hold the plane to the hub until it is shaved off sufficiently to drive on the band.

Fig. 200.



Band-saw Setter and Filing Frame.

Fig. 202.

Band Setter.

Bank'-note En-grav'ing. The subject is considered on pp. 228, 2368, 2369, "*Mech. Dict.*"

Mr. George W. Casilear, Superintendent of Engraving in the United States Treasury, Bureau of Engraving and Printing, describes an improved method for engraving denominations or lettering upon lathe-work counters, used on bonds, bank notes, and other securities, by the transfer process: —

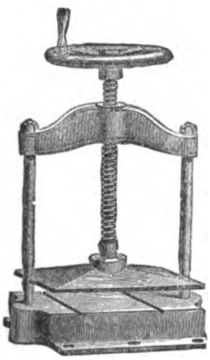
"Instead of proceeding as heretofore by hardening the die laid down from the shell, and taking up a roll for cutting out the white figures or letters, and then hardening the roll and laying down a second bed-piece for finishing with the graver, then in turn taking up a second roll called the finished roll. My improvement consists as follows, in taking the original die as made from the shell, and transferring with my numeral or alphabet rolls directly upon the face of the lathe work the required denomination or lettering. The parts of the lathe-work appearing over the face of the figures is then scraped and burnished away and a new surface gained, by having the die or plate set up from the back in the usual manner known by engravers and transferrers, using the precaution to have a bit of paper between the anvil and plate to protect the lathe-work, the paper only to cover those parts of the lathe-work which are to appear intact.

By this improved process a roll is saved, also a bed-piece, and the lathe work is purer and sharper, being transferred direct from the shell while there is no engraving of the denomination or figures on the die or plate, as the work is all done by the transferrer. The result being more perfect, and a great saving of cost."

Bank'-note Pa'per. See SAFETY PAPER.

Bank'-note Press. One for pressing and packaging bank notes. It has grooves for cords in the bed and follower, so that the notes may be tied up before the platen of the press is raised.

Fig. 203.



Bank-note Press.

Ban'ner. Formerly, the small, square flag of a knight, and charged with his arms.

Ban'ner Net'ting. For painted signs or banners to be hung across a street. The open work avoids injury by the wind.

Bar. Bars of furnaces are *bearer* bars, and *grate* bars; the former hold up the latter, and these the fuel.

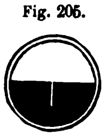
Bar and Open Bead Sight. (*Rifle.*) A form of sight in which the *aperture* is supported on a segment plate in the ring. Fig. 204.

Fig. 204.

Bar and Open Bead Sight.

Bar and Slit Sight. (*Rifle.*) A form of sight having a plate with a vertical slit. Also called a *slit-bar sight*. See Fig. 205.

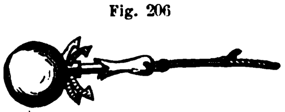
Fig. 205.



Bar and Slit Sight.

Barbed Shot. (*Life-saving Apparatus.*) A ball having grapnels attached and intended to be fired from a mortar to carry a line between a shore and a stranded vessel, or *vice versa.*

Fig. 206

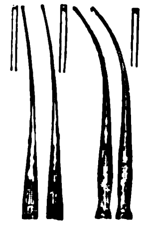


Barbed Shot.

Otherwise known as an ANCHOR-SHOT, or GRAPPLE-SHOT, which see.

Barbed Sca'ler. An instrument, Fig. 207, designed to pass between and around the necks of teeth which are loosened by old deposits of tartar. Being in pairs, with the barbed edges on opposite faces, they admit of application right and left, and on proximate surfaces. While holding the tooth with the finger upon it firmly in the socket, they can be used either by pushing to scale with the chisel edge, or by making the draw-cut with the barbed edge.

Fig. 207.



Dentist's Scalers.

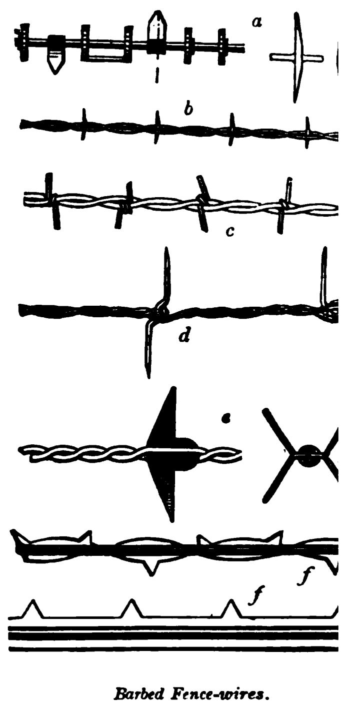
Fig 208.

Barbing Pinc[h'ers.]

Barb'ing Pinch'ers. A tool especially adapted for closing and clinching wire staples upon fence-wire.

Barb Wire. Wire with iron spikes [...] clinched upon it, to prevent breaking [...] when strung between posts as a fence.

Fig. 209.



Barbed Fence-wires.

Fig. 209 shows the prominent feat[...] history of the barb wire.

The upper illustration, *a*, shows the H[...] rough and incomplete invention, but in[...] bottom idea, *i. e.*, a fence wire provided[...] or barbs. Spur wheels or single spurs [...] attached to the wire.

b. Shows the next step, Kelly's pate[...] pointed spurs are strung on the wires [...] place by twisting a second wire around [...]

Glidden, *c*, substituted for the sheet-[...] a barb of wire twisted about one strand [...] place by the pressure of the other. [...] of modifications of this idea is extremel[...]

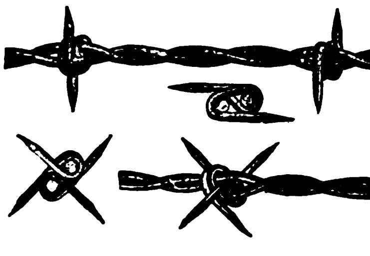
Haish, *d*, is the pioneer in that for[...]

with specially wrapped wires, the conjoined ends are hooked together and form projecting spikes.

Frentress, *e*, is probably the pioneer in that class in which separate sheet-metal plates, so cut as to have projecting barbs, are wholly fastened to the rod by twisting the wire.

In *f*, Allis's, the material is a rod with two flanges, one of which is cut into spurs and spaces, and the whole, being twisted, presents the barbs on all sides.

Fig. 210.



Two-spur and Four-spur Barb Wire.

Fig. 210 shows the barb wire in two forms, two-pointed and four-pointed. Each is shown in perspective and in cross-section. The cable consists of two strands twisted together, and the barbs are fastened between and around both strands, and their points stand out at right angles to the cable. The wire is painted, galvanized, or japanned.

Bar'-cut'ting Ma-chine'. A heavy shears for cutting bar-iron.

Ba-rege'. (*Fabric.*) A French worsted dress goods, woven on a gauze or open taffeta loom, and having a cotton warp and an English wool weft. Usually printed.

Bar'-i-ron Test'er. A form of machine for testing bar-iron. See TESTING MACHINE.

Bark'ing Ma-chine'. Forsaith's barking machine for rossing logs for the making of wood pulp is an annular plate, set with plane bits, and revolving in a vertical plane.

	"*Manufacturer and Builder,*" * xii. 198.
Nomaison, Fr. .	* "*Engineering,*" xxii. 299.
Decorticator, Fr.	* "*Scientific American Sup.,*" 2478.

Bar'ley Fork. A four-pronged light-tined pitching fork, especially adapted for pitching unbound gavels of cut grain.

Bar'ley Hum'mel-er. A machine for taking the awns off the grains of barley.

Fig. 211.

Barley Hummeler.

The barrel is made of iron, and in it is a rapidly revolving spindle, furnished with knives so shaped as to feed the grain towards the exit.

Barm. Yeast. Sometimes used in the preparation of core-sand, to make it adhesive.

Barn-door' Hang'er. A suspending device for sliding-doors. See Fig. 1687, p. 721, "*Mech. Dict.*"

Anti-friction.
Brown & Curtis. . . * "*Iron Age,*" xx. p. 9, July 26.

Barn-door' Rail. The rail on which the sheave of a barn-door traverses. See Fig. 1687, p. 721, "*Mech. Dict.*"

Bar Net. (*Fishing.*) The intercepting portion of a net set across a stream to direct fish into a wing pound. See STAKE-NET.

Ba-rom'e-ter. An instrument for determining the weight or pressure of the atmosphere.

In *Deschanel's* "*Natural Philosophy,*" Part I., may be found illustrations of the following barometers on the pages noted. (American edition.)

Torricelli's	110	Sympiesometer . .	156
Fortin's	147	Aneroid	157
Tripod	149	Counterpoised . .	159
Siphon	154	*Fahrenheit's* . . .	160
Wheel	155		

The "Farmer's Weather-case," or Indicator, and direction for its use, furnished in the circular of the United States Meteorological Signal Office, is shown in "*Harper's Weekly,*" supplement of September 21, 1878.

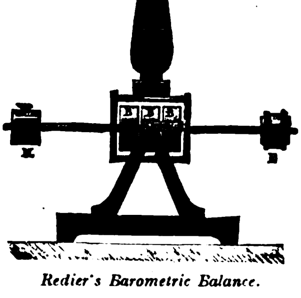
The following references may also be consulted: —

Green	* "*Manufacturer and Builder,*" ix. 61.
Dalton	* "*Scientific American Sup.,*" 742.
Glycerine, *Kew* . .	* "*Scientific American,*" xliii. 134.
Mariotti	* "*Engineering,*" xxiii. 314.
Optical	* "*Scientific American,*" xxxiv. 148.
Redier	* "*Scientific American Sup.,*" 574.
Registering, *Barnes*	* "*Scientific American,*" xxxiv. 308.
Water	* "*Manufacturer & Builder,*" viii. 37.
Barometer and Thermometer combined.	* "*Scientific American,*" xliii. 246.
Barometric Governor for Ventilating Fan.	* "*Engineering,*" xxviii. 354.

Works on the subject: —

Plympton's "*The Aneroid Barometer: Its Construction and Use.*"
Williamson "*On the Barometer.*"

Fig. 212.



Redier's Barometric Balance.

Ba-rom'e-ter Flow'ers. Artificial flowers colored with chloride of cobalt. When exposed to sun and dry air the leaves become deep blue; when the air is saturated with moisture they become pinky. Intermediate shades are easily observed.

Ba-ro-met'ric Bal'ance. An invention of M. Redier, of Paris. It has a long index-needle having an arc of vibration of large amplitude, 30 to 60 centimeters, which makes it visible at a considerable distance.

B B B are three aneroid barometer cases. To the first case to the left is attached a frame which carries the counterpoises M and E. On the same frame is fixed the large index needle. The whole apparatus pivots on a knife blade, T, and the counterpoises M and E being movable, the apparatus can be balanced in such a way as to cause the index to point to any division desired. The cases are attached to a second frame, V. When the pressure increases, these cases are expanded and the two counterpoises move toward the right. The equilibrium is thus broken and the needle moves toward the same side. When the pressure diminishes the contrary effect is produced, and the needle moves to the left.

Ba′ro-mo′tor. A portable hand and foot power invented by Bozerain (France). It has two treadles connecting with cranks on a fly shaft.

"*Manufacturer and Builder*" . . .	* ix. 280.
"*Scientific American*"	* xxxvii. 242.

Bar′o-met′ro-graph. (*Add.*) *Laboulaye's* "*Dictionnaire des Arts et Manufactures,*" iv., ed. 1877, article "*Météorographes,*" Figs. 1-7, gives descriptions of those of —

* *Bréguet.*	* *Gros-Claude.*
* *Hipp.*	* *Secchi.*

Bar′on Steel. (*Metallurgy.*) Steel made by the Mackintosh process, for which "Baron" is an adopted name. See Mackintosh Steel.

Bar′rage. A movable dam. Views of the barrages used in the river improvements between Paris and Auxerre, and a description of the substitution of a continuous navigation upon the upper Seine and Yonne by the aid of movable dams, for the intermittent navigation by flashes, are to be found in the report of Dr. Watson, "*Civil Engineering, Public Works and Architecture;*" "*Vienna Exposition Reports,*" vol. iii., section C, chapter V.

Poirée's movable dam or barrage, at Basseville, at the crossing of the Yonne over by the Nivernais canal, is shown in Plate IV.

"It consists of a succession of iron frames called *fermettes*, placed parallel with the current, and turning around their bases in bearings which are firmly attached to a carefully-prepared bed. The *fermettes* are united above by bars, having jaws or catches at their extremities. Against these *fermettes*, thus united, rests a screen, placed vertically, and composed of a number of wooden battens about 0.075 meters square and 2 meters long, called needles; the bottoms of these needles are placed against the sill, and their tops rest against the *fermette* bars placed near the level of the water, which the *barrage* is intended to maintain. Each *fermette* is trapezoidal; the two bases are horizontal. The lower base is terminated by gudgeons, which are received by two cast-iron bearings. The upper bases support a foot-bridge, used by the lock keeper to work the *barrage*. The details of the hooks, bars, washers, etc., which serve to unite the *fermettes*, are shown in the lower portion of the plate. When it is required to open the *barrage*, the lock-keeper and his assistant remove the needles one by one; the bars, planks, hooks, etc., are removed, and the *fermettes*, turning on gudgeons at their bases, fall into a recess prepared for them below the level of the sill. When it is required to raise the *barrage*, the lock-keeper lifts the *fermettes* by grappling for them under the water, reconstructs his foot-bridge, and replaces the needles. The time required to raise the *fermettes* and place the needles, is about one and a half minutes per running meter; and the time to open the *barrage* thirty seconds; for the complete opening and lowering of the waters fifty seconds." — *Poirée.*

Formerly, during the low water season on the Yonne, the navigation was intermittent, and took place by a system of flashing, which may be thus described: In the upper parts of the river, the water was accumulated by movable dams; a part of one of these dams being suddenly removed, an artificial flood called an *éclusée*, or flash, was formed. Barges and rafts, previously collected above the dam, were carried by the flood down the river with a velocity of from 0.50 m. to 1.50 m. per second.

In Plate IV. the upper figure shows the plan of the crossing of the Yonne River by the canal at Basseville.

Next beneath is an elevation of the barrage, showing half the barrage close fermettes raised, and the other half close fermettes lowered.

Next, a plan of the same.

Next, a transverse section on a mucl scale, showing the needle, the fermette an ings.

On the left, at the bottom of the plate tion and plan of the details for unitin fermettes.

On the right, beneath, transverse se plan of the gudgeons and bearings of a f

Plate XIV. of Dr. Watson's report a gives details and drawings of Chan rage dam at Port à l'Anglais, on the S Paris.

See also article "*Barrage,*" vol. iv., "*Dictionnaire des Arts et Manufactures,*"

Barrage, Godavery, India,	* "*Engineering,*" xx
Barrage, Nile	* "*Engineering,*" xx
	* "*Engineering,*" x 218, 245.

See, also, references under Dam.

Bar′rel. 1. A cask.

The following references may be cons

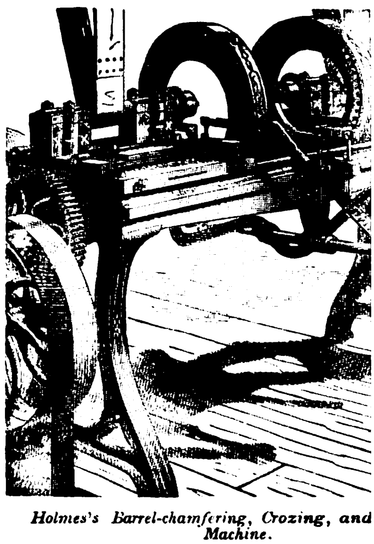
Barrel for shipping bottled liquors.	
Strauss	* "*Scientific American,*
Barrel head making machine, Eng.	
Worssam	* "*Engineer,*" xlviii. 3
Barrel-hoop, corrugated.	
Eiselein	* "*Scientific American*
Machine, *Holmes* . .	* "*Engineer,*" xli. 431.
Charring, *McNurtrie* .	* "*Scientific American*
Machine, *Monroe*. . .	* "*Scientific American*
Machine, Ger., *Guelph*	* "*Engineer,*" l. 266.
Machine, *Ransome* .	* "*Engineering,*" xxi.
Barrel machinery, on.	* "*Engineering,*" xxi.
Windlass, *Holmes* . .	* "*Engineer,*" xli. 431.
Cask washing machinery, Brewery (3 Figs.). A	* "*Engineer,*" iii. 404.

2. A description of the mode of manu the proving of rifle barrels may be seen *tific American Supplement,*" * 386.

Bar′rel Bolt. A form of door-bolt a round bolt moving in a cylindrical ca

Bar′rel-bor′ing Ma-chine′. (*Fir*

Fig. 213.



Holmes's Barrel-chamfering, Crozing, and Machine.

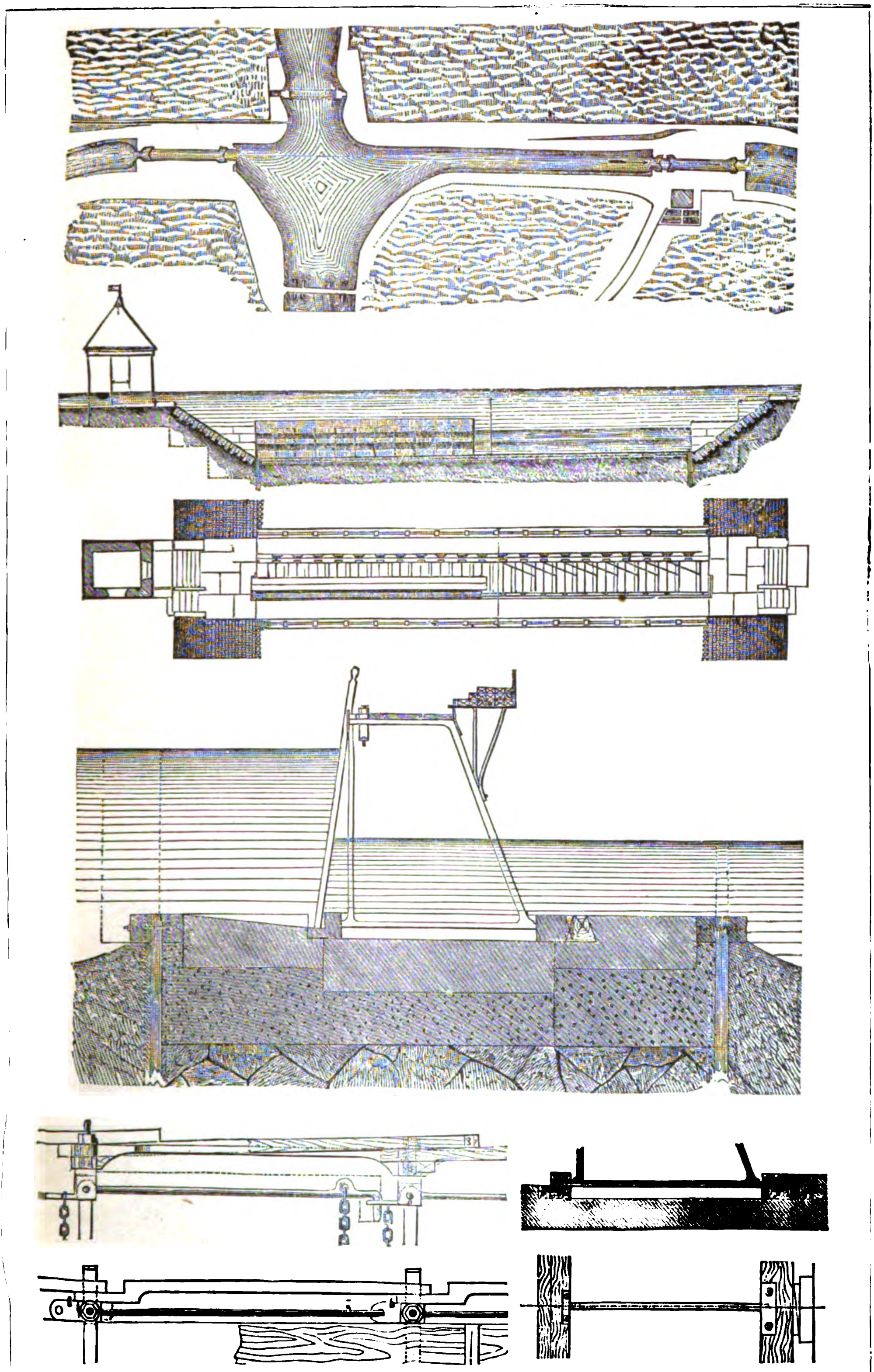


PLATE IV. POIRÉE'S BARRAGE, AT BASSEVILLE, RIVER YONNE, FRANCE. See page 76

lathe specially adapted to boring out gun-barrels. See RIFLING MACHINE.

Bar'rel-cham'fer-ing, etc., Ma-chine'. This machine is designed to chamfer, howel, level, and croze a cask of imperfect periphery, and to finish both ends of the cask at once. See Fig. 213.

To accomplish this, the three tools are placed in one revolving head, which, while revolving with high speed inside of the cask, is controlled by the rest upon the outside, compelling a uniform thickness and depth of chine, while it levels the same in a perfect manner; the rest and cutting head oscillating to conform to the outside irregular form of the cask while the latter makes one revolution; it having been placed within the chuck rings for that purpose.

All kinds of barrels, such as turpentine, oil, whiskey, pork, syrup, cement, sugar, flour, and other barrels, are made upon this machine, and it will finish any size desired by using the proper sized chuck rings. Rings for different sized barrels will fit the machine. The performance is 1,200 tight or 2,000 slack barrels per diem.

"*Engineer*," *xli. 431.

Bar'rel Clamp. A hoisting clutch or sling for barrels. The Yale barrel-clamp, "*American Miller*," vii. 275.

Bar'rel Cock. A faucet. The one shown is for racking, or drawing off the contents by pipe, the outer end of the faucet having a screw coupling.

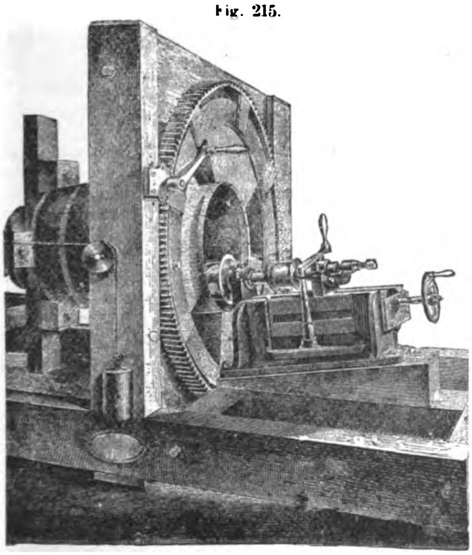
Fig. 214.

Barrel Cock, with coupling.

Bar'rel-cro'zing Ma-chine'. A machine for making the *croze* in the heads of casks. The *croze* is the groove in which the edge of the head is inserted and held. See BARREL-CHAMFERING MACHINE.

Bar'rel-fa'cing, Cro'zing, and Cham'fer-ing Ma-chine'. A machine for dressing the ends of casks, and making the head croze.

Fig. 215.

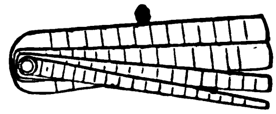


Barrel-facing, Crozing, and Chamfering Machine.

The machine shown is that of Arbey, of Paris. The cask is chucked in a revolving head, and each portion of the end circumference brought in turn against a rotating tool which planes and rounds the interior near the end, makes the croze groove, and chamfers the chine. The tool has all the requisite longitudinal and lateral adjustments.

Bar'rel Gage. A gage for testing the diameter of gun-barrels according to a standard; the instrument has several tapered slips, each graduated, and having a certain range of sizes, the diameter of the barrel being determined by slipping the gage into the muzzle.

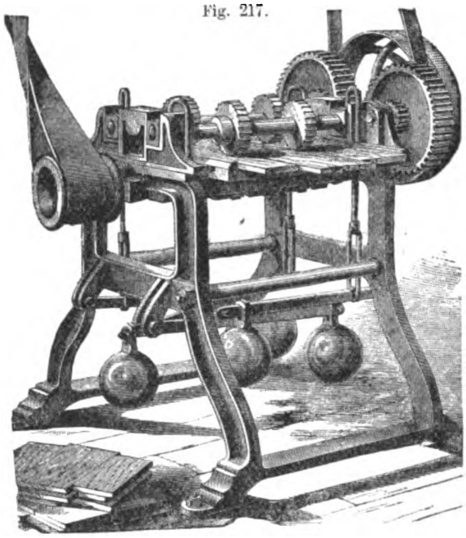
Fig. 216.



Gun-barrel Gage.

Bar'rel-head Dress'ing Ma-chine'. A machine for leveling, facing and dressing on one side the rough barrel-head, made of staves doweled together.

Fig. 217.



Barrel-head Dressing Machine.

The prepared head is laid on the table, is fed by four corrugated feed-rolls above, and its under side dressed by a planer cylinder rotated by a belt shown on the left hand. The pulleys on the right actuate the feed-rolls, which are held against the head by weighted levers acting upon the bearings. The revolution of the feed-rolls carries the head over the planer knives which smooth off the heads at the rate of 20 per minute, feeding rapidly in succession.

Bar'rel-head Joint'ing and Dow'el-ing Ma-chine'. A machine which dresses the edges of staves for heads, and bores the holes for the dowel-pins which hold the head-staves together.

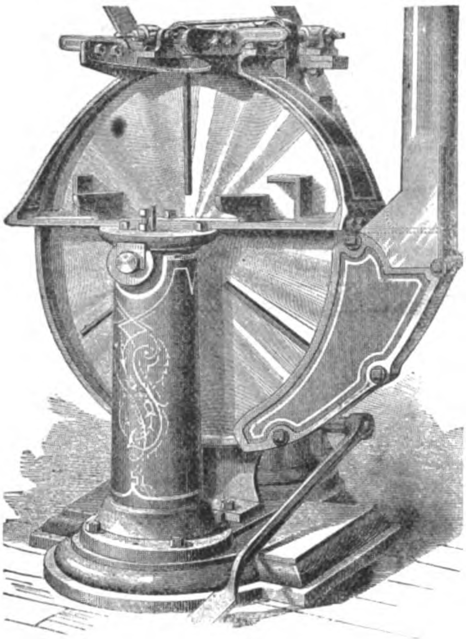
The machine, Fig. 218, has a metallic disk with three radial cutters which act upon the edge of a stave presented to them while lying upon the side-rest diametrically of the rotating disk.

The stave is then removed to the upper rest, and the two rotating augers which bore the dowel-holes are brought against it by pressing the foot upon the treadle.

Bar'rel-head Round'er. A machine (Fig. 219) which works upon the head-blank, rounding it and beveling the edge to fit the croze of the cask.

The head-staves, being jointed and doweled to-

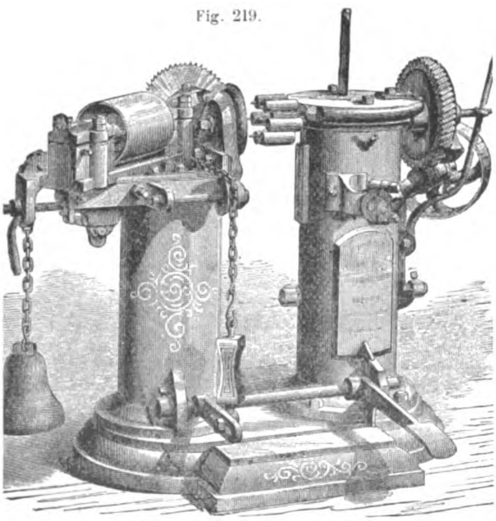
Fig. 218.



Barrel-head Jointing and Doweling Machine.

gether, are placed between the two clamps, one of which is on each side of the posts, so that the head, being in a vertical plane, revolves between them. This clamping is done by treadle, the head with pins being made to approach the round disk on the left. A circular saw brings the head to a round shape, and cutters chamfer the edge. This machine follows Fig. 217, the head dresser.

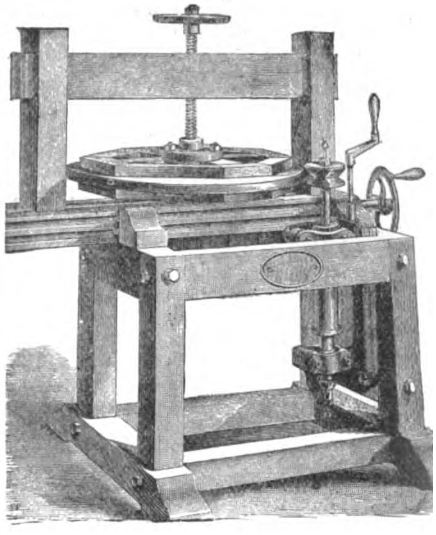
Fig. 219.



Barrel-head Rounder.

Bar'rel-head Turn'ing and Bev'el-ing Ma-chine'. Fig. 220 is a French machine for this purpose, made by Arbey of Paris. The head is carried in a frame, which has a horizontal adjustment to bring it in relation to the concave-faced revolving cutter, and is rotated, to bring each part of its periphery to the tool.

Fig. 220.



Arbey's Barrel-head Turner.

Bar'rel Hooks. Suspension hooks in pı for hoisting casks by the chines.

Fig. 221.

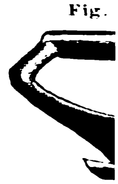
Barrel Hoo

Bar'rel Lev'el-ing Ma-chine'. A machine (Fig. 223) which brings the end of a cask or barrel to a level, that is, to a plane at right angles to the axis of the cask, so that it will stand squarely and vertically upon the floor.

Two end truss hoops are put on to the cask, which is then rolled into the press, the power applied, and the movable disk driven up against one end of it, bringing it into shape, leveling it and driving the truss hooŗ instant.

The machine has an iron frame, upon wh placed two leveling plates upon slides or and operated by cams. Two other plates ‹ are worked by cranks. Upon the latter aı drivers. The leveling plates are first m their cams, and then, while the cask is iı the hoop drivers advance and force all tl hoops to their places. The leveling plates ; ers then recede, and one barrel is discharged from the machine by the introduction of another. The capacity is from 4,000 to 5,000 barrels per day.

Fig.



Barr

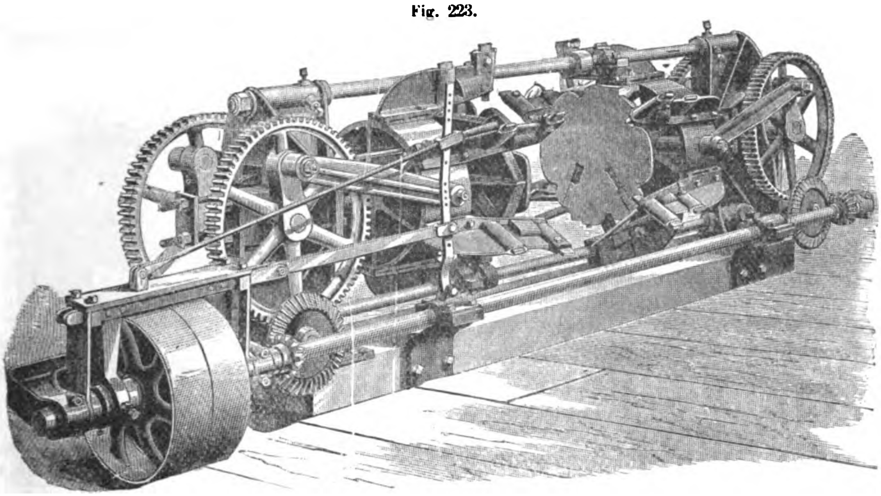
Bar'rel Lift'er. 1. A handled hook for lifting a cask by the chine. Used in warehouses, and for stowing away barrels and kegs in holds of vessels.

2. In another sense: an apparatus for hoisting barrels.

Brown . . . . "*Scientific American*," xli
German . . . . "*Scientific American Suppl.*

Bar'rel Mak'ing Ma-chin'e-ry. for making hogsheads, casks, barrels, anc

Fig. 223.



Holmes's Barrel Leveling Machine.

classed by size, by their nature, whether for *tight* or *slack* work, and whether for working on staves for sides or heads, for working on hoops of wood or iron, for putting up and finishing, etc.

Stave Machinery: —
Stave riving and sawing machines.
Dressing rived or sawed staves.
Stave jointing and listing.
Stave equalizer.
Stave saw.
Head Machinery: —
Heading saw.
Head turning machines.
Head dressing and leveling machines.
Heading jointing and doweling.
Head rounding machines.
Hoop Machinery: —
For punching, flaring, and riveting iron hoops.
For bending and rendering flexible wooden hoops.
Barrel Machinery: —
Power windlass, for putting up.
Chamfering, howeling, and crozing machines.
Leveling and trussing machines.
Truss-hoop driving machine.
Turning and smoothing machine.
Setting-up forms.
Barrel elevators.
Barrel heaters.

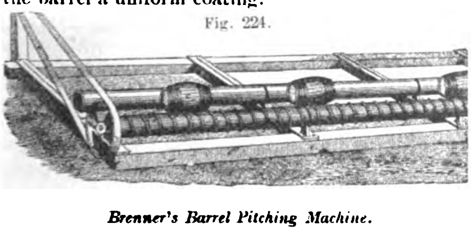
See under the various heads and in "*Mech. Dict.*"

Bar'rel Pitch'ing Ap'pa-ra'tus. An apparatus for pitching the interior of casks.

The machine (Fig. 224) is provided with two lines of rollers, one of which has a screw thread upon its periphery which imparts a lateral as well as rotary motion to the cask, which is placed upon and between the two rollers, and thus passed from one end of the machine to the other, the liquid pitch being distributed over its whole interior.

In Vollmer's apparatus for pitching barrels, the pitching material is placed in the barrel, which is made to rotate; a blast of hot air being forced in melts the pitch, and spreaders give to the inside of the barrel a uniform coating.

Fig. 224.



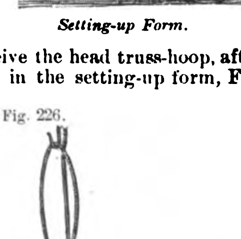
Brenner's Barrel Pitching Machine.

Bar'rel Saw. An annular or cylindrical saw for curved work.

See *Avrillon*, 2d Series French *Brevets*, vol. xxiv., pl. 2.

Bar'rel Set'ting-up' Form. An annular tray and elevated hoop for holding a set of staves while being placed in position to form a cask, shown in Fig. 225. The form is made adjustable, to suit the size and kind of barrel.

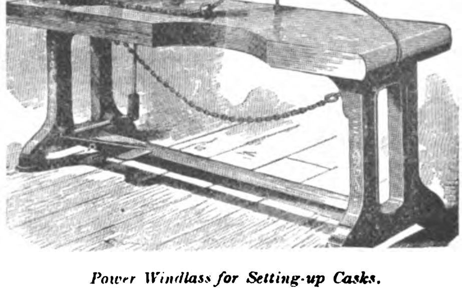
Fig. 225.



Setting-up Form.

Bar'rel Set'ting-up' Ma-chine'. A machine (Fig. 226) by which the ends of staves are drawn together, ready to receive the head truss-hoop, after they have been set up in the setting-up form, Fig. 225.

Fig. 226.



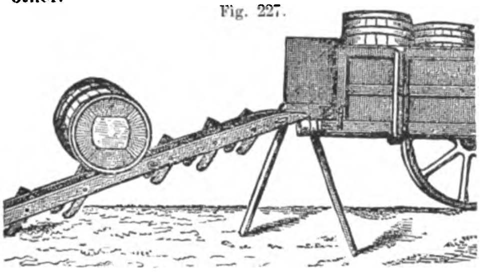
Power Windlass for Setting-up Casks.

The machine has a frame, upon which is planted a windlass operated by friction wheels and supplied with a rope.

The cask, having been set up with the ends of the staves in one head truss-hoop, is placed in the machine, and the rope wound around the flaring ends of the staves. The friction wheels are brought in contact, which starts the windlass and draws in the ends of the staves ready to receive the other truss hoop.

Bar'rel Skid. Fig. 227 shows a skid with pawls, which yield to the pressure of the cask in ascending, but oppose its return. The pivoted stops swing in one direction, but are locked in the other.

Fig. 227.

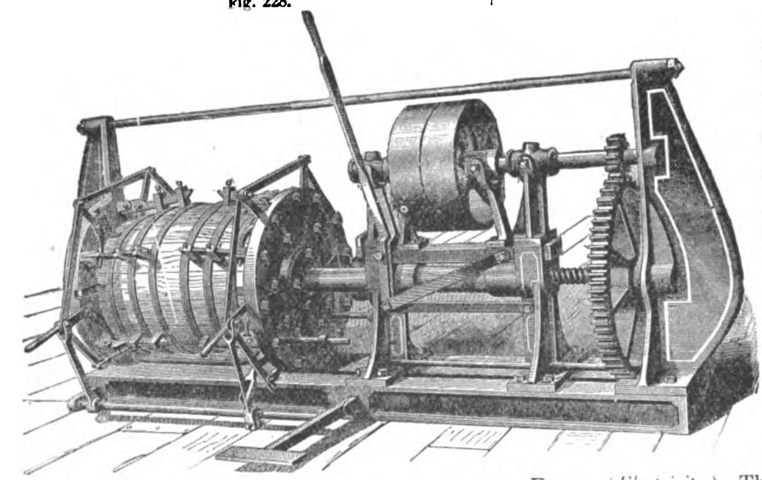


German Barrel-skid.

Bar'rel Stand. See CASK STAND.

Bar'rel Truss'ing Ma-chine.' A machine (Fig. 228) for operating upon slack barrels; compressing a barrel endwise to make it symmetrical and enable it to stand vertically when placed upon end, at the same time driving all the truss-hoops. The machine receives the barrel with all the truss-hoops upon it, but not driven; by placing the foot on the treadle and the hand on the lever, the machine being in motion, the drivers are brought in contact with all the truss-hoops, forcing them to their proper places and at the same time leveling the cask.

Fig. 228.

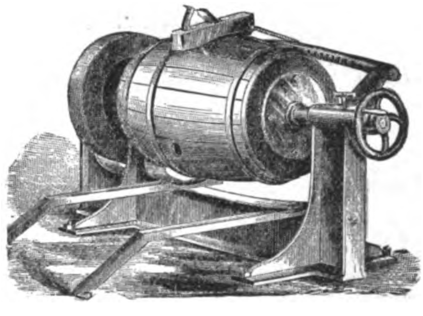


Combined Leveling and Truss-hoop Driving Machine for Slack Barrels.

Bar'rel Turn'ing Lathe. (*Fire Arms.*) See MILLING MACHINE.

Bar'rel Turn'ing Ma-chine'. A machine (Fig. 229) in which a barrel is chucked and revolved while the plane is kept in line by the back arm of the machine, the operator having only to guide it.

Fig. 229.



Barrel Turning Machine.

Bar'rel Wash'er. The barrel is placed on four adjustable supports and rinsed by jets of water from the pipe extending in at the bung-hole. (Fig. 230.) It is so arranged that when the barrel is placed on the supports the water-supply valve is opened; and is closed by means of a spring when the barrel is removed.

A more pretentious machine is that shown in Fig. 231, in which each barrel receives two motions, one on the axis of the chucks which hold it, and the other by the revolution in a vertical plane of the whole frame in which the barrels are held. The former motion throws the water from end to end and the latter from bilge to bilge.

Bar'ri-er. (*Mining.*) A strong pillar of mineral left between two mines, or between two distinct drifts or workings.

Bar'row. See —

Baggage barrow.	Dumping barrow.
Baggage truck.	Pump barrow.
Bloom truck.	Railway barrow.
Box barrow.	Sack truck.
Carboy barrow.	Stone truck.
Coke barrow.	Tub barrow.

See 24 varieties of French wheelbarrows in "*Scientific American Supplement*," * 2622–24.

Bar'row-way. (*Mining.*) An old term for a way in a working. Now *tram-way*.

Bar Shear. A heavy shearing machine for cutting bar iron.

Bar Weir. (*Fishing.*) A weir which is raised as the tide flows into a pond, estuary, or inclosed space; and drops automatically when the tide commences to ebb, thus preventing the return seaward of the fish.

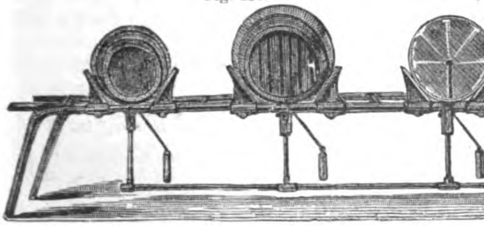
Base. (*Electricity.*) The part of an electro-magnetic instrument containing the helix, switch, primary and secondary binding posts, etc.

Base'-line In'stru-ments. For the measurement of the foundation line of a trigonometrical survey.

See p. 2461, "*Mech. Dict.*," and "*Report of Secretary of War*," 1878, vol. ii., Part III., p. 1401, *et seq.*, and Fig. 4.

Base Rock'er. A chair which rocks upon a base piece, having supporting casters.

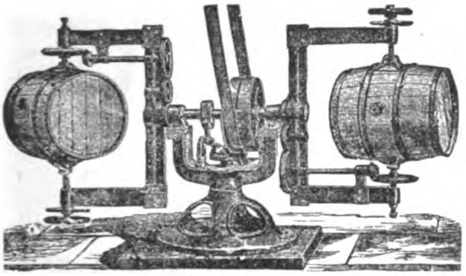
Fig. 230.



Zoller's Machine for Washing (Rinsing) Kegs.

Bas'ic Lin'ing. As applied in convertors or boshes of metallurgic furnaces; a lining which has a tendency to absorb the phosphorus present in the iron.

Fig. 231.



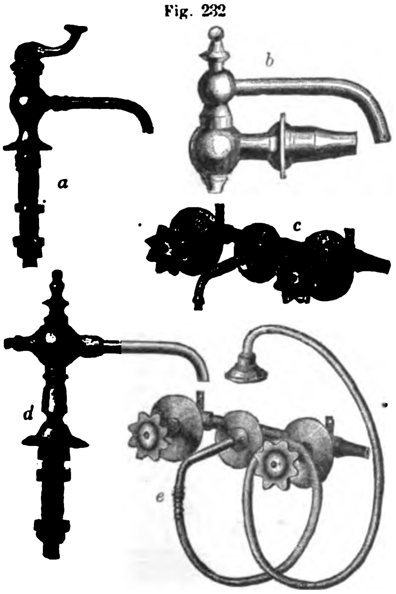
Barrel Washer.

In the Thomas furnace a basic calcareous or magnesian lining is used in the convertor, and lime, or lime and oxide of iron, is added to the charge of metal to insure a highly basic and calcareous slag, in which phosphorus is retained and by which it is removed.

Jacob Reese's Patent, 1866.

Thomas's British Patent, and United States Patent 216,910, June 24, 1879.

Fig. 232



Basin Cocks.

a. Telegraph basin-cock; on account of the shape of the trigger, resembling the key of the telegraph instrument.
b. Bracket basin-cock.
c. Combination basin-cock; for hot and cold water.
d. Ground basin-cock.
e. Combination basin-cock, with rubber tube and sprinkler, for shower-bath or shampooing.

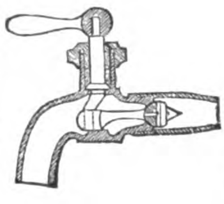
Ba'sin Cock. A faucet to a wash-basin. See Fig. 232.

Fig. 233 shows the positive self-closing cock, which has a spring to force the disk on to its seat, and is removable by pressing together the two horns. The pressure withdrawn, the spring recloses the valve-way.

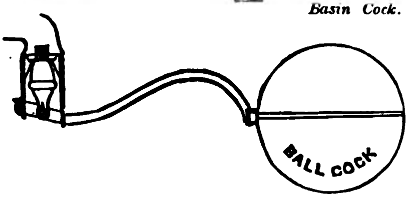
Fig. 233.

Fig. 234 shows the Fuller-Meyer basin cock, in which a conoidal plug of caoutchouc is forced into a conical opening while the pressure of the water tends to confirm the joint. Fig. 234 also shows a Fuller-Meyer ball cock, similar to the basin cock in the special feature mentioned.

Fig. 234.

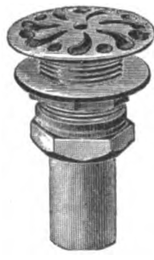


Basin Cock.



Basin Cock and Ball Cock.

Fig. 235.



Basin Grate.

Fig. 236.

Basin Plug.

Fig. 237

Basin Stopper.

Ba'sin Grate. A grated opening to the waste-pipe of a basin or bath-tub, opened by screwing up, and closed by the reverse motion. Fig. 235.

Ba'sin Plug. The stopper of a standing wash-bowl. Fig. 236.

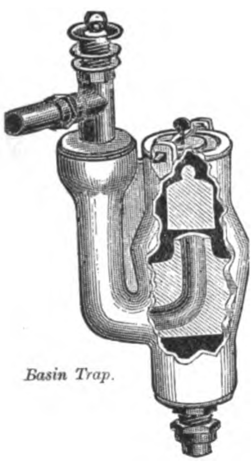
Ba'sin Stop'-per. A plug, Fig. 237, for the waste-pipe of a standing wash-bowl.

Ba'sin Trap. A seal against sewer-gas in the waste-way of a standing wash-bowl.

The arrangement shown in Fig. 238 excludes sewer-gas, whether water is in the trap or not, —

the porcelain valve seating itself upon the upturned end of the pipe.

Fig. 238.



Basin Trap.

Ba'sin Valve. A plug for the aperture at the bottom of a standing wash-basin.

See Basin Stopper.

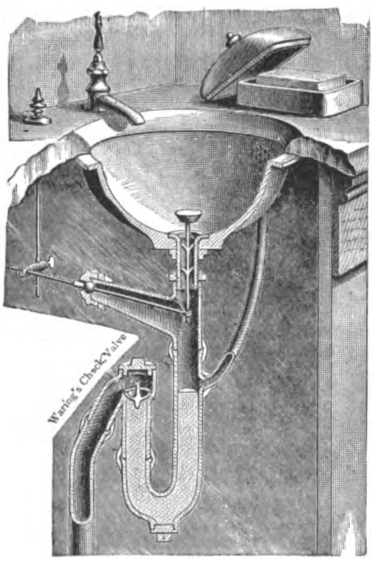
Ba'sin Waste. A pipe at the bottom of a standing wash-basin for the discharge of water. Stopped by a valve.

Fig. 239 is a substitute for the usual chain and plug for stopping the waste of wash-basins. Touching the knob on one side of the bowl opens or closes the valve.

The figure also shows a trap provided with check-valve to prevent passage of sewer-gas.

Ba'sin Wrench. A plumber's wrench with the nipper-jaws presented laterally to enable screws, nuts, and collars to be reached in peculiar situations.

Fig. 239.



Weaver's Basin Waste.

Bas'ket. (*Add.*) 2. (*Fabric.*) An all-wool fancy French coating.

Fig. 240.

Basin Wrench.

Bas'ket-rack. (*Railway.*) A receptacle in a passenger car for holding baskets, shawls, etc.

Bass Clar'i-net. (*Music.*) An instrument an octave below the clarinet, in B flat.

Bas'si-net. (*Fr., dim. of bassin.*) A light basin-shaped helmet without a vizor.

Bas'son-Quinte. (*Music.*) A double-strument, the diminutive of the bassoon, it being one fifth higher.

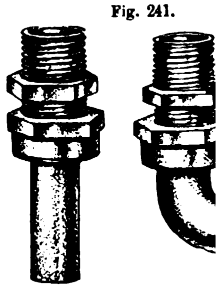
Ba-ta'vi-a Weave. (*Weaving.*) See Tw Armure.

Bath. 1. For bathing the person. See "*Mech. Dict.*"

Arrangement of building for Turkish baths. * "*Manufacturer and Builder*," ix.
Swimming Bath, London. * "*Scientific American Supplement*
Roman Bath. * "*Plumber and Sanitary Engineer*,'

2. Used in laboratories and factories fo ing the objects plunged therein. The reservoir may be a sand-bath, water-bath, oil-bath, mercury-bath, lead-bath, bain-marie, etc., according to circumstances.

Fig. 241.



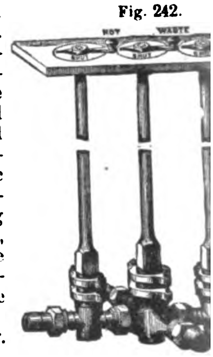
Bath-boiler Union.

Bath'-boil'er Un'ion. A coupling in the pipe uniting the boiler and the bath reservoir.

It is made straight or goose-neck, acco convenience.

Bath Cock. A faucet for bath use. In superior instances the arrangement has separate cocks for hot and cold water, and waste, with engraved labels. The cocks have gun-metal stuffing boxes, brass levers, union-joints, the water cock 1″ diameter, and the waste 1¼″.

Fig. 242.



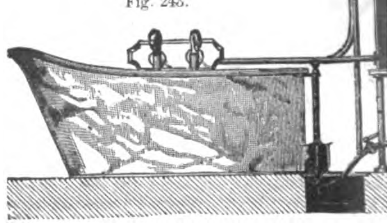
Bath Cocks.

Bath Heat'er. A special arrangement for heating baths, when it is not convenient to connec usual house service of hot and cold water

A small stove is surmounted by a flue, *A B*, Fig. 243, leading to the chimney. Surrounding the flue fire-chamber is a water reservoir, *M N*, which communicates with the bath-tub faucets. Cold water enters in the direction of the arrows.

Fig. 244 shows a portable bath-

Fig. 243.

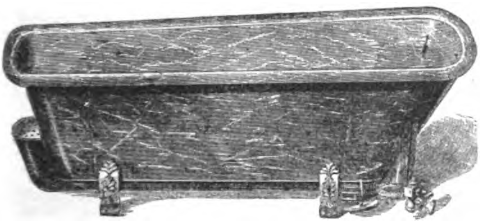


Stove Bath-heater.

tub heated by gas, which requires but an elastic tubular connection with a burner in the room. A ring of gas-jets burns beneath the tub, and at the foot end the exhaust gases pass out at a grated opening.

Bath heater. "*Manufacturer & Builder,*" viii. 43.

Fig. 244.



Gas Bath-heater.

Bath'ing Car. A car fitted up to contain the apparatus of a Turkish bath. The invention of C. H. Cooper.

The internal arrangement is a parlor or drawing-room, 10′ by 15′; Russian and plunge bath, 8′ by 7½′; three shampooing rooms, 6′ by 7½′; tepidarium, 10′ by 23′; movable closets, 2½′ by 10′; passages 18″ wide. The temperature in the various rooms will vary from 80° to 160°. The whole is lighted by blue glass. The car may be used on trains or side-tracked at towns where no such establishments are in operation.

Bath-om'e-ter. The name given by Dr. C. W. Siemens to his instrument for sounding the depth of the sea without the use of a line. The principle upon which the action of this instrument depends is the diminution of the influence of gravitation upon a weighty body, produced by a decrease in the density of the strata immediately below it; thus the density of sea-water being about 1.026 and that of the solid constituents which form the crust of the earth about 2.75, it follows that an intervening depth of sea-water must exercise a sensible influence upon total gravitation if measured on the surface of the sea.

"*Engineering*" . . . . * xxi. 260.
"*Scientific American Supplement,*" * 368.
"*Scientific American*" . . . . * xxxiv. 231.
Laboulaye's "*Dictionnaire des Arts et Manufactures,*" iii., article "*Sondage à la Mer.*"
Fol's Bathometer, * "*Scientific American,*" * xxxvi. 260.

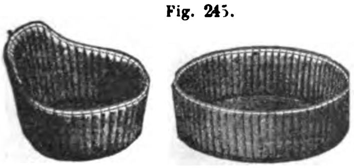
See also Sounding Apparatus, p. 2247, *et seq.*, "*Mech. Dict.*"

See also Flying Sounder, *infra.*

Bath Stove. A stove with circulating pipes connecting with and designed to heat a bath. See Bath Heater.

Bath Tub. Fig. 245 shows a tub of flexible

Fig. 245.



Portable Bath Tub.

material with braces sufficiently strong to preserve the outline of the upper edge of the tub when arranged for use, but sufficiently flexible to admit of their being bent so as to be inclosed in the tub when it is folded. There are also vertical props for supporting the sides and an air-cushion for the head.

Bath'-tub Strain'er. A perforated plug or plug-cover in the waste of a bath to keep soap, linen, or what not from entering the waste-pipe.

Ba'ting. (*Tanning.*) Steeping hides in a lixivium of hen manure, after coming out of the lime-vats.

The process tends to separate the lime, oil, and glutinous principle, and to make the skins pliant, porous, and ready to imbibe the tanning principle.

Ba'tiste. A fine, thin French cassimere made for use in tropical countries in place of cotton and linen fabrics.

Bat Print'ing. (*Ceramics.*) An adaptation of the transfer-printing process as applied to pottery.

An impression in glue (instead of ink) from a copper plate, is transferred to the biscuit, and on this viscous surface metallic color in powder is dusted. The ware is subsequently glazed and baked.

Ba-to're-om'e-ter. An instrument invented by Professor Giordano of Naples, for measuring minute variations of thickness, as, for instance, the increased thickness of a pane of glass due to heat derived from a finger resting upon it.

A vertical tripod is traversed by a very fine micrometer screw, and surmounted by a dial, the border of which is marked off into divisions according to a certain scale.

The object is laid upon the table and the micrometer screw caused to approach it. As soon as contact takes place an electric current, shown by a galvanometer, passes between the point of the screw and the table. If the object to be measured be a poor conductor, it is coated with gold-leaf.

Bat'te-ry. (*Electricity.*) An electro-magnetic instrument taken as a whole.

The part of the machine composed of the jars containing the plates and exciting fluids.

See Galvanic Battery; and list under Electrical Apparatus.

(*Naval.*) See Iron-clad, Armor, etc.

Stevens's Battery, "*Iron Age,*" xix., April 19, p. 1.

(*Military.*) See Battery Gun, Machine Gun, "*Mech. Dict.*"

(*Mining.*) An embankment.

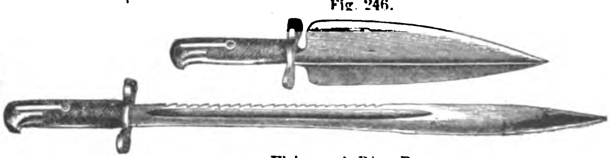
Bat'tle-dore. (*Glass-making.*) The wooden paddle used in shaping articles while blowing. For instance, it is held against the inside of a tumbler to render it circular in shape while the article is revolved.

Bau'de-kin. (*Fabric.*) An English brocade.

Name derived from Baldachini, from Baudas, Baldac, *i. e.*, Baghdad. From the use of the stuff in canopies, the word has been transferred to the latter. — Col. Yule's "*Marco Polo.*"

Bay'o-net. The Rice trowel-bayonet, the invention of Col. Edmund Rice, and the Elcho saw bayonet, invention of Lord Elcho, are shown in

Fig. 246.



Elcho and Rice Bayonets.

Fig. 246. It has been proposed to issue them in certain proportions to troops. See "*Ordnance Report,*" 1872, 1873.

The Snider bayonets for the British Government, triangular in section, are forged from $1\frac{1}{16}''$ round steel bar, which is drawn down under a power hammer, about 4″ remaining untouched to form the socket. The bar is next bent or "broken down," as the term is, in two places. After being cut off from the bar, sufficient metal being left for the blade, it is stamped in a pair of dies; the blade is then drawn out by the hammer. The rolling is performed by Barnes' patent rolling machines, in which there are two horizontal spindles, each carrying four cams, in which the dies are fixed. These cams occupy about one third of a circle; and the dies, which are cut on the periphery, are set so as to give the required thickness to the bayonet blade. After the bayonet has been trimmed, it is hardened and ground. The socket is next drilled and milled, the slot for forming the attachment to the rifle being afterwards cut; and after the further operation of "blueing" and polishing, the bayonet is complete.

See also "*Ordnance Report*," 1877, appendix L, p. 565, and Fig. 99.

Bay′on-et-tooth For′ceps. (*Surgical.*) A tooth forceps, the prongs of which are set off from the side though parallel with the general trend of the instrument, in a manner similar to the position of the bayonet relatively to the barrel of the musket.

Bay Win′dow. A projecting window with angular corners. A compass window.

Beach Com′bi-na′tion Sight. A sight for near or distant shooting: in the former case with the globe down, exposing the fin; and for distance, with the globe and its protecting ring erected.

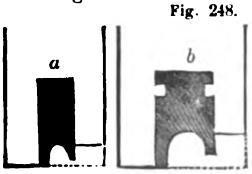
Fig. 247.

(As Open.) (As Globe.)
Beach Combination Sight.

Bea′con. A mode of illuminating sea beacons by gas from a position on shore is described in a paper by *J. Wigham*, "*British Association*," Mechanical Section, 1878. "*New Applications of Gas for Lighthouses.*" Reported in "*Scientific American Supplement*," * 2339.

A small light is kept by day by means of a by-pass connection, and full gas turned on at night.

Fig. 248.



Bead Planes.
(*a.*) Full boxed bead. (*b.*) Dovetail boxed bead. (*c.*) Double-boxed bead.

Bead. 1. (*Planes.*) An inserted guide in the sole of a molding plane. Fig. 248.

2. (*Glass.*) Glass beads are made from glass tubes.

See also BEAD, BEAD-FURNACE, pp. 253, 254, "*Mech. Dict.*"

3. (*Architecture.*) Globular ornaments carved on moldings.

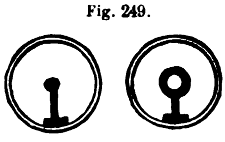
Bead′er. (*Sheet-metal Working.*) A machine for making beads on round boxes, such as blacking boxes, for instance.

Bead Sight. (*Rifles.*) One form of sight; a small circular object elevated on a thin stem and placed in the line of sight. Also called *pin-ball* sight.

An *open bead* has a circular opening through a bead somewhat larger than a solid one. Also called *Aperture* sight.

Combined sometimes with a *bar*. See BAR AND BEAD SIGHT.

Fig. 249.



Bead. *Open Bead.*

Beam. 1. Curved wooden beams are of four kinds: *scarfed, bent, flitched, laminated*, which see.

See also pp. 254-257, "*Mech. Dict.*"

Curved beam. * "*Scientific American Supplement*," 2035.

2. A weighing scale, or the main member of a lever scale.

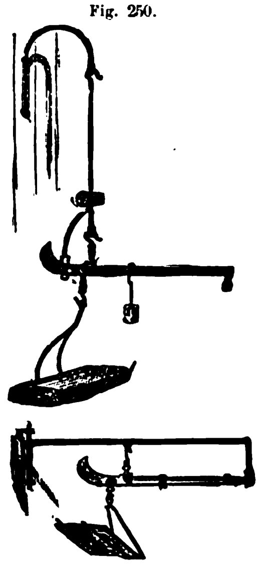
An *even-beam*; one hung by the middle, as in the regular balance.

A *cloth-beam* is for determining the weight per yard by weighing the piece of cloth.

A *paper-beam* is for determining the number of pounds to the ream by weighing one sheet of paper.

A *cotton-beam* (Fig. 251) is for weighing bales. All these are applications of the *Statera*, the *balance-Romaine*.

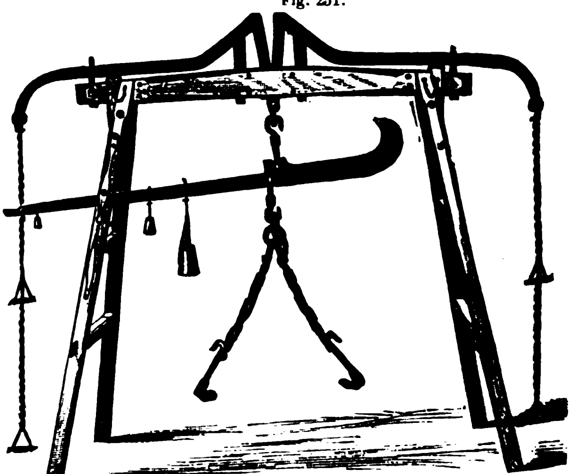
Fig. 250.



Cloth and Paper Beams.

3. (*Leather.*) An inclined block at which a currier stands to shave the leather with a knife, which agrees in the shape of its edge with the plate of mahogany or *lignum vitæ* which forms the face of the beam.

Fig. 251.



Cotton-weighing Beam

Beam Com′pass. Suggested forms: —

"*Scientific American Supplement*,"	* 315.
"*Railroad Gazette*"	* viii. 212.
"*Engineering*"	* xxi. 189.

Beam En′gine. See the following references:

Beam Engine.	
Chickering Factory. . . .	* "*Sc. Amer.*," xxxix. 256.
Corliss, Phila., 1876 . . .	* "*Engineer*," xli. 413.
	* "*Engineering*," xxi. 413.
(France).	* "*Sc. Amer. Sup.*," 2829.
Heslop, 1790, Br.	* "*Engineer*," xlvii. 69.
	* "*Engineering*," xxvii. 101.
Thomas & Powell, Fr. . .	* "*Engineering*," xxvii. 50.
Windsor, Fr.	"*Engineer*," xlvii. 99.
La Concorde Mine, Belg. .	* "*Engineer*," xlvii. 190.

Beam'er. A beaming machine.

Beam'ing Ma-chine'. One for filling yarn beams of looms. Fig. 252.

Rosseter's self-stopping beaming mill (British) is described and shown in the "*Textile Manufacturer*," 1878, and reproduced in "*Scientific American Supplement*," * p. 1938.

Bean Mill. A mill used in Britain for crushing beans for horse-feed, and known there as a *kibbler*.

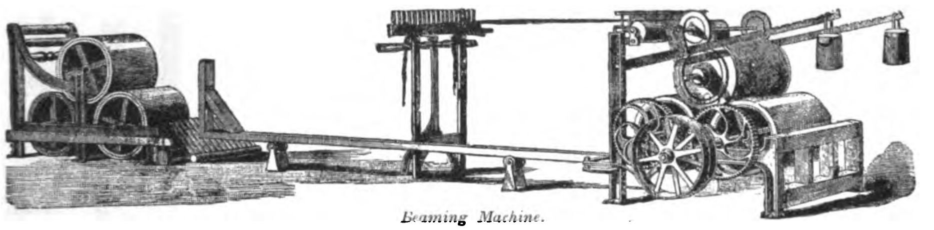
Bidwell's has triangular blades placed around the circumference of two lateral disks.

Bean Sli'cer. An invention of A. Bens, Deventer, Netherlands. A machine for slicing French beans.

Bear'er Bar. A bar in a furnace beneath and supporting the grate bars.

Bear'ing Feel'er. An arrangement invented by Alley of Glasgow, whereby the melting of a plug of hard lubricant caused by the heating of a bearing, allows a spring to drive a hammer and make a number of strokes on a bell, thus calling attention to the fact that the bearing has become heated.

Fig. 252.



Beaming Machine.

"*Engineering*," * xix. 120; * xxi. 96.

Beat'ing Ham'mer. (*Bookbinding.*) A hammer with two round faces; used in condensing and shaping backs of books in the process of binding.

Fig. 253.

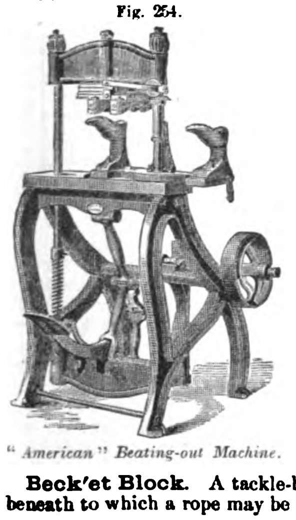
Beating Hammer.

Beat'ing-out' Ma-chine'. A machine for shaping shoe-soles which are presented on a last to a form above, being lifted by a toggle, operated by foot or by power. Fig. 254. It is a machine forming a substitute for the hammer.

Beat'-away. (*Mining.*) To excavate. Usually applied to hard ground.

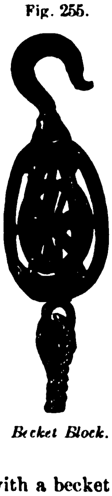
Beat'er. (*Add.*) 6. (*Mining.*) An instrument for packing stemming on a charge of powder in a blast-hole.

Fig. 254.



"*American*" *Beating-out Machine.*

Fig. 255.



Becket Block.

Beck'et Block. A tackle-block with a becket beneath to which a rope may be bent. Fig. 255.

Beck'et Hitch. Another name for the FISHERMAN'S KNOT, which see.

Becque-rel' Bat'tery. (*Electricity.*) 1. The sulphate of lead battery, consisting of zinc in sulphate of zinc and lead in sulphate of lead.

2. The oxygen-gas battery. A glass tube containing solution of potash, closed at the bottom by a porous partition, is placed in a flask containing nitric acid. In each liquid is placed a bar of platinum, which being put in metallic connection, a current is produced, the water is decomposed, the hydrogen goes to the nitric acid, which it reduces, and consequently there is no polarization. The oxygen goes to the potash which surrounds the platinum plate. This was the first battery employing two liquids or a porous diaphragm, and consequently the first one to give a constant current.

"*Niaudet*," American translation, 239.

Bed. 1. Fracture beds with limb elevators and suspenders, counter-extension apparatus, splints, cradles, etc., are shown in *Tiemann's* "*Armamentarium Chirurgicum*," Part IV., pp. 57, 97, 104.

2. (*Mining.*) A horizontal seam or deposit of mineral.

Bed-mor'tis-ing Ma-chine'. A large mortising machine for working on beds and frames of railway cars, etc.

Fay & Co., * *Thurston's* "*Vienna Report*," iii. 260.

Bed'stead Joint. The mode of connecting the side-rails to the head and foot portions respectively, so as to be detachable.

The patents on this subject are numerous. Two modes are shown in Figs. 625, 626, p. 262, "*Mech. Dict.*"

Beef Sha'ver. 1. A knife set in a stock in manner of a spoke-shave or slaw-cutter, for slicing dried beef.

2. A swinging knife pivoted on a frame so as to make a draw-cut on the beef which is advanced in the trough beneath. Fig. 256.

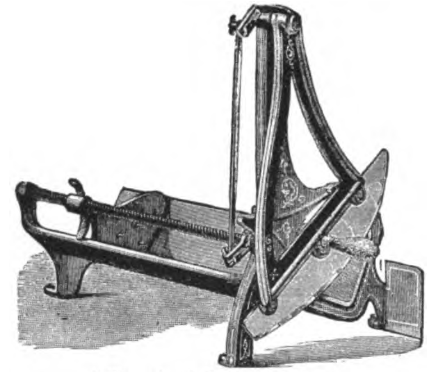
"*Iron Age*," * xxi., March 28, p. 19.

Beer. See the following: —

Barreling Apparatus, Austria. * "*Engineer*," l. 458 (Figs. 45, 46).

Condenser . . . . . "*Scientific American Sup.*," 87.
Coolers, Austria . . . * "*Engineer*," l. 266, 303.
Coolers . . . . . . "*Scientific American Sup.*," 4076. (Figs. 6, 7, 8).
Preserver, *Weinmar* . . * "*Scientific American Sup.*," 57.
Refrigerator, *Hoerr* . . * "*Scientific American*," xl. 22.
Beer Resuscitating Apparatus, Austria.
* "*Engineer*," l. 462 (Figs. 49, 50).

Fig. 256.



"*Champion*" *Dried Beef Shaver.*

Beer, Con-densed′. Beer reduced in a copper vacuum pan to $\frac{1}{18}$th its bulk in solids, and an equal quantity of alcohol: 36 gallons of beer making 2 gallons of solids and 2 of alcohol, to be remixed.

Dr. Bartlett in "*Scientific American Supplement*," 191.

Beer Cool′er. The devices are numerous. Two are shown at Figs. 631, 632, pps. 264, 265, "*Mech. Dict.*" They take the form shown in other industries, and various shapes; the same in principle may be found under "*Condenser*," "*Evaporator*," *Ibid.*

The "*Refrigerant Dubuc*," made at Carignan (*Ardennes*) is a favorite in France. It is on the method of trickling over pipes, — the Derosne principle. Fig. 1421, p. 609, *Ibid.*

The *Roos* refrigerator follows the same idea.

The *Trageser* cooler also.

The Austrian beer cooler, by *Raimond Metsche*, at Olmutz, has a system of circulating pipes in the wort or beer back.

Weinhagen's beer cooler is for quickly cooling a small quantity of beer for testing the strength of the wort.

Woerle's cooler consists of tin vessels freighted with ice swimming in the vat.

An elaborate apparatus, *Patent-gegenstrom Bierkühlapparat*, on the system of Brüder, Noback, and Fritze, of Prague, was shown at Paris. It consists of convolutions of double pipes, one carrying the beer and the other the cold water, circulating continuously in different directions.

Beer Pre-serv′er. An arrangement by which the space in the barrel above the beer is filled with carbonic acid gas from a reservoir alongside. Wiesebrock's.

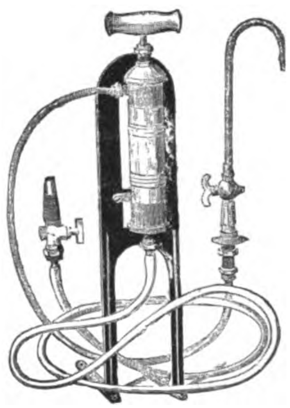
Fig. 257.

Beer Preserver.

The apparatus of Otto Zwietusch, of Milwaukee, is a regular carbonic acid gas generator, with marble-dust and acid chambers, gas washer, holder, etc., with connecting pipes and valves, to serve a row of barrels or kegs under draft. Patents, May 19, and July 2, 1874.

Beer Pump. A hand-pump, forming a connection between a counter in a saloon and the barrel in the cellar. The pump has two tubes, with a barrel cock at one end and a dispensing goose-neck at the other.

Fig. 258.



Beer Pump.

Bees. (*Nautical.*) Of a bowsprit: *bee-blocks.* Pieces of wood bolted to the outer end of a bowsprit to reeve the foretopmast stays through.

Bees′wax. A fraudulent imitation of beeswax is made of a mixture of paraffine and common resin. It resembles the genuine article very closely in color, fracture, and adhesiveness.

The cakes are generally covered with a thin coat of genuine beeswax.

Beet Gra′ter. A machine for grating beetroot for obtaining the juice by expression or diffusion in the manufacture of sugar.

"In the California machine, of the Union Iron Works, San Francisco, the beets are fed continuously into a hopper, which is at the top of the machine. Directly under the hopper are two ways, or sluices, in which the feeding plungers slide. The plungers are actuated by the revolution of a cranked shaft, through the medium of slotted levers and connecting links. The turning and sliding of the cranks in the slotted levers gives a quick return motion to the plungers, and causes their forward motion to be almost constant. The forward motion of the plungers presses the beets, which have fallen into the sluices, while they are drawn back, against a quick revolving drum, which makes about 600 or 800 revolutions in a minute. The drum consists of three grooved flanges, about 22″ diameter, mounted on a shaft, and having 8″ space between them. The grooves are in the inside faces of the flanges, and near their circumferences. They are filled with strips of steel saws, with a strip of wood setting back from the points of the teeth between each two of the blades. About 400 saws are necessary to fill a double drum of these dimensions. The drum, revolving at a high speed, grates the beets which are pressed against it, and discharges the pulp into a chute which leads it into movable hoppers, by which it is transported to the centrifugal machines."

See BEET-RASPING MACHINE.

Beet-juice Def′e-ca′tion Pan. The purifying process formerly adopted with beets was as follows: The juice in the defecating pan was rapidly heated to 185° F. At this moment milk of lime was poured into the juice and well stirred in. When a thin layer of scum had formed on the top of the juice, the supply of steam was gradually shut off, so that at the moment of ebullition the supply of steam was one fourth the original quantity. The steam was suddenly cut off when ebullition was fully developed, indicated by an eruption of clear juice on the surface.

The juice was then filtered through animal char-

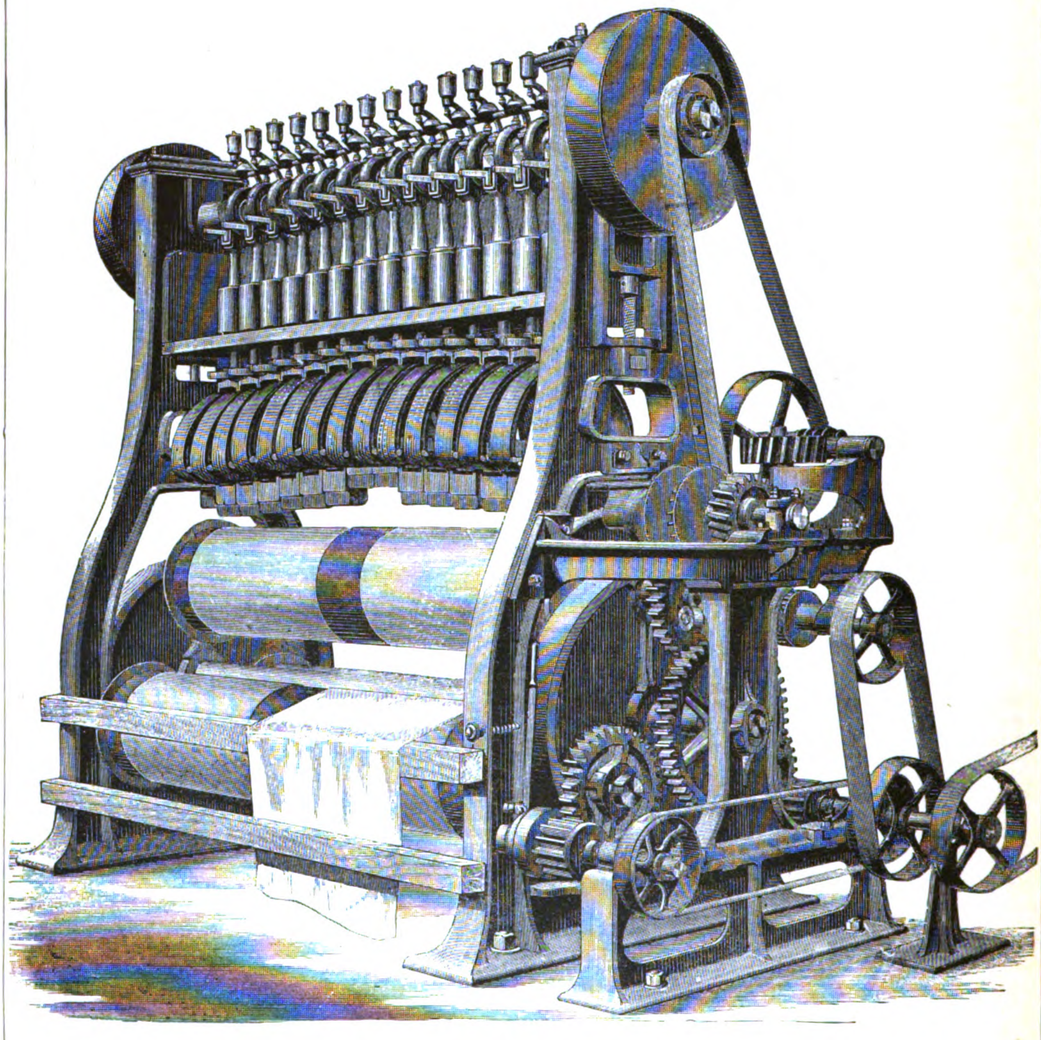


PLATE V PATTERSON'S BEETLING MACHINE. (MATHER & PLATT, MANCHESTER, ENGLAND.) See page 87

coal. CARBONATATION (which see) has been largely substituted for the above process.

Bee'tle De-stroy'er. An implement or machine for killing the potato bug. Numerous kinds are noted under INSECT DESTROYER, which see.

Bee'tling Ma-chine'. A machine for finishing linen or cotton goods by a hammering process. The beetling machine referred to on p. 265 of "*Mech. Dict.*," had a series of vertical stamps lifted by pins or cams in manner of an ore-stamping mill, but the Patterson beetling machine made by Mather & Platt, of Manchester, England, and shown in Plate V., has a series of spring-hammers worked at high speed. These hammers are worked by eccentrics on a shaft which extends along the top of the machine, there being interposed between the eccentric rods and the hammers a spring connection which relieves the working parts from the recoil of the blows, and materially reduces wear and tear. The spring connection is made by suspending each hammer from a leathern belt attached to a semicircular steel spring.

In the old-fashioned beetling machines the hammers or *fallers* were lifted by cams, and allowed to drop by gravity, while the utmost speed at which they could be run was about sixty blows per minute. In the Patterson machine the hammers each give 420 blows per minute, while the striking effect of each blow is the same as in the old machine. The hardness of the blow can, however, be varied by altering the speed.

The cloth being operated upon is carried by one of three rollers which revolve in bearings carried by disks, as shown, these disks being themselves capable of revolving. The three cloth rollers can thus be brought successively under the action of the hammers, and the operation of the machine is thereby rendered continuous, the filling and stripping of the rolls not interfering with the beetling.

"*Engineering*," * xxvi. 91.

Beet Press. One for pressing the juice from the grated pulp of the sugar beet.

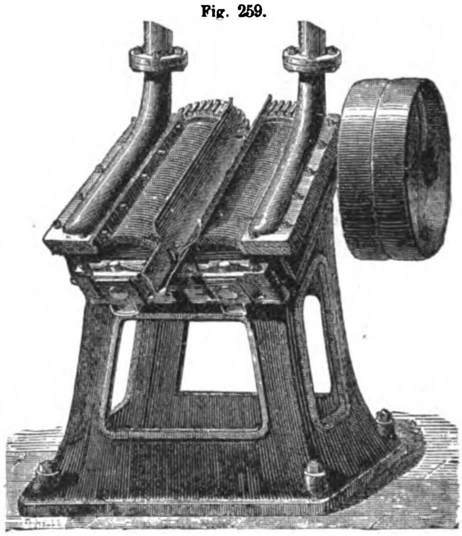
The beet industry has attained its great proportions since the hydraulic press has been in common use, and this description of press in various modified forms is well adapted to this industry.

Lalouette introduced the arrangement which dispensed with the use of sacks which were and are used in the stearine and flaxseed-oil works. He made a chest with strong iron bars lined within with a perforated copper sheet. Sheets or cloths divided the marc into layers. A second pressing was necessary, the first was frequently done in a filter-press (which see), and the pulp fell from that into the chest of the Lalouette press. Sixty per cent. of the juice was obtained.

The direction now seems to be in the line of continuous presses, which so much reduce labor in handling. They usually depend upon rollers.

The cylinders of continuous presses are, (1) constructed with apertures perforating their rolling surface, so that the juice is caused to pour into the interior, from which it is allowed to escape, as in the presses of Pecquer, Champonnois, and Lebée; or (2) the pulp is carried, by means of endless belts of linen or jute, between a series of solid

Fig. 259.

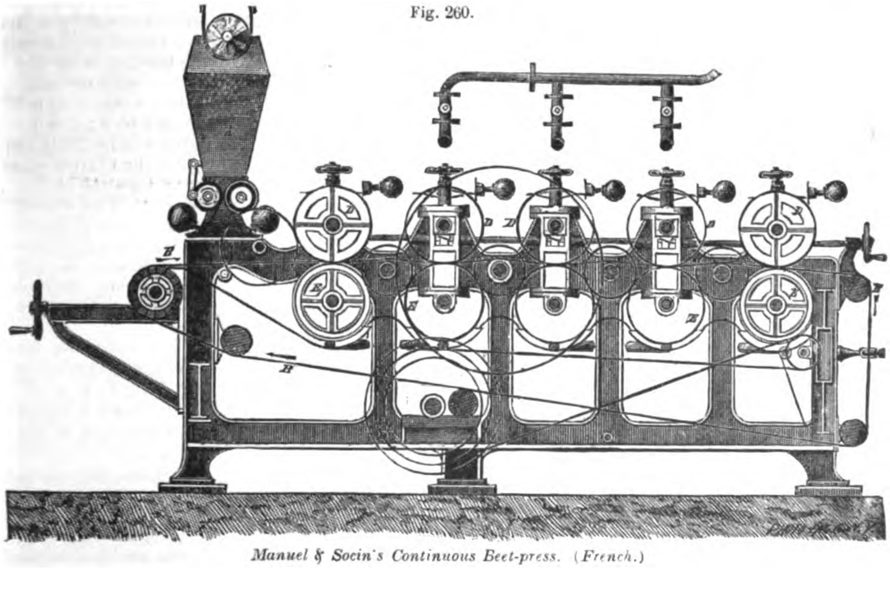


Champonnois' Continuous Press.

rollers, effecting a gradually increasing pressure, as in the presses of Poizot and Manuel & Socin.

1. Pecquer commenced with cylinders perforated

Fig. 260.



Manuel & Socin's Continuous Beet-press. (French.)

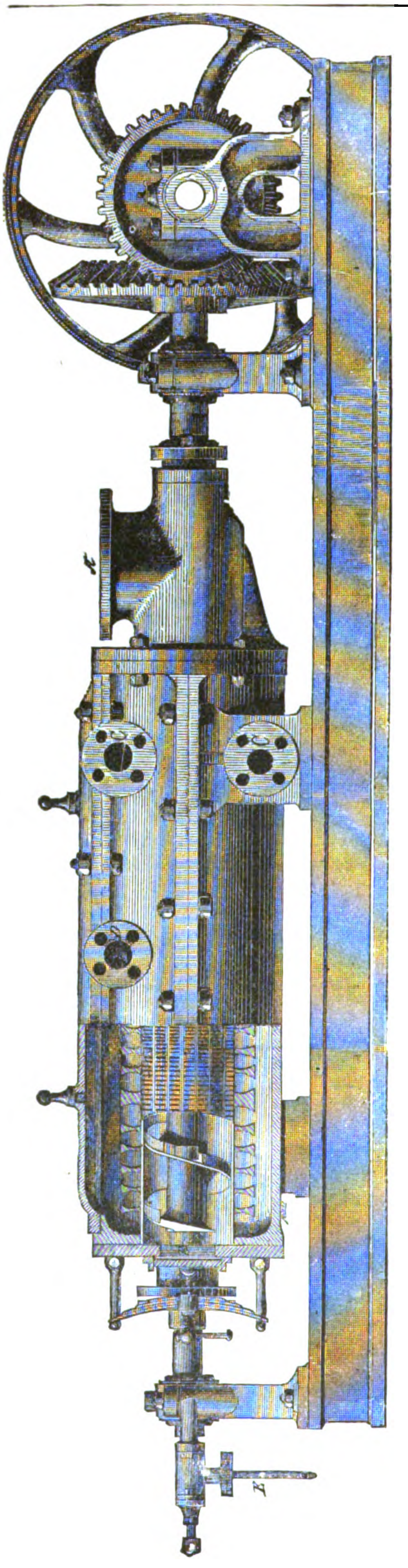


Fig. 261. V. Pierron's Continuous-screw Beet-press. (French.)

A Entry of pomace. B. Exit of pulp. C C. Exits of juice. D. Entry of water for washing. E. Supply of water for injection through center of screw.

with round holes, but Champonnois improved upon this by making longitudinal slits in the cylinder and adding a spiral wire covering, which gives an infinitude of extremely narrow exits for the juice. Fig. 259.

The Lebée press has cylinders whose peripheries consist of movable frames made of narrow bars and intervals respectively 0.05″ and 0.004″ wide. These are soldered in sets to be replaced readily. The pulp requires several pressings. After passing between the first set of filtering cylinders, the pulp passes under a solid cylinder, rolling upon one of the filtering cylinders, after which it is treated with a spray of water, and again passed under solid cylinders, rolling upon another filtering cylinder.

In the Collette press the filtering surfaces consist of sheets of finely perforated copper.

In the Dujardin press the cylinders are covered with heavy brass sheeting about .08″ in thickness. The openings made in this metallic sheet are cylindrical for a short distance, after which they expand conically toward the under side, and by this means the difficulty of choking the holes is largely avoided.

The difficulty encountered in these presses by the escape of pulp with the liquid is somewhat obviated by the addition of milk of lime to the juice, which seems to solidify the pulp.

2. The continuous presses which have an endless cloth filtering surface, depend upon the principle of subjecting the pomace to a gradually increasing pressure by passing between different series of rollers, the pomace being carried between endless belts of the material mentioned above. The first of these presses is stated by Basset to have been devised in 1812, but Poizot seems to have been the first to make an effective one, and to apply it in industrial work.

That described by Basset consisted simply of an endless sheet carried between two rollers held in contact with each other by means of levers to the farther end of which weights are attached. The material was distributed upon this belt and by it carried between the rollers.

Poizot's press, according to his first design, had two belts between which the pulp was carried around a large cylinder, against which smaller rollers were forced with a gradually increasing pressure in the course of the series, followed by a pressure between two large rollers. Poizot now uses a single web of cloth, the pulp passing over the small rollers and in contact with the large cylinder. The pulp falls from the web into a tank, is subjected to a spray of water and passes to a second press.

The Manuel & Socin press (Fig. 260) depends upon the same principle, but the system of rollers is arranged horizontally, and consists of five pairs of cylinders of the same size. The distance between the cylinders of each pair varies respectively, according to its distance from the point of supply. The pressure exerted by each pair of rollers is governed by a strong steel spring, the power of which may be increased or diminished at will by means of a screw regulator.

The pomace from *A* falls between the feed-rollers upon the endless belt *B*, and is carried between the solid rollers *D D D D D* and *E E E E E*. The pressure exerted by the rollers is adjusted by means of screws and springs attached to the journals.

The Leroy press, constructed by Messrs. Mariolle Brothers, of Saint Quentin, is provided with rollers and an endless sheet upon which pulp is distributed by means of a special apparatus called the *préparateur*, founded upon the same principle as the press properly so called; that is to say, in the *préparateur* the material coming directly from the trough of the rasp and equally distributed upon an endless sheet is submitted to an energetic preparatory pressing by means of a series of rollers, gradually approaching each other more and more, in such a manner as to distribute upon the press only pulp partially exhausted of its juice.

The endless sheet is here a thin sheet of steel pierced with a large number of small holes, forming the filtering surface for the juice. In the press the endless sheet is of the same nature, but it is doubled, as it were, by a woolen sheet, upon which the pulp to be pressed is distributed. Good filtration of the juice is thus assured, and at the same time almost all the fatigue is referred to the metallic sheet. — *La Sucrerie Indigène*, xii. 367.

The Pièron press (Fig. 261) is more simple in construction. It consists of a screw arranged horizontally within a perforated cylinder of copper, and the whole hermetically inclosed in an envelope of cast iron provided with internal channels for flow of the juice. The blades of the screw are of copper, and the axis of bronze. The blades are in sections, and may readily be removed and cleaned. The pulp to be pressed is forced into the cylinder by means of a strong pump, and is carried by the revolving screw toward the other end. When it first enters the press, the pulp is submitted to very slight pressure, but the pressure increases as the pulp approaches the other end, where it is forced out through a valve so arranged that the discharge of pulp may be regulated at will. A portion of the axis of the screw is hollow, and the portion beyond the discharge orifice connects with the water supply, so that a small quantity of water may be continuously added to the pulp at the latter part of the pressing to effect a saving in the sugar that would otherwise be left in the pulp.

To secure effective work with this as with other continuous presses, the method of double pressing must be employed, and for ordinary working six presses are used for the first pressing, and two for the second pressing. For the first pressing the motive force required by each press is one and a half horse-power, and for the second two horse-power. The advantages claimed for the press are its solidity, slight liability to accident and repairs, and small amount of labor required in its management. The work of grinding and pressing being altogether automatic, one man can attend to both operations. There is no opportunity for the juice to come in contact with the air between the press and the liming-vat, and there is consequently little or no change. The pulp of the first pressing contains 80 to 83 per cent. moisture, and 7 to 9 per cent. of sugar; and that of the second pressing contains 4 to 5 per cent. of sugar. The final pulp represents 26 per cent. of the beets worked.

See report by Dr. W. McMurtrie, "*On the Sugar Beet and the Manufacture of Sugar therefrom.*" Special Report, No. 28, Department of Agriculture, Washington, 1880.

The following continuous presses are referred to in Dr. McMurtrie's Report on the pages indicated.

French.	*Poizot*		Plate XVI.
	Lebée		Plate XVII.
	Manuel & Socin	Page 142.	Plate XVIII.
	Champonnois	Page 140.	Plate XIX.
	Dujardin	Page 141.	Plate XX.
	Pièron	Page 142.	Plate XXI.

See also the following journals and treatises: —

Maumené . . . . "*Traité de la Fabrication du Sucre.*"
La Betterave à Sucre.
La Sucrerie Indigène.
Basset's "*Guide pratique du fabricant de Sucre.*"
"*Journal des Fabricants de Sucre.*"
Stammer's "*Traité theorique et pratique de la Fabrication de Sucre.*"
Walkoff's . "*Traité de Fabrication et Raffinage du Sucre de Betteraves.*"
Grant's . . "*Beet Root Sugar and Cultivation of the Beet.*"
Beet Root Cultivation . "*Scientific American Sup.*," 1032.
Beet Sugar Industry.
Drouyn de Lhuys . . "*Scientific American*," xxxvii. 169.

Beet-rasp'ing Ma-chine'. The machines for rasping beets are of several forms, three of which, of different constructions, are presented.

It is necessary that the cellular structure of the beet shall be entirely degraded in order that there shall be as little loss as possible in the subsequent operation of pressing, which requires to be very carefully performed, and is, in fact, repeated to express the last attainable quantity of saccharine juice from the pulp. See BEET PRESS.

In the greater number of *sucreries* on the Continent of Europe, the rasping machine forms the first of the series of apparatus in the establishment; but of late another system has come into extensive use, and is increasing in popularity. It is to have the *râperies* in the villages or communes, or on farms of extensive area, and to convey the juice by underground pipe-lines to a central *sucrerie* where the subsequent operations are conducted. This enables a single sugar factory to work up the beets of a much larger area than would be possible were the roots to be carted to the central factory.

The system is the invention of Linard, and some data in reference to it are given under PIPE-LINE, which see.

Its advantages are in —

Placing the heavier portion of the work, and that in which the larger number of workmen are employed, in the villages in which they reside.

Increasing the area of the profitable cultivation of beet in the neighborhood of a *sucrerie*.

The decreased weight to be transported.

The transference of the transport from the roads, which are injured by the heavy carts.

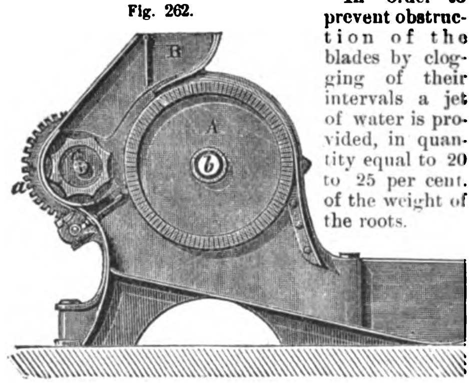
Leaving the residual pulp in the communities where it is needed for cattle and sheep feed.

The opportunity of purchasing the juice by the saccharometer tests instead of by the weight of the roots.

The Lampadius and Kluseman rasps have cylindrical drums furnished with knives, acting upon the roots placed in a hopper, which partially incloses the circumference of the rasping cylinder. The *râpe* of Lampadius is shown at Plate XI. of Dr. McMurtrie's Report on the Culture, etc., of the Sugar Beet, Special Report, No. 28, of the Department of Agriculture, 1880.

The calculation for effectiveness is that a machine which has 70 square decimeters of rasping surface, and 650 turns per minute, which answers to a developed surface of 27,300 meters, will produce 1,000 kilograms of pulp per hour. One horse-power is estimated for each 450 kilograms per hour. In order to prevent obstruction of the blades by clogging of their intervals a jet of water is provided, in quantity equal to 20 to 25 per cent. of the weight of the roots.

Fig. 262.

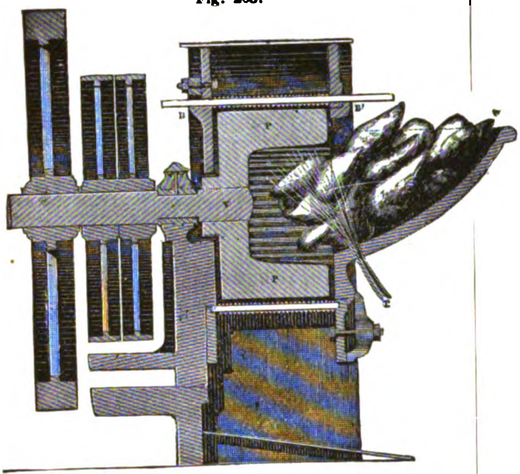


Kluseman's Beet-rasping Machine.

Kluseman's rasping machine, Fig. 262, has a drum *A*, whose perimeter is furnished with radial blades. The roots are put into the hopper *B*, and passing downward, are caught in the flutes of the roller *c*, which makes one turn — towards the rasp — for every 25 revolutions of the rasp. Its duty is to hold the roots against the rasp, and these escape into the box beneath when they are grated sufficiently fine to pass the throat piece which is adjustable from beneath. *a* is the cog-wheel which turns the roller *c*; the gearing of the rasp cylinder on the axis *b* is hidden by the machine.

The Champonnois rasp, Fig. 263, has an axis *V*,

Fig. 263.



Champonnois' Beet-rasping Machine.

with heavy cast-iron arms, *P*, which revolve at a rapid rate, and by centrifugal force and actual grinding action force the roots delivered in the hopper *V* against a series of rasps which are arranged circumferentially as at *B B′*, tearing them into fragments, and pushing them through the interstices between the rasps, whence they fall into the box below.

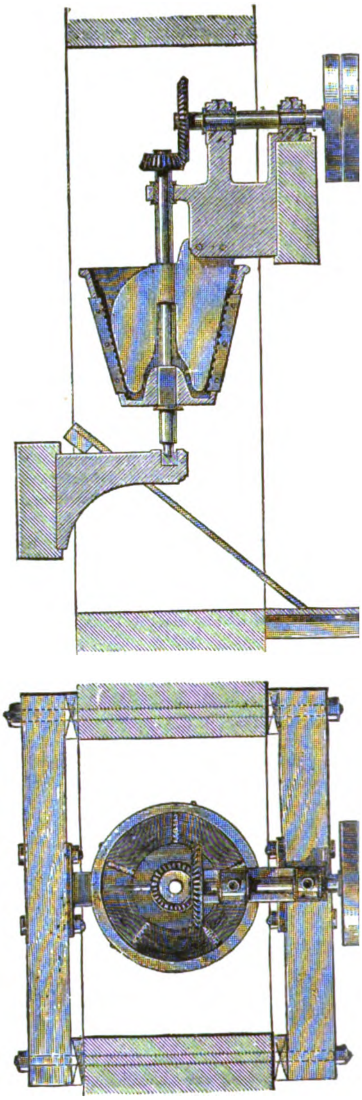
The series of marks, looking like bars, appearing beyond the roots, are the rasps which are set thus close together. At *T* is shown the pipe for the injection of water into the interior of the rasp.

The rasp of Champonnois is powerful, and produces from 6,000 to 7,000 kilograms of pulp per hour, if it be actively fed, and is one of the most efficient root graters.

Another form of *coupe-racine* is that shown in Fig. 264, which consists of a cast-iron vase of a frusto-conical shape mounted on a vertical shaft which receives from 200 to 400 turns per minute. The vase has 6 straight openings like the throats of a plane, and each of these has a toothed blade which grates the roots, and the fragments pass out at the openings.

A fixed metallic plate descends into the interior of the vase, acting as an abutment for the roots, to prevent their revolving with the vase, and is distant from the surface of the blades 4 or 5 mm. The size of the pieces is from 0.005 to 0.010 m. × 0.003 to 0.004 m. They are expelled by centrifugal action, and the apparatus requires a casing, which is not shown in the cut.

Fig. 264.

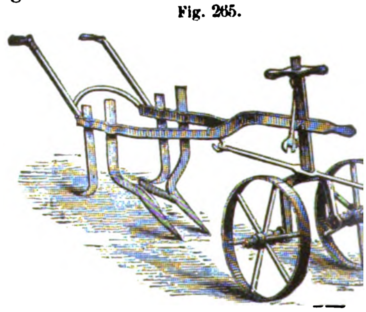


Beet-root Rasping Machine.

Beet-root Rasp, Fr.
Lampadius, "*Dept. Agric. Sp. Report*," No. 28, Pl. XI.
Champonnois, "*Dept. Agric. Sp. Report*," No. 28, Pl. XII., XIII.

Beet′-root Dig′ger. This generally consists of a sort of fork mounted on a wheeled frame and slanting downward so as to include the root between its prongs, and lift it upward and forward. It injures the beet to bruise it or to break the tap-root, as it bleeds and wastes the sweet juice. Following the fork are prongs which lift the roots clear of the soil in which they are more or less imbedded, as they are simply upset and drag the ground.

Fig. 265.

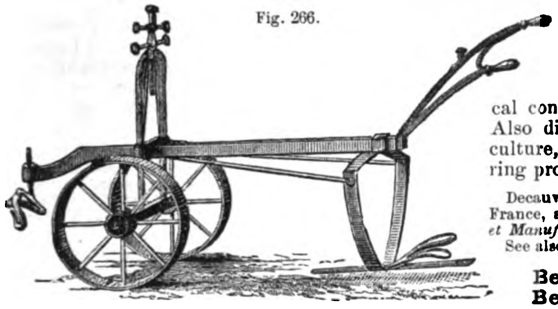


Beet-root Digger.

Figs. 266 and 267 are other forms, made by Delahaie-Tailleur & Bajac, Liancourt, France.

The former has a bow-shaped standard, having

Fig. 266.

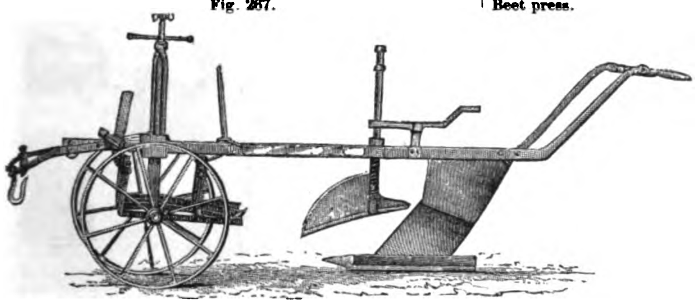


Beet-root Puller.

a lifting share in front and several prongs behind, to raise the beets and leave them on the surface of the ground.

The latter example has a precedent share (*coupe collet*) for cutting off the leaves of the beet simultaneously with the pulling of the root. Several forms of interchangeable shares are furnished with the implement: shares without branches, or with two or three branches, according to the kind of beet and the nature of the soil. The work performed is 1 hectare (2½ acres) per diem.

Fig. 267.



Beet-root Digger.

French beet-root pullers are shown in *Knight's* "*Report on Agricultural Implements*," *Paris Exposition Reports*, * vol. v., pp. 51, 52.
See also "*Scientific American*," * xxxix. 165.

Beet'-root Sli'cer.

The centrifugal root cutter of the "Union Iron Works," San Francisco, "is composed of a stationary drum, in the form of a truncated cone, provided with six grooves, into which are fastened as many grooved-toothed knives. To this drum is attached the feed hopper. A horizontal shaft which is keyed to the head pulley, carries at one of its ends a cast iron disk, armed with two flyers, turning in the stationary drum, and leaving a working space between the edge of each and the inner wall of the drum. The beets come from the washing machine through a channel into the hopper, and thence to the drum. Here the flyers of the disk drive them violently against the blades of the stationary drum, where they are cut into slices of a uniform thickness of one sixteenth of an inch, and a width of about three eighths of an inch. The stationary drum is surrounded by a thin casing of sheet iron, the object of which is to direct the slices thrown out of the machine, downward. This casing is movable, so as to give access to the knives, and allow them to be taken out.

This machine can cut three tons of beet-root in half an hour, with the shaft moving at the rate of 350 revolutions per minute. A single horse power is all that is necessary to actuate it. The blades are fastened into the grooves by screw bolts, and can be adjusted and set at any desired distance apart within given limits."

Beet'-root Su'gar Ap'pa-ra'tus. For a recent timely and excellent treatise on the inception, progress, and success of the beet-root sugar industry in Europe, see Dr. McMurtrie's Report, "*U. S. Department of Agriculture, Special Report, No. 28,*" 1880.

It includes also tables and maps, indicating the regions in the United States included in the belt, where the meteorological conditions favorable to beet culture prevail. Also dissertation on varieties of beet, analyses, culture, manuring, harvesting, and manufacturing processes and apparatus.

Decauville's beet-root machinery and still, at Petit Bourg, France, are described in *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," vol. iv., ed. 1877, Article "*Distillation*."
See also "*Sucre*" in same work, iii.

Beet Pul'ler. See Beet-root Digger.

Beet'-root Su'gar Ma-chin'e-ry. The series of machines made by the Union Iron Works of San Francisco is as follows: —

Beet-washing machine.	Grating or pulping machine.
Bone-black washer.	Hydraulic press.
Carbonic acid pump.	Lump breaking machine.
Centrifugal machine.	Monte-jus.
Charcoal filter.	Sugar-mixing machine.
Defecating pan.	Vacuum pan.
Evaporator.	Vapor pump.
Filter press.	Vivifying kiln.

Notices or references will be found under the following heads: —

Animal charcoal revivifier.
Beet grater.
Beet juice defecation pan.
Beet press.
Beet rasping machine.
Beet-root digger.
Beet-root slicer.
Beet-root sugar apparatus.
Beet-seed drill.
Bone black revivifier.
Cane cutter.
Cane mill.
Carbonatation.
Centrifugal filter.
Charcoal washer.
Concentrating apparatus.
Condenser.
Cube-sugar machine.
Cultivator, Beet.
Defecator.
Diffusion process
Evaporator.
Filter.
Filter press.
Hand drill
Hydraulic press.
Malaxator.
Ridging plow.
Root cutter, Beet.
Root digger, Beet.
Seed drill.
Silo for beets
Sugar diffusion process.
Vacuum pan.

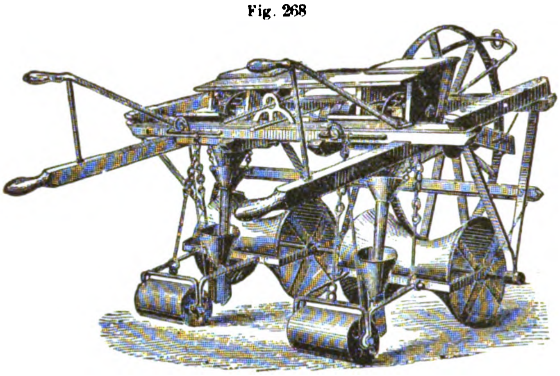
Beet-seed' Drill. A machine for drilling beets, usually upon a ridge listed up.

Fig. 268 is a drill for beet-seed or turnips, made by Corbett & Peele, of Shrewsbury, England. It is specially adapted for sowing on the summits of ridges. The machine drills two parallel rows. On each side of the machine is a concave ridging-roller, a hollow share which receives seed from the box above, and an iron roller for covering the seed. The seed-wheels are of the usual English form, having little hemispherical cups which dip up seed and drop it into hoppers, from which conductors lead to the hollow shares which open the furrows.

The beet-seed drill of Smyth & Sons, of Peasenhall (Suffolk), England, has a range of 5 hoes with a distance apart of 0.45 meter, but the machines vary in the number and interval distance of the hoes and in price.

The seeding is performed by its own set of conductors and hoes, in such manner that the fertilizer is covered with earth in advance of the deposit of the seed, which is not placed in contact with the fertilizer, so that the special nourishment to the roots of the young plant is not furnished until they

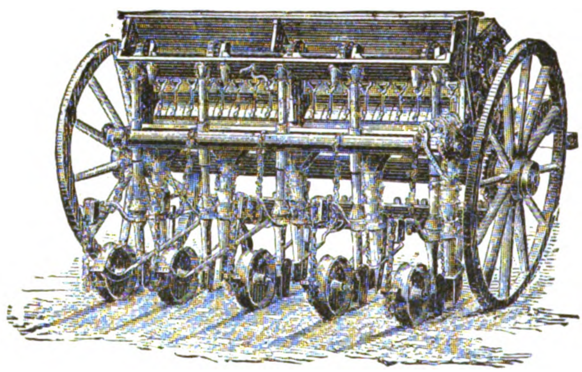
Fig. 268



Beet-seed or Turnip Drill.

have attained a certain development. The concave-faced rollers, which are independent of the hoes, follow in the rear and make a little ridge over the seed and fertilizer, which compacts the soil and makes the row of plants more conspicuous in the earlier stages of their growth.

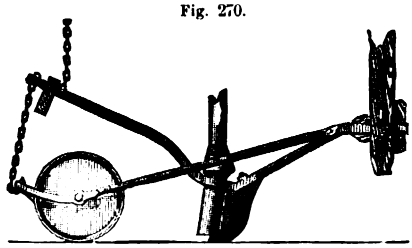
Fig. 269.



Beet-seed Drill.

The device shown in Fig. 270 is for attachment to the ordinary drills of this firm to adapt them to drilling beet seed. The roller has flat, concave, or convex face, as may be ordered.

Fig. 270.



Beet-seed Planter.

English and French beet-drills are shown in Dr. McMurtrie's Report No. 28, Special, Dep. of Agriculture; and in Dr. Knight's report, "*Paris Exposition Reports*," * v., 115-117.

Bell. (*Music.*) 1. An instrument in an orchestra, used for dramatic effects. According to *tone* they are known as *high* bells or *low* bells. Berlioz quotes the use of the former in the graceful chorus in the second act of "*Guillaume Tell*," of which the burden is "*voici la nuit;*" and of the bell in low F, in the 4th act of Meyerbeer's opera, the "*Huguenots*," to give the signal for the mas The bell refrain in "*Les Cloches d nouailles*" is familiar to most of us.

Sets of bells are used in military i a number being fixed one above ai on a frame of iron, and ranged di cally in the order of their sizes. Th made to vibrate by a little hammer. GLOCKENSPEIL, GONG, PAVILLON NOIS, "*Mech. Dict.*"

The bells in Japan are not sounded wit pers, but with suspended levers of wood, u a battering-ram, striking the bell on the ou

See Report on Bells by *H. K. Oliver*, in xxv., vol. vii., "*Centennial Exhibition R* p. 53."

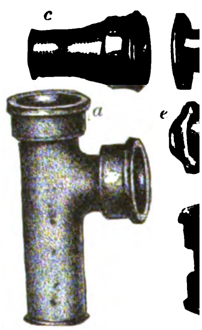
Casting	* "*Manufacturer and I* viii. 54, 228.	
Clapper and Hammer, Br. *Mackenzie*	* "*Engineer*," xlix. 268.	
Mending. *Riggs* . .	* "*Scientific American*," xxx	
Church	"*Iron Age*," xxii., Dec. 26,	

2. The enlarged end of a pipe which recei smaller end of the next pipe in line. The usually packed with lead or cement. Th usual mode of connection is by flange, which

3. The cover in the hopper of a blast f top. See BELL AND HOPPER.

Bell and Hop'per. (*Metallurgy.*) The ing device on top of a blast furnace. The bell is dropped to allow the contents of the hopper to fall into the shaft.

Fig. 271.

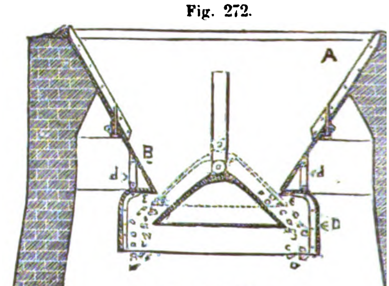


Bells for Mains

a. Bell T-Pipe.
b. Double Bell.
c. Bell and Reducer
d. Flanged Bell.
e. Saddle-flanged Be

A is the hopper in which the stock is p feed the furnace. *B* is an extension of t per, called the mouth-piece. *C* is the b

Fig. 272.

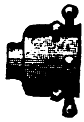


Bell and Hopper.

the hopper called a bell, which is lowere able distance when feeding the stock to nace. *D* is an apron or fender, attache mouth-piece *B*, to prevent the stock from striking the walls of the furnace. The apron is secured to the hopper by straps *d d*.

Bell Chuck. Whitworth's lathe chuck, made bell-shaped, with set-screws by which the object is clamped.

Fig. 273.



Bell Chuck.

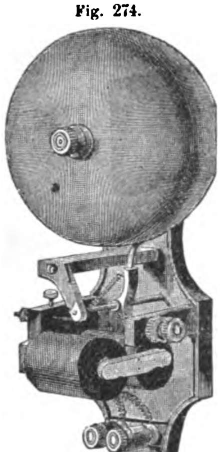
Bell Cord. (*Railway.*) A cord running continuously through the cars, and leading to a signal bell on the engine. It forms a means of communication between the conductor and engineer.

For all the parts and fittings, see "*Car Builders' Dictionary*," pp. 8-10, and illustrations cited, pp. 392 *et seq.*

The inventor of the bell cord on cars was Capt. Ayres, who, in 1842, introduced it on the train of which he was conductor. — *Paterson (N. J.) Press.*

Bell Mag'net. An audible alarm. A clapper is caused to strike the bell by completing the electric circuit, the connecting wire leading from the apartment whence the call proceeds.

Fig. 274.



Bell Magnet.

Electric bells are now extremely common in departments, offices, manufactories; placing a proprietor or superintendent in connection with any office or department in his building or abroad.

Bell Met'al. An alloy which does not tarnish nor crack, has a good sound, and relatively moderate weight, is prepared as follows: —

Nickel 1 pound, copper 6 pounds, are melted and cooled.

Add zinc 1 pound, aluminum ½ ounce. Melt and cool.

Melt and add ½ ounce quicksilver and 6 pounds melted copper.

Other recipes: —

	Copper.	Tin.	Lead.	Iron.	Zinc.
Useful bell metal . .	144	53	–	3	–
Useful bell metal . .	53.5	10	2.13	–	–
House bells	16	4	–	–	–
Soft musical bells .	16	3	–	–	–
Common bells . . .	50	15	–	–	–
Bells of Rouen . .	40	5	2	–	3
Chinese gongs . . .	40	10	–	–	–

An imitation silver, having sonorous quality: —

Take one part of pure pulverized manganese, one part of copper filings, and two parts of animal charcoal. Intimately mix these substances and expose the mixture to a high temperature in a graphite crucible. After cooling, will be found at the bottom of the crucible, a substance having the appearance and sound of silver. This substance is ductile, malleable, and easily takes the finish of silver.

Bel'lows Steam-en'gine. A form of engine invented by Reilley, in which steam extends longitudinally an expansible bellows-sided chamber, the head of which carries gudgeons which connect by rods to the crank shaft. The moving head, the equivalent of a piston, is in fact placed between two such chambers, which act upon it in succession.

"*Scientific American Supplement*," * 181.

Bell Pump. A bell-shaped pump; used in cleaning gas and service pipes.

Harris, Griffin & Co., in "*American Gas-light Journal*," * July 3, 1876, p. 9.

Bell Punch. A hand-punch, for perforating a ticket or trip slip. It secures the piece punched out, and rings a bell; in some instruments it also registers the fares collected.

Bell Ring'er. Reese's bell-ringer, for ringing the bells of locomotives, is an application of steam to a small piston, which acts upon a sliding bar connected to the bell crank.

"*Railroad Gazette*," * xxiv. 415.

Bell Rope. See BELL-CORD.

Bell Strap. A signal strap in a street car, reaching along the ceiling to a bell at the forward end. It forms the means of communication between the conductor and the driver; or, in some cars, the passengers and the driver.

Bell Tel'e-graph. An indicator for hotels, steamers, etc. A series of plates inscribed with the numbers of the rooms; the ordinary wants of the guests, etc., are connected by wires with the various apartments, and are displaced so as to attract the attention of the clerk in waiting, by touching appropriate knobs in the various rooms.

Fig. 275.

Bell Telegraph.

In the illustration the apparatus is an alarm telegraph, in which an indicator for each of six apartments may show where the entrance of unauthorized persons has taken place.

Bell Tel'e-phone. The articulating telephone of Alexander G. Bell. See TELEPHONE, TRANSMITTER, etc.

Bel'ly-pipe. A flaring blast-pipe nozzle for blast furnaces. In Vielhaber's patent, 182,621, — the belly-pipe nozzle is hollow, and has inlet and outlet pipes for the circulation of water there through. See, also, WATER BREAST.

Belt. (*Mining.*) 1. A body strap with chain attached by which miners draw corves in the workings.

2. A strap for transmitting motion.

The following dimensions and weights of large belts are given in the journals: —

New Jersey Zinc Co., Newark, N. J., 102′ long, 4′ wide, 2,200 lbs. weight.

J. B. Hoyt, New York, 186½′ long, 5′ wide, 2,212 lbs. weight.

P. Jewell & Sons, Hartford, Conn., 147½′ long, 3′ wide, 1,130 lbs. weight.

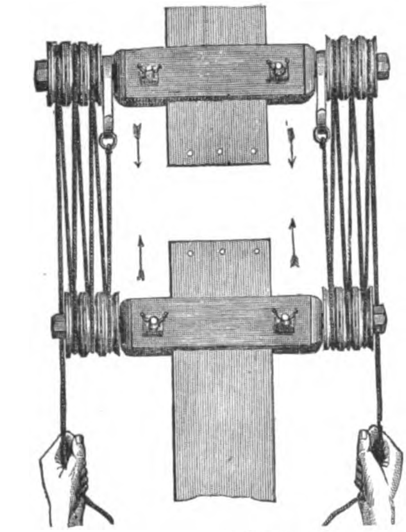
N. Y. Belting and Packing Co. (Makers), 331′ long, 4′ wide, 4,000 lbs. weight. For use in N. Y. Central and Hudson River Railroad Elevator, Sixtieth Street, New York.

Sampson & Co., Manchester, England, 90′ long, 38″ wide. Said by "*British Trade Journal*" to be "the largest ever made in England."

Belt Clamp. A device for approaching the ends of belts in position in order to lace or otherwise attach them.

Fig. 276 has two wooden vises clamped fast to the respective belt-ends, and drawn together by cords and pulleys in order to approach the ends of the belt and hold them while being laced.

Fig 276.

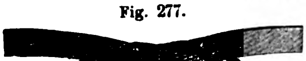


Spiers's Belt Clamp.

Belt Coup'ling. A device for attaching the ends of a belt. See Belt Fastener.

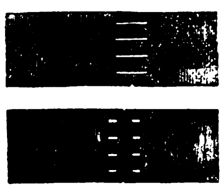
Belt Fast'en-er. In addition to the examples of means for attaching the ends of belts, and shown in Fig. 649, "*Mech. Dict.*," several others are here shown. See also Belt Screw.

Fig. 277.



Lincolne's Belt Fastener.

Fig. 278.



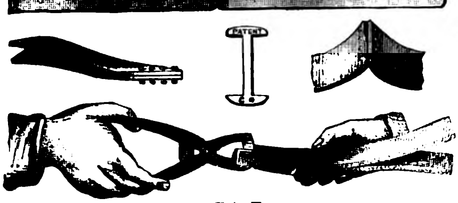
Clinched Staple Belt Fastener.

In Fig. 278 a row of holes being made in each end of the belt, the staples are inserted therein, and the ends turned down and clinched.

Fig. 279 shows Greene's belt-fastener and the tool for inserting the headed pins.

In Fig. 280, in addition to the security of the usual method of attaching the cord to the coupling, — by screwing it in and then riveting, — a gimlet-pointed screw, of the same pitch as the threads in the coupling, penetrates the center of the cord.

Fig 279.



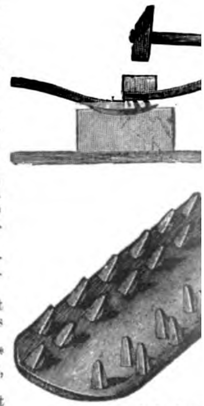
Greene's Belt Fastener.

Harris's belt fastener is a shield-shaped piece with hooking studs. It is applied as follows: Lay the casting, teeth uppermost, on something solid, place one end of the strap on one of the sets of teeth and hammer it on. Repeat the with the other end of the strap on the set of teeth. The curve of the plate gives the hooking position to the teeth.

Fig. 280.

McBride's Coupling for Round Belts an

Fig. 281.



Harris's Belt-fast

The following notices may be referred to: —

Several belt couplers, Scholl's "*Mechanic's Guide*," 483-485.

Ends of belt scarfed, glued, pressed, and fastened with shoe pegs, Cooper's "*Belting*," 183.

Dried eel-skin lacings, Cooper's "*Belting*," 183.

Wilson's belt hooks,* Cooper's "*Belting*," 184.

Blake's belt studs,* Patents April, 1860, March, 1861.

"Champion" belt hook,* Cooper's "*Belting*," 186.

McIntosh & Sons, Scotch, machine rivete "*Belting*," 186.

Lincolne, belt fastener,* "*Engineer*," Jan. 2

Belt coupling,* *Howarth*, "*Mech. Mag.*," xci

J. B. Hoyt & Co., Cooper's "*Belting*," 188.

Belt fastener, *Badger*, Br., * "*Engineer*," 1.

Belt'ing.

Rohrer's "Improved Union Belting" is made between two or more thicknesses of leather, layers of heavy duck, and then riveting or stitc out the entire length.

Walrus hide belting is manufactured from which are from 0.5″ to 1.25″ in thickness. — " *ing Journal.*"

Holbrook's folded-twist belting is a round la tented June 18, 1872.

Alexander Bros. patented belting, June 15, 1 the mode of cutting the hide and making the put the firmest portion of the leather on the belt, to prevent them from becoming convex o

Sheep intestines (which average 55′ in lengt used for belting. — Cooper "*Belting*," xv.

Eel skins, for bands and ropes, "*Journal F tute*," April, 1844.

Gut bands, Clark's "*Exhibited Machinery o* don.

Steel belting, "*American Artizan*," Aug. 2, 1

Round belts of catgut or hemp, Fairbairn *Millwork*," ii. 1.

Round belts in multi-grooved pulleys, *Ne *nal*," 1857, N. S. vi. 163.

Comparison of rubber, gutta-percha, and leather. J. B. Hoyt, quoted in Cooper's "*Belti* kine's "*Machinery and Millwork*."

Gut woven into ribbons, *Edwards*, Eng., C *ing*," 128.

Woolen bands, *Heywood*, Eng., Cooper's "*B*

Gutta-percha with wire-gauze core, *Rattier*, "*Belting*," 129.

Raw hide, "*Engineering*," June 19, 1874.

Russian sheet-iron, *Spiers*, Cooper's "*Beltin*

Alexander, Wide leather belting,* Patent Ju

Vulcanized rubber belts, Cooper's "*Belting*,"

Edge-laid belt,* *Leigh*, Cooper's "*Belting*," Haines, Eng., Patent Feb. 14, 1860.

Paper belting, *Crane*, Cooper's "*Belting*," 1

Water-proofed belting, Cooper's "*Belting*," 2

Angular belting, *Underwood*, Cooper's "*Belt*

Angular belting, *J. B. Hoyt*, Cooper's "*Belting*," 205.
Compound leathern belts, European, *Auchincloss*, "*Paris Exposition Report*," 1867.
Steel wire flat woven belting, "*Practical Mechanical Journal*," Nov., 1867, 237.
Thin sheet metal coated with rubber, *Sanderson*, Eng., Patent Dec. 8, 1862.
Strips of metal covered with gum, made into a flat band, with a weft of hemp, *Spile*, Eng., Patent Nov. 9, 1859.
Woolen belt covered with resinous cement, "*London Mech. Mag.*," March, 1868.
Alternate links of leather and metal, *Clissold*, "*Franklin Institute Journal*," Aug., 1868, p. 121.
Consult Cooper's "*Treatise on the Use of Belting*," 310 pp. Phila., 1878.
It contains a large collection of authorities, figures, tables, rules, and formulas.

Woven cotton	"*Iron Age*," xxi., Jan. 10, 24.
Calculating power of	"*Scientific American Sup.*," 612.
Jewells' factory	* "*Scientific American*," xlii. 95.

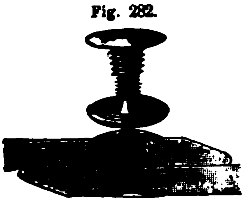
Belt'ing Ce-ment'. For leathern belting. Take common glue and American isinglass, equal parts, place them in a boiler and add water sufficient to just cover the whole. Let it soak ten hours, then bring the whole to a boiling heat, and add pure tannin until the whole becomes ropy or appears like the white of eggs. Apply it warm. Buff the grain off the leather where it is to be cemented; rub the joint surfaces solidly together, let it dry for a few hours, and it is ready for practical use; it is said that, if properly put together, it will not need riveting.

Belt La'cing.

Dried eel skins	Cooper's "*Belting*," 183.
Directions for lacing paper belting	Cooper's "*Belting*," 187.
Annan	"*Sc. Am.*," Jan., 1866.

Belt Screw. A clamp screw for fastening belts. The fastening consists of two screws, one with a right and one with a left hand thread.

Fig. 282.



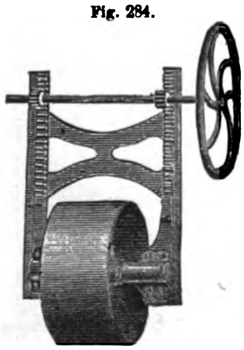
Sonnenthal's Belt Screw.

The former is of bronze and has a coarse exterior thread cut conically, while the hollow has a fine thread tapped inside. The interior screw is of steel, and has a conical shoulder underneath. The heads of both screws are slightly rounded and formed with circular grooves on the under side, to give them a firm grip on the leather. The conical screw is first run into the

Fig. 283.

Belt Shipper.

Fig. 284.



Noyes' Belt Tightener.

leather, and the steel screw is then introduced. The belt is run with the head of the latter on the inner side.

"*Engineering*," * xxviii. 69.
"*Engineer*," . * xlviii. 84.

Belt Ship'per. 1. A pivoted lever, to shift a belt from a tight to a loose pulley, or *vice versa*. Fig. 653, "*Mech. Dict.*"

2. A hand implement: a conical pin with a flange, on the end of a staff. See Fig. 273.

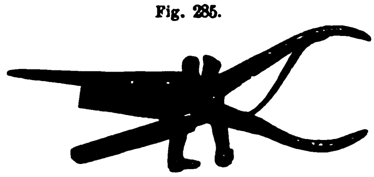
Selig . . . . . "*Engineering*," * xxiv., 135.
Cooper on "*Belting*," 209.

Belt Ten'sion Ap'pa-ra'tus. Apparatus for determining the variation of tension of belts, used by A. Morin, * Cooper's "*Belting*," 244. See also "*Morin's Mechanics*," N. Y., 1860.

Belt Tight'en-er. In Noyes' belt tightener the pulley is journaled in an iron frame capable of being moved in slides by means of rack and pinion, to increase or diminish the frictional adherence of the belt.

Tightener	*Walker*	* "*Am. Miller*," v. 141.
Tightening pulleys,	*Sellers*	* "*Engineer*," xlii. 64.
	Cresson	* "*Engineer*," xlii. 64.
	Jones & Laughlin	* "*Engineer*," xlii. 64.

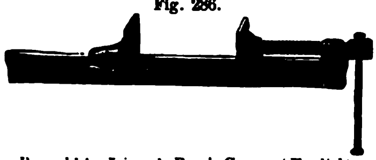
Fig. 285.



Belt Punch and Cutter.

Belt Tool. A combination of punch, cutter, awl, and nippers.

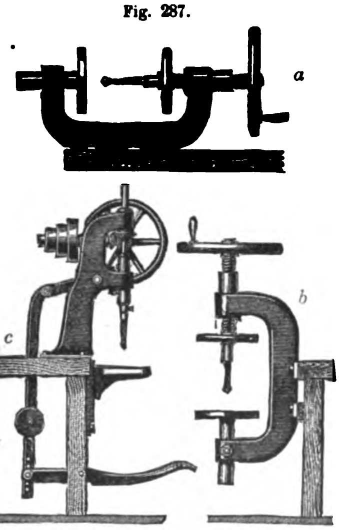
Fig. 286.



Reynolds's Joiners' Bench Cramp (English).

Bench Cramp. A clamping tool used on a bench in securing pieces of work together, or holding a piece while under treatment.

Fig. 287.



Bench Drills. (Atlantic Works.)

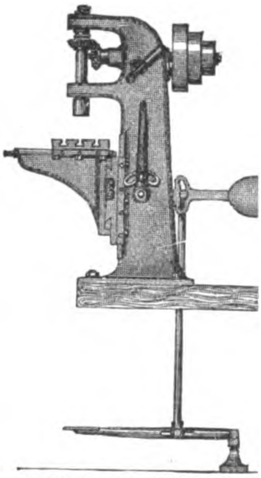
Bench Drill. A hand or machine-drill attachable to a bench.

Fig. 287 shows: —

a. A hand-drill on vise-bench, the spindle horizontal

b. Drill arranged with cone for countershaft, and adapted to be driven by power or by hand; the spindle adjusted by the foot.
c. Drill on vise-bench: spindle vertical.

Fig. 288.



Whitworth's Bench Drilling Machine.

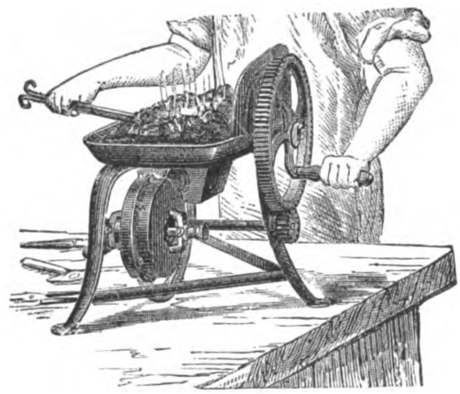
Bench Dril'ling Ma-chine'. In Sir Joseph Whitworth's bench drill, the machine is fixed to a bench, and the work on the rest is raised to the drill by hand-lever or treadle.

Bench Forge. A small hearth and blower, to be used on a workman's bench. Fig. 289. Such a forge will weigh 50 pounds, and heat to redness ¾″ iron in two minutes.

Bench Hatch'et. One of the form shown in Fig. 293, is used in bench-work.

Bench Lev'el. A machinist's level, Fig. 290, used in setting up machines in placing their beds strictly horizontal.

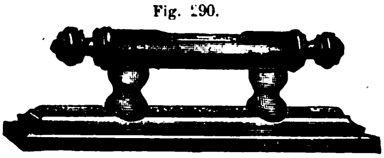
Fig. 289.



"Empire" Bench Forge.

Bench Sail'-hook. A hook used by sailors

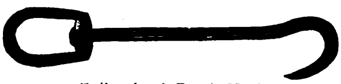
Fig. 290.



Bench Level.

and sail-makers as a holder for the sail when sew-

Fig. 291.

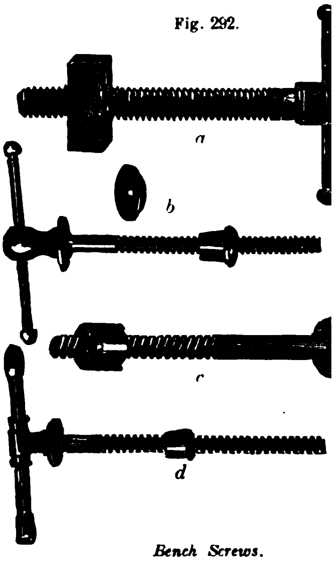


Sailmakers' Bench Hook.

ing. The loop being passed over a nail or other object, the sail is caught upon the hook and held against the pulling of the sailmaker a his canvas taut to make a straight seam.

Bench Screw. The screw for fas vise jaw of a carpenter's bench.

Fig. 292.



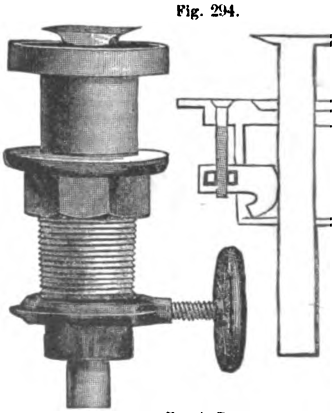
Bench Screws.

a, is the ordinary wooden bench scre
b, is an iron screw with iron handle.
c, *d*, are iron screws with wooden ha

Bench Stop. A device on a carpenter's bench which can be raised to hold a piece which is being worked, against the thrust of a plane. In the ordinary form it is a square prism which is lifted above the general level of the bench, but in the superior forms shown in Fig. 294 the piece is of iron, has a talon and is adjustable. The bench stop on the left in Fig. 294 has a screw socket in which the stop is raised and held by a screw. The other bench stop in the figure is held by a cam-piece which is controlled by a screw.

Br

Fig. 294.



Bench Stops.

Bend. A flexed pipe, changing If it be angular, it becomes a ***branch***.

Bend'ing and Straight'en-ing Ma-chine'. A machine for bending or straightening iron bars or plates.

Fig. 295.

Pipe Bends.

a. Eighth bend.	*e.* Offset bend.
b. Flanged eighth bend.	*f.* Flanged offset bend.
c. L or quarter bend.	*g.* Return bend.
d. Flanged L bend.	*h.* Double hub bend.

Bement's machine is capable of bending plates of any length up to 10½'. Both lower rolls have a positive motion by gearing and are driven by two belts, by which they can be run in either direction. Each of the rolls is cast upon a large wrought iron shaft forming the journal bearings, the upper one being extended at one end to receive the pressure of a screw, which supports the upper roll when a circle or flue is to be removed at the other end, the jointed bearing being movable for that purpose. The two ends of the upper roll have a vertical adjustment, together, or separately, by hand-wheels at the end of the machine. The usual diameter of the lower rolls is 10″, upper roll 11″.

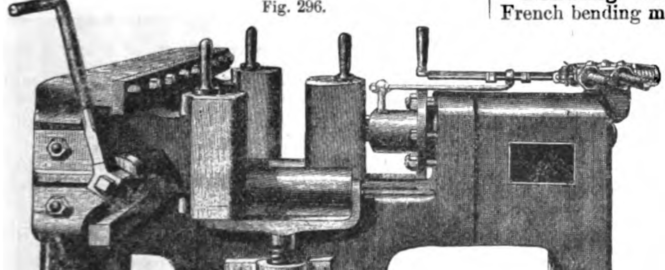
Tweddell's hydraulic bending and straightening machine for angle-iron, beams, pipes, etc., has no gearing, and the pressure cannot exceed that due to the accumulator. The machines are generally made to work at a pressure of 1,500 lbs. per square inch, this being the pressure at which Tweddell's riveting, punching, and shearing machines work; but they can be made to work at any other pressure if desired. The position of the abutting blocks is altered by means of a right and left-handed screw, thus ensuring exact work and saving much labor.

The stroke of the machine can be varied from *nil* to the maximum travel; this is an advantage over a geared machine, or when a cam is used, since the cam must either complete its revolution, or else a break-down occurs, should too large a piece of work be put in. By means of the tappet-gear exact uniformity of stroke can be obtained for consecutive operations; the valve can be worked by the man's foot if desired, leaving his hand free; and the pressure can be kept on as long as desired.

Several of these machines of different powers are found in the British and French government dock-yards.

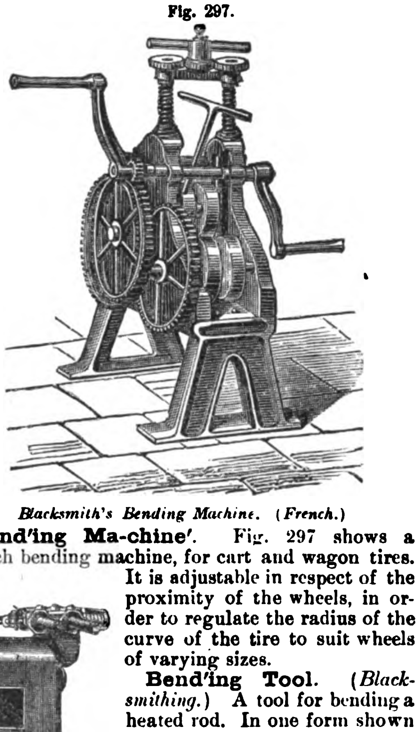
Hyd. Toulon Arsenal . .	* "*Engineer*," xliii. 24.
Bennie, Br.	* "*Engineer*," xliv. 386.
Bar Straightening Machine .	"*Iron Age*," xix., Jan. 18, 3.
Howells	* "*Scientific Am.*," xxxiv. 306.

Fig. 296.



Tweddell's Hydraulic Bending and Straightening Machine.

Fig. 297.



Blacksmith's Bending Machine. (French.)

Bend'ing Ma-chine'. Fig. 297 shows a French bending machine, for cart and wagon tires. It is adjustable in respect of the proximity of the wheels, in order to regulate the radius of the curve of the tire to suit wheels of varying sizes.

Bend'ing Tool. (*Blacksmithing.*) A tool for bending a heated rod. In one form shown in Fig. 298 it is a hand-bar with a crotch; in the other the crotch is to be planted in the hardy-hole of the anvil, in the manner of a swage-tool.

Bent Beam.

An article on bent and built arched beams, published in the "*Building News*," was reproduced in "*Scientific American Supplement*," * 2035. It has numerous references, ancient and modern.

See also Figs. 312–316, pp. 138, 139, "*Mech. Dict.*," and *Price's* "*British Carpenter*."

L'Orme's "*Nouvelles Inventions pour bien Bastir*," 1561.

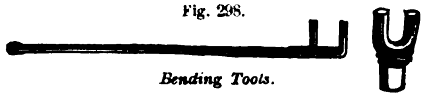
Emy's "*Nouveau Système d'Arcs pour les Grandes Charpentes.*" Paris, 1828.

Tredgold's "*Carpentry.*"

Gwilt's "*Cyclopædia of Architecture.*"

Be-rard' Steel. (*Metallurgy.*) Steel made by adding hydrogen gas to the air-blast of Bessemer, to remove sulphur, phosphorus, and arsenic.

Fig. 298.



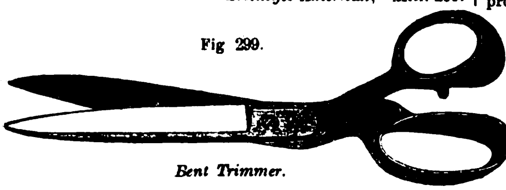
Bending Tools.

Ben-zine'. A hydro-carbon product of petroleum.

Ben-zole'. A hydro-carbon product of coal, made from coal-tar. Distinguishable from *benzine* by placing a piece of pitch in a test-tube. Benzole dissolves it into a tar-like mass Benzine is scarcely colored by the pitch.

Benzole, its compounds and derivatives,
"*Scientific American*," xliii. 200.

Fig 299.



Bent Trimmer.

Bent Trim'mer. A tailor's shears, bent in the handle so as to make the scissors run more readily upon the board on which the cutting is being done.

Bent Wood Fur'ni-ture. A Vienna industry which has been widely extended of late.

The wood employed is Carpathian mountain beech. The practice in Kohn's factory, in Vienna, is about as follows: —

"The wood to be utilized is cut in the forest, by means of easily transportable steam saw-mills, directly into strips of the dimensions that the separate pieces of the furniture have in the rough. These strips are then conveyed to the factory, where a considerable quantity is simultaneously subjected to the action of steam, until it is both thoroughly saturated therewith, and the vegetable juices largely removed. In this condition the wood is extremely flexible, and when dried is far more durable than when in its natural state, inasmuch as the operation washes out all the soluble constituents and leaves the unalterable cellulose, or woody fibre, behind.

"After steaming, each of the pieces is forced into an iron form, having the shape which the stock is finally destined to possess, and allowed to remain there until quite dry. The several subsequent processes of joining and finishing, involved in the union of the bent sticks into the completed article of furniture, need not be described.

"The advantages possessed by furniture constructed of bent instead of sawed pieces may be briefly summarized as follows: The bent wood furniture possesses superior strength and durability, with the smallest quantity of material, which permits of that admirable combination of lightness with elegance of design which characterizes this class of furniture. The widest scope is allowed for the exercise of artistic talent since the bending process permits of the production of the most varied and intricate patterns." — *Official Report.*

Ber'lin I'ron Work. Very fine cast-iron work such as jewelry, chains, etc., made in Berlin. The art is said to have originated in 1813, when the people of Prussia generally gave their jewelry to the government to assist in resisting Napoleon, and received in exchange similar articles made of cast iron. Some of the separate pieces of which these articles are made up are so small that it is said that there are nearly 10,000 in a pound weight.

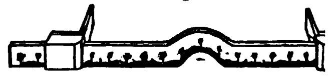
Berth. A bed in a vessel's cabin or state-room, or in a sleeping car.

Berth, Ship's, Self Leveling.
Huston . . "*Scientific American*," xlii. 341.
Berth, Swinging.
Andrews . . * "*Scientific American Supplement*," 125.
Couch, Equilibrio.
Anderson . . * "*Scientific American*," xxxvii. 134.

2. A position occupied by a vessel alongside a quay or wharf.

Be-si-clom'e-ter. (*Optical.*) An which indicates the proper breadth of

Fig. 300.



Besiclometer.

between hinges; that is to say, the bre forehead.

Bes'se-mer Steel. (*Metallurgy.*) in convertors from cast iron. A blas driven through the molten metal to carbon and silicon. Spiegeleisen is adde oxides. See pp. 277, 2364, 2365, "*Mech*

"At the period of the Crimean war, the B production of all kinds of steel was only tons, but immediately after the close of Bessemer process was invented, and in than 850,000 tons of steel were made by it Britain.

"The production of Bessemer steel in al 1879 was about 2,700,000 gross tons of ing 000 tons of rails.

Country.	Ingots. Gross tons.
United States	829,489
Great Britain	834,711
Germany	450,000
France	250,000
Belgium	100,000
Austria	100,000
Russia	50,000
Sweden	20,000
Total	2,634,150

"There are eleven establishments in the Un the manufacture of Bessemer Steel — one in in Pennsylvania, one in Ohio, three in Illino Missouri; all of these, except the last, were ir 1878. Each establishment has two convertors *J. Morrell.*

See *A. L. Holley's* report of Group I., "C *ports*," iii., pp. 85–87.

"The Bessemer practice of the United States by that of any other country in the world. Britain falls far behind it. With 114 converto of which may be presumed to have been active produced in 1878 only 850,000 tons of ingo United States in the same year, with 22 conv of which were active, produced exactly 653,77 of ingots.

"The firm of Brown, Bayley & Dixon, of land, exhibited at the Paris Exposition, 1878, a rolled direct from the ingot, and bent into four each, the whole measuring 4½' across." — *Ho rell.*

The following may be consulted: —

Bessemer, Account of . . . "*Sc. Am. Su*
Convertor bottom, *Jones* . . * "*Iron Age*," x
Bessemer's Inventions . . . "*Sc. Am.*," x
Ladle stopper, *Lance*, Br. . * "*Engineer*," x
Bessemer plant
Brown, Bayley & Dixon, Br. * "*Engineer*," x
Cambria Iron Works . . * "*Engineering*,
Cleveland . . . . * "*Engineering*,
Edgar Thomson Co. . . . "*Iron Age*," x
Holland . . . . * "*Sc. Am. Su*
Basic process, *Holley* . . . * "*Engineering*,
Vulcan Iron Co., St. Louis. * "*Engineering*, 208.
"*Iron Age*," xvii
Bessemer steel, "*Times*" . "*Van Nostra* xviii. 239.
Steel apparatus . . . . * "*Sc. Amer.*,"

Bé'ton. The aqueduct from La Paris, 135 miles long, is nearly entir *Coignet.* The Fontainebleau section over dry quicksand, is composed of arches, some of them 50' high. Ei bridges of span from 75′ to 90′ are also of *béton*. For foundation and gravel walls, the composition is, sand 2½, gravel 2½, hydraulic lime 1, Portland cement ½. For pillars, abutments, etc., sand 4, hydraulic lime 1. The other portions, sand 4, hydraulic lime 1, Portland cement ¼ to ½.

The ingredients are mixed in a dry state, then slightly moistened and ground in a mill that transforms it into a paste almost dry, which is then directly put into the molds. The latter are made of wood lined with sheet iron on the inside. The material is thrown into them by hand and stamped. As soon as the mold is filled it is turned out and left to dry for a few days, as it is only then that it will bear transportation. Compressed *béton* pipe is hard, compact, homogeneous, and resists a very high pressure. It has a smooth surface, so that the flow of the water is greatly facilitated. As this pipe is absolutely tight, filtration of noxious matter is impossible.

The Santorin *béton* used at Pola, was composed of Santorin earth — a volcanic product from the Greek island of Santorino — and common lime paste, in the proportion of 7 cubic feet of the former to 2 cubic feet of the latter, forming the hydraulic mortar; and to this was added 7 cubic feet of broken stone of the size usually employed in making concrete. The whole yielded a batch containing 9 cubic feet, was made into a conical heap, and tempered by open air exposure for a period varying from one day to three days, when the heaps were ready to be used under water.

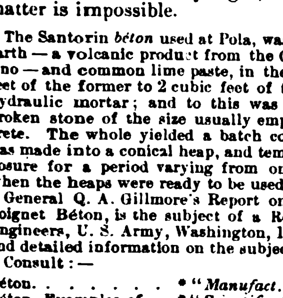
General Q. A. Gillmore's Report on *Béton agglomèré*, or Coignet Béton, is the subject of a Report of the Corps of Engineers, U. S. Army, Washington, 1871, and contains full and detailed information on the subject.

Consult: —

Béton. . . . . . . * "*Manufact. and Builder*," x. 126.
Béton, Examples of . * "*Scientific American Sup.*," 1872.
Manufacture, *Goodridge* "*Scientific Amer.*," xxxvii. 201.
Repairing with, *Goodridge* "*Scientific American Sup.*," 1509.
Under water . . . . "*Scientific American*," xxxvi. 246.
Fountain in Prospect Park, Brooklyn.
* "*Sc. Am.*," xxxviii. 215.
Aqueduct of La Vanne. * "*Sc. Am.*," xxxiv. 194.
* "*Sc. Am. Sup.*," 660.
Manufacture of Béton blocks, N. Y. Docks.
* "*Sc. Am. Sup.*," 364.
List of uses of Béton: fountains, arches, tunnels, foundations, buildings, piers, floors, etc. * "*Sc. Am. Sup.*," pp. 1872–74.

Bev′el. An instrument with a handle and adjustable blade, the latter, in the example shown, being secured at any angle by a peculiar arrangement. By moving the thumb-piece at the lower end of the handle the longer lever acts upon the shorter one, which latter, being attached to a nut inside the upper end of the handle, operates as a wrench to turn it upon the screw, and thus fasten or release the blade.

Fig. 301.

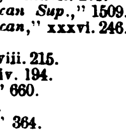


Bevel.

Bradshaw's bevel, * "*Sc. Amer.*," xxxv. 338.

Bev′eled Fur′ni-ture. (*Printing.*) The *side-sticks* and *foot-sticks* used in *imposing* forms or *locking up* galleys; beveled (tapered) pieces of wood or metal, less than type high.

Fig. 302.

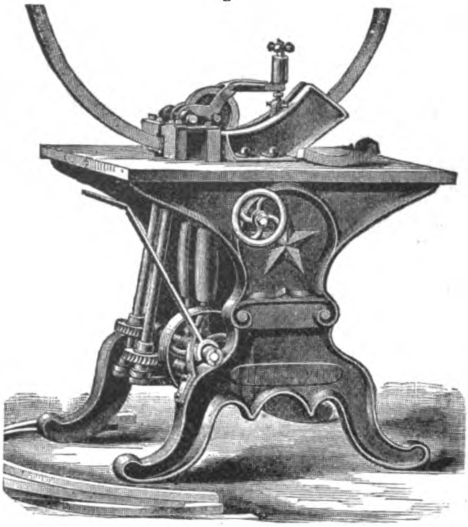


Beveled Washer.

Bev′eled Wash′er. A washer with an upper face oblique with the base, so that a nut with oblique presentation may seat itself squarely upon it.

Bev′el Fel′ly-pla′-ner. A machine for dressing the sides of fellies or bent rims, either square or beveling. It has a strong feed, easily regulated, and is adjustable for different sizes of fellies, and from square to bevel work. It bevels the rims before they are rounded inside, ready for finishing by the sand belts.

Fig. 303.



Bevel Felly-planer. (*Fay & Co.*)

Bev′el-gear′ Cut′ting Ma-chine′. Corliss's bevel-gear cutting machine was shown in the Machinery Hall, Philadelphia, 1876, near the great beam-engine. See "*Centennial Report.*"

Grub's bevel-gear cutter was shown in the German section of the same Exhibition. See GEAR CUTTER.

Corliss . . . . * "*Engineering*," xxv. 288.
Corliss . . . . * "*Engineer*," xlii. 364.
Corliss . . . . * "*Sc. American Sup.*," 783.
Corliss . . . . * "*Sc. American Sup.*," 369.
Anton, Fetu & Deliège, Belg. * "*Engineering*," xxvii. 195.

Bev′el-head Bolt. A carriage bolt with a truncated conical head, as seen in Fig. 304.

Fig. 304.

Bevel-head Bolt.

Bev′el Hub. A form of bent pipe connection. See HUB, BEND.

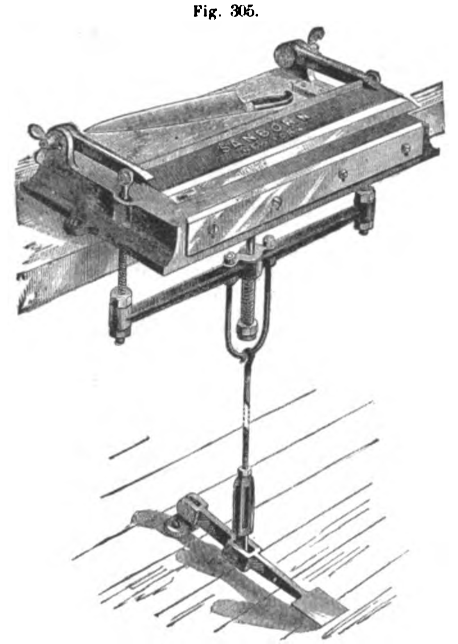
Bev′el-ing Ma-chine′. 1. (*Stereotyping.*) A machine for dressing off and beveling the edges of stereotype and electrotype plates equally on all sides, and parallel to the matter. The edge of the printing matter is placed against an adjustable side gage, secured in this position by clamps, and passed quickly before the revolving cutter, a stationary cutter at the same time taking off the sharp corner from the under edge of the plate. The table can be adjusted in height and also inclined to give a bevel more or less acute, and the revolving cutter-head is adjustable horizontally to suit the position of the table. A brass cover over the cutter prevents the chips from flying, and drops them into a box below.

2. (*Bookbinding.*) A clamp for holding binders' boards while being beveled by the knife.

In Sanborn's machine, Fig. 305, the board is placed between the jaws, and the upper jaw brought down by the treadle to clamp and hold the board. The board is adjusted by back and front gages. The paring knife has the two metallic edges to guide it.

Fig. 306 is Hoe's machine for the same purpose.

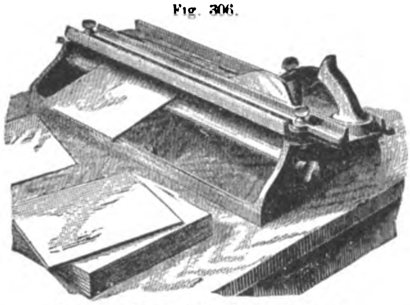
Fig. 305.



Foot Beveling Machine.

It is of metal. The plane runs in an oblique channel so as to use the whole edge of the knife, and give a shearing cut to the board. The table is

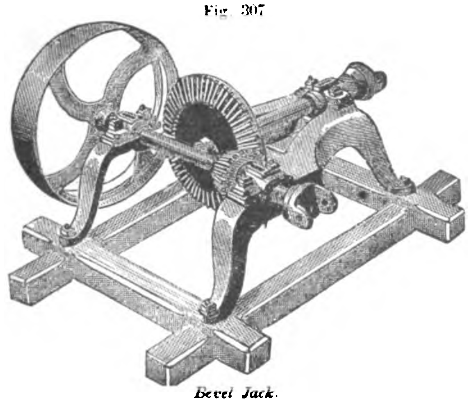
Fig. 306.



Beveling Machine for Binders' Boards.

adjustable to give any required bevel. The front gage or stop is formed by the farther edge of the groove; the end gage is movable on the table.

Fig. 307



Bevel Jack.

Bev'el Jack. An intermediate geari
a prime motor and a machine to be dr
the motion of a tumbling rod is to be
cated to a band, and thereby to the macl

In the *bevel* jack the gearing is by l
and pinion.

In England called an *intermediate moti*

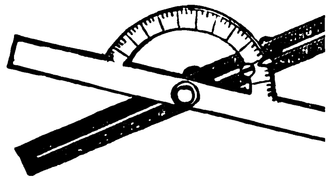
Bev'el Joint. A miter or sloping
faces being dressed to an angle, usually

Bev'el Pla'ter. A mill for rolling l
circular plates. The thickness is decrea
center circle to the edge; such plates
for shingle and veneering saws.

Jepson . . . . . "*Scientific American Su*
Pedder & Abel . . . "*Scientific American Su*

Bev'el Pro-tract'or. A drafting

Fig. 308.

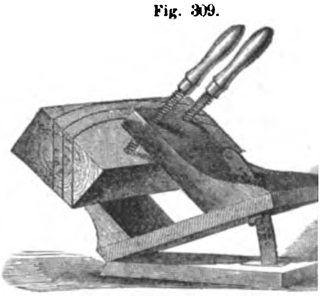


Bevel Protractor.

with a pivoted sliding arm, which has a
divided to degrees. Fig. 308.

Bev'el Rest for Band Saw Cu

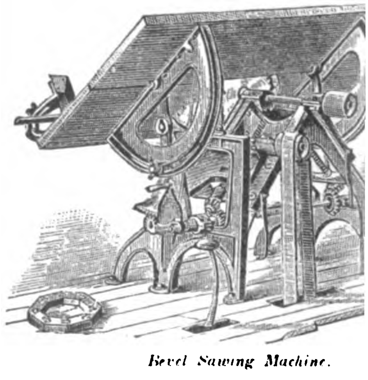
Fig. 309.



Rest for Bevel Cutting with Band Saw (*A*

holder for stuff on the band-saw table,
arc adjustment of being inclined so as
the stuff obliquely to the table base to
any angle by the saw.

Fig. 310.



Bevel Sawing Machine.

Bev'el Saw'ing Ma-chine'. A
table of which has underneath sector

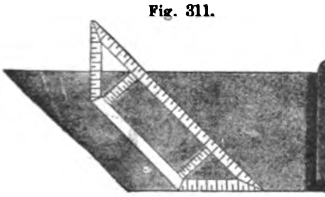
so as to be set at any inclination, and present the stuff to be split obliquely by the saw.

See also BAND SAW, Fig. 196 *supra*, and Plate III., opp. p. 76; also BEVEL SCROLL-SAW, p. 279, Fig. 669, "*Mech. Dict.*"

Bi'ar-etz. (*Fabric.*) A French goods, warp and weft of merino wool, and woven with a corded or cannel armure.

Bi'as Meas'ure. A graduated measure with

Fig. 311.



Bias Measure.

ends at angles of 45° with the base, to assist in measuring and marking off or cutting goods to be "cut on the bias."

Bibb. A bent-nosed faucet.

Plumbers catalogues cite many varieties: three are shown in Fig. 672, p. 280, "*Mech. Dict.*" Others are known as —

Plain Bibbs,	Compression Bibbs,
Hose Bibbs,	Telegraph Bibbs,
Wash-tray Bibbs,	Bath Bibbs, etc.

Biche'roux Fur'nace. (*Metallurgy.*) One form of GAS-GENERATING FURNACE, which see.

May consult: —

"*Engineering and Mining Journal*,"	* xxi. 55; xxiv. 862.
"*Scientific American Supplement*,"	* lxxxviii. 1331.
"*Iron Age*"	* xvii., Jan. 13, p. 24. Jan. 29, p. 1.
"*Engineer*"	* xlvi. 91.

Bi-chro'mate Bat'te-ry. (*Electricity.*) One in which bichromate of potash with dilute sulphuric acid is used as an exciting fluid.

Grenet's is a familiar instance, having a zinc element between two carbons.

Prescott's "*Electricity*"	* p. 72
"*Niaudet*," American translation . .	211, * 223.
"*English Mechanic*"	xxiii. * 12, *466.
Simple form of. "*Sc. American Sup.*,"	* 2263.
Erck, "*Scientific American*" . . .	xl. 169.
Brgström, "*Sc. American Sup.*," . .	3791.
McCarty. "*Sc. American Sup.*," . .	3791.

Bi'cy-cle. A two-wheeled vehicle, the *ultima ratio* of the old velocipede.

The "Paragon" may serve as an example. The spokes are of wire, and on the spider-web principle, each spoke having an independent tension. The fellies are of angle iron, the angle holding the round hoop of caoutchouc, ⅞" diameter, which is secured by cement. The backbone is tubular; the front wheel runs on conical bearings.

The pedals are of two kinds: wooden blocks with steel bushes and pins, and oval or triangular pedals composed of steel pins, mounted in brass, and covered with India-rubber.

The handles are of rosewood, ebony, or ivory, upon a steel rod, the support of polished gun-metal, level with the top of the socket, an arrangement found to render it easier to mount and dismount, and giving more command over the machine generally, both in ascending hills and on the level.

Leg-rests are of two kinds, one of which is fixed to the front fork, folding up when not in use, and the other over the front wheel.

The saddle is placed as near the wheel as practicable, to enable a rider to use a machine with wheels as high as possible.

Turner, Eng.	* "*Sc. American Sup.*," 1999.
English	* "*Sc. American Sup.*," 856. "*Sc. American Sup.*," 1283.
"Columbia"	* "*Sc. American*," xl. 35. * "*Sc. American Sup.*," 2585.
Garrood	* "*Sc. American Sup.*," 1569.
Manufacture	* "*Sc. American*," xlii. 181.
Otto	* "*Sc. American*," xxxix. 42.
"Paragon," "Ariel," etc.	* "*Sc. American Sup.*," 1160.

Bi-cus'pid For'ceps. (*Dentistry.*) Forceps

Fig. 312.

Forceps for Upper or Lower Bicuspids.

with moderately narrow curved beaks, adapted for the extraction of bicuspid teeth.

Bi-det'. A wash-pan, having special uses.

Bid'i-ri. (*Fine Art Metal Working.*) A species of damascening or inlaying upon an object made of an alloy of copper, lead, and tin, blackened by dipping in a bath of sal-ammoniac, saltpeter, salt, and blue vitriol. Named from Beder in Hyderabad.

Big'gin. 1. A hood or cap.

2. A percolator or strainer for holding coffee while boiling water is poured through it.

3. (Welsh, *pigyn*; Gaelic, *pigean.*) A small earthen pitcher or pot.

Bil'let. (*Harness.*) 1. A short strap punctured with holes and attached to various parts of the harness; used for connecting by a buckle different straps and portions.

2. (*Metallurgy.*) A bloom or loup of iron in the furnace or mill.

Bil'liards. See

Billiard cushion rail.	*Collender.*	* "*Sc. Am.*," xxxvii. 147.
Billiard table . . .	*Collender.*	* "*Sc. Am.*," xxxvii. 22.
Billiard table leveler	*May*. . .	* "*Sc. Am.*," xxxv. 211.
Billiard table manufacture . .		* "*Sc. Am.*," xl. 302.

Bind. (*Mining.*) Derbyshire: indurated clay.

Bind'er. 1. A binding reaper. See REAPER; REAPER AND BINDER.

2. A machine for binding gavels left in the swath by a reaper.

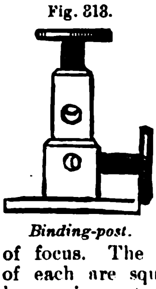
Fig. 315 shows a one-horse machine, having a gathering-rake in front which passes beneath the gavel, raises it by the assistance of a rake reel, and discharges it on to a rear platform, where it is bound, and from whence it is discharged. The machine follows in the wake of a self-raking reaper.

3. An implement to assist in hand-binding of sheaves. See SHEAF BINDER.

4. (*Mining.*) A piece of iron attached to a truck or barrel, and to which the pit rope is fastened.

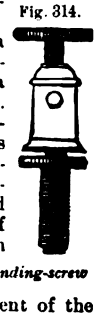
Bind'ing Post. (*Electricity.*) A device with a screw, which secures the end of an electric wire.

Fig. 313.



Binding-post.

Fig. 314.

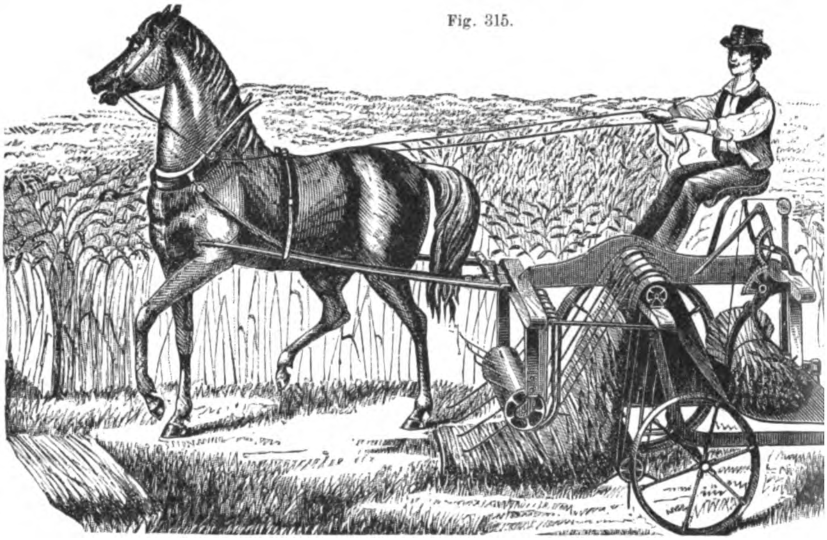


Binding-screw

The examples are a double table binding-post, Fig. 313, and a binding-screw, Fig. 314.

Bi-noc'u-lar Tel'e-scope. Ponti's (Venice) portable binocular telescope consists of two conjoined parallel telescopes of equal power and length of focus. The object-glass and tube of each are square, and each tube has a micrometer screw for the adjustment of the

Fig. 315.



Johnston's Sheaf Binder.

focus. The square form permits the eye-pieces to be brought to the same distance apart as the axes of the eyes of the observer.

Binocular microscope.
Molera & Cebrian . . . *"*Sc. American Sup.*," 3869.
Binocular vision . . . . . "*Sc. American*," xxxvi. 20.

Bi'o-scope. A double-vision instrument. In a recent invention of M. Eugène Simmonar, a portrait is shown with the eyes sometimes open, sometimes shut. The illusion of the same person alternately awake and asleep is very perfect. To obtain this effect, the inventor takes a double photograph of a sitter in exactly the same position, only in the first the eyes are open, in the second closed. From these two negatives prints are taken, one on the right side, the other on the reversed side of the same sheet of paper, in such a way that the two images, when viewed by transmitted light, accurately coincide; this can easily be done by the carbon process. By means of a small instrument arranged for the purpose, the light and reversed sides of the paper are alternately illuminated, and the face is seen with the eyes successively open and shut. Thus the illusion of a person rapidly winking can be perfectly produced.

Bird Foun'tain. A drinking vessel for birds, on the principle of the fountain inkstand.

Bis'cuit Ma-chine'. A machine for making crackers, biscuit, etc. See CRACKER MACHINE.

Bi-sec'tor. (*Surgical.*) A lithotomic instrument used in connection with a grooved staff in cutting the prostate gland in operating for stone in the bladder.

Fig. 133, p. 38, Part III., *Tiemann's* "*Armamentarium Chirurgicum.*"

Bis'muth Al-loy'. A careful statement of the character and uses of various bismuth alloys is to be found in "*Guettier's Metallic Alloys.*" Copied into "*Polytechnic Review,*" and also into "*Engineering and Mining Journal,*" xxii., p. 137.

Bismuth extraction process. *Painter's* "*Report Vienna Exposition,*" iv. 94.

Bis'muth Bronze. An alloy composed as follows:—

	Hard Bron
Bismuth	1
Lead	3
Zinc	6
Nickel	15
Copper	25
Antimony	50

"*London Mining Journal.*"
See also "*Mining and Sc. Press*" . xxx

Said to withstand oxidation, and to be p able for the preparation of lamp reflectors.

Bi-soc'. (*Agriculture.*) The Fre a two-furrow plow, or gang plow wit See GANG PLOW.

Bis'tou-ry. (*Surgical.*) A s knife. Fig. 692, p. 287, "*Mech. Dict*

The figures ensuing refer to the pages in *mamentarium Chirurgicum.*"

The *bistoury caché* has a concealed knife. and Figs. 76, 584, 591, Part III.

Staphylorrhaphy Bistouries, pp. 66, 67, P Part V.
Tenotome, p. 61, Part I.
Sharp-pointed Bistouries, pp. 6, 46, 56, Pa
Probe-pointed Bistouries, pp. 6, 46, 56, Par
Hernia Bistouries, pp. 6, 46, 56, Part I.
Finger Bistouries, pp. 6, 46, Part I.
Ear Bistoury, p. 46, Part II.

Bi-sul'phide of Car'bon Ap'p addition to the reference to the Ellis "*Mech. Dict.,*" consult Engl. Pat. 1 Two engines, one worked by stean vapor of ether, etc. The exhaust ste gine vaporizes the ether of the other

No. 11,625 additional thereto.
No. 96 of 1854, uses bi-sulphide of carbo
Pecoul, No. 1,008 of 1855, spiral tubes are coiled in each end of the cylinder.
Sulphuric ether is injected into each en alternately and vaporized in the tubes.
2,768 of 1853 mixes vapor of ether with a
See also: —

Bi-sulphide of Carbon Apparatus.
* "*Mining and Scientific Press,*" xx
Bi-sulphide of Carbon Engines.
"*Manufacturer and Builder,*" xii.
Bi-sulphide of Carbon Motors, Eng.
"*Iron Age,*" xxv. February 5, p. 1

Bit. (*Manége.*) The variety of bits used in England much exceeds our knowledge of the manége. The following are those on sale: —

Breaking bits.
Van and cab bits.
Wilson snaffles.
Snaffles and bits, polished, tinned, or galvanized.
Hackney bits and bradoons.
Pelhams.
Gig bits.
Buckstone, or fancy-cheek carriage bits.
Carriage swivel bradoons.
Stallion bars and chains.
Spring hooks and snaffles.
Regulation officers' tee padroons.
Slabbering bits.
Ladies' riding bits.
Hanoverian bits.
Australian ring snaffles.
Indian snaffles and bits.
Hackney curbs.
Carriage curbs.
Gig curbs.

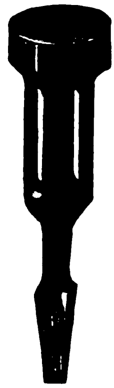
A French electric bit is thus arranged: The coachman has under his seat an electro-magnetic apparatus, which he works by a little handle. One wire is passed through the rein to the bit and carried to the crupper, so that a current once set up goes the entire length of the animal along the spine. A sudden shock will, it is stated, stop the most violent runaway.

Bit Brace. A crank handle for working a bit. Figs. 856–858, p. 353, "*Mech. Dict.*"

Bit-stock . . *De Bert* . . * "*Sc. American,*" xli. 18.

Bit'-brace Die. A screw-cutting die set in the end of a bit to be worked by a brace. Fig. 316. The tool is useful for re-dressing bolts, clips, staples, etc., that have lost nuts, when set in wood-work where it is desirable to cut them without removal or marring paint; also, for cutting stove rods and small bolts, in tin-shops and elsewhere. The collets, of malleable, iron, measure in their largest diameter 1½". The dies are made of one piece of steel, split on one side, held in position in the collet and adjusted by three screws.

Fig. 316.



Bit-brace Die.

Bit Stand. A turned piece of wood with perforations in which bits may be stuck to keep them in order and ready for use. For dentists' purposes principally.

Bit Strap. (*Manége*). A short strap used to attach the bit to a short cheek bridle, or to a halter.

Bit'ting Har'ness. (*Manége.*) A harness consisting of a plain halter, a girth with wooden uprights placed in the center of the pad and set at an angle, and leather reins with rubber web ends. Rings are attached to the uprights and sides of the girth, into which the ends of the reins are buckled after being passed through the ring of the bit. Used for breaking colts to the bit. Also called breaking harness.

Bi'valve Spec'u-lum. (*Surgical.*) One having two leaves or flaps.

The figures refer to *Tiemann's* "*Armamentarium Chirurgicum.*"

Bivalvular Anal Speculum, p. 118, Part III.
Bivalvular Ear Speculum, p. 34, Part II.
Bivalvular Nasal Speculum, p. 55, Part II.
Bivalvular Vaginal Speculum, pp. 60, 66, Part III.

Black-ba'salt Ware. (*Ceramics.*) One of the contributions of the admirable Wedgwood to the Ceramic art. Invented by him in 1766. It is a fine black ware, choice, and an *article de luxe.*

Black Brick. Bricks colored by heating red-hot, and dipping the exposed surface into a pan containing half an inch or so of melted coal-tar. Soft bricks are the best. "*American Architect.*"

Black Flux. Composed of 7 parts of crude tartar, 6 parts of saltpeter, 2 parts of common bottle glass, and by some a small amount of calcined borax is added. These ingredients are first finely pounded and mixed, and then gradually heated in an iron pot or ladle so as to burn them together. Care should be taken to not overheat the mixture, and as soon as it is thoroughly melted and mixed together it should be removed from the fire and allowed to cool. After it has cooled it is finely pulverized and sifted, and is then ready for use.

Black Glass. The black glass made in Venice is famous for the intensity of its color. M. Kayser, a Nuremberg chemist, has ascertained by analysis that manganese is the substance used. To confirm this result, he melted in a small furnace a mixture of sand and sulphur, in which he introduced 15 per cent. of peroxide of manganese. He thus obtained a glass of a deep black color; in very fine threads or thin splinters it was of a sombre violet.

Black'ing. 1. For Iron Castings: —

Common. — Coal tar.
Finer. — Japan varnish.
Work exposed to heat. — Graphite.
Work exposed to weather. — Black varnish, dusted with dry graphite, and brushed.
Ornamental Castings. — Heat to blue annealing heat, coat with black copal varnish, and dry at same heat. To polish, give another light coat, and heat moderately.
Mantels. — Enamel varnish.
Lead-color Paint. — Oxide of lead heated in a pot, and flower of sulphur and oil stirred in.

2. For Leather: —

Harness and Bridle Leather. — A decoction of iron-rust and vinegar, or iron-rust and sour wine or sour beer, applied to the grain side of the leather after it has been stained. The vinegar solution is the best. After this application the leather is said to be *blacked on the grain.*
Wax Leather. A compound of lampblack and soft soap, laid on the flesh side with a brush. The skin is now said to be *blacked on the flesh*, or *waxed.*

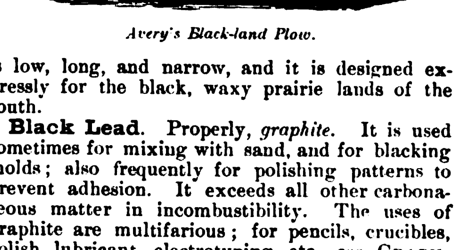
3. (*Founding.*) Charcoal in fine powder dusted from a bag on the mold or applied as black wash.

Black'ing Bag. (*Founding.*) A linen bag from which ground charcoal is dusted on to the surface of a mold.

Black'ing-box Press. A sheet-metal press expressly for cutting and drawing blacking-boxes and covers. See STAMPING PRESS.

Black'-land Plow. A light, one-horse, 7" cut, steel plow. The model of its mold and share

Fig. 317.



Avery's Black-land Plow.

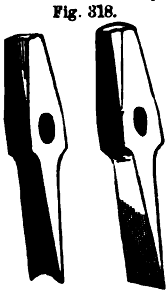
is low, long, and narrow, and it is designed expressly for the black, waxy prairie lands of the south.

Black Lead. Properly, *graphite.* It is used sometimes for mixing with sand, and for blacking molds; also frequently for polishing patterns to prevent adhesion. It exceeds all other carbonaceous matter in incombustibility. The uses of graphite are multifarious; for pencils, crucibles, polish, lubricant, electrotyping, etc., see GRAPHITE, page 1010, "*Mech. Dict.*"

Black Mor'tar. Take good fat lime, and use no sand, but mix it with fine coal-dust instead of sand. Merely to paint the joints black, mix lampblack with boiled linseed oil. In the first case it is put in place with the pointing tools; in the second ca-e, it is applied by the particular kind of brush u-ed by house-painters for that purpose.

Black'smiths' Chis'el. A hammer-shaped tool with one sharp edge, and used in cutting iron by a blow delivered with a hammer.

Fig. 318.

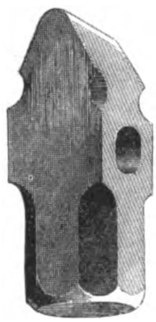


Blacksmiths' Chisels.
(*a.*) *Gouge chisel.*
(*b.*) *Hot chisel.*

Black'smith's Lathe. A lathe of moderate size, adapted especially for performing repairs in workshops and factories. A special lathe for this purpose turns 12″ in diameter over shears, is arranged to be driven by steam, water, horse or hand-power, is self-acting, with means of varying the feed, and can be employed for turning, boring, or drilling, as occasion may require.

Black'smith's Sledge. A heavy hammer wielded by the blacksmith's helper, and having a cross or straight peen.

Fig. 319.



Blacksmith's Cross-peen Sledge.

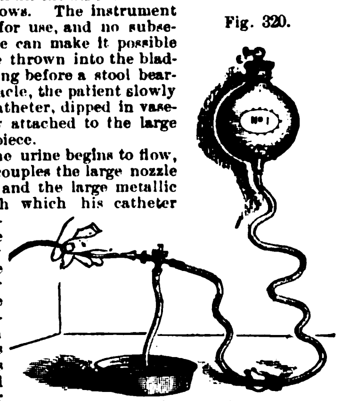
Black Wash. (*Molding.*) A fluid application to the surface of dry sand molds, loam molds and cores, consisting of very thin *clay wash*, with an addition of powdered charcoal. When dried it forms a thin layer, which prevents *sand burning*, and gives a clear skin to the casting, performing the same function as *blacking dust* on green sand molds. It is also used as a *parting* in loam molding.

Blad'der In-ject'or. An instrument to wash out the bladder. It consists of a soft rubber catheter, with injection apparatus and valves.

The instrument may be described by a detail of the manner in which the patient uses it.

He prepares eight ounces or more of the injection fluid at a temperature of 110° F. The bag, filled with the warm fluid, is hung up about 6′ from the floor. The stopcock is now turned on till all the air is forced out of the tube and a jet of water follows. The instrument is now charged for use, and no subsequent disturbance can make it possible for any air to be thrown into the bladder. Now, standing before a stool bearing some receptacle, the patient slowly introduces his catheter, dipped in vaseline, and already attached to the large metallic mouth-piece.

Fig. 320.



Dr. Keyes' Bladder Injector.

As soon as the urine begins to flow, he immediately couples the large nozzle of the stopcock and the large metallic mouth-piece with which his catheter has been provided, and the urine flows promptly through the short rubber tube into the vase on the stool before him. When the urine has escaped, he turns the stopcock and the bladder slowly fills. As soon as the organ begins to feel distended, he turns the stopcock again. The simple motion of turning a stopcock does not communicate the slightest jar to the neck of the bladder, while the water flows in and out of the body, obeying the natural law of gravitation, so slowly and quietly that the patient scarcely perceives it.

He may thus wash his bladder very thoroughly four, five, or six times, without any change of the instrument or its adjustment, except the simple turning to and fro of a stopcock; and this he does until the water flows c clear from his bladder.

Blad'der In'stru-ments. (*Surgi* are of various kinds, not including the rating for stone in the bladder, lithotom tic, lithoclastic instruments.

The figures refer to *Tiemann's "Armamenta gicum."*

Bladder evacuating apparatus . . .	pp. 37,
Extrophy (inverted bladder) apparatus	p. 47,
Puncturing apparatus ; trocars . . .	p. 30,
Tapping apparatus ; aspirator . . .	p. 30,
Washing apparatus ; syringes, catheters, etc.	p. 44,

Blan'ket Rif'fle. A blanket is tak into strips, and these strips sewed toget fit into the sluice under the settler. Th the strips of blankets then form a seri for catching quicksilver, gold, and sulph blanket riffles are about 6″ apart.

Under the blanket are several half c iron flat side down, which extend lon through the sluices, and are fastened to bell-crank motion moves these bars ba and forth under the blanket riffles, and to keep the material gently stirred up tailings will flow off readily. By this tion of the bars under the blanket, the vented from packing. The edges of riffles are of the best form for catchin quicksilver, and the blankets can be ta washed, or eventually burned in the usu

Blank Flange. A round plate t on the flanged end of a pipe to close the

Blank'ing Press. A stamping pr ply cutting out blanks.

Blank'-work Fold'er. A paper-chine, especially adapted for folding bl sections, quires, or single sheets.

Blast Fur'nace. (*Metallurgy.*) (ing upon a column of air *driven into* it cal means, as distinguished from an *ai wind* furnace, which depends upon ch *Plenum* and not *vacuum*.

"The number of blast-furnaces in the U now 700, of which not quite 300 were in blas 1878." — *Morrell.*

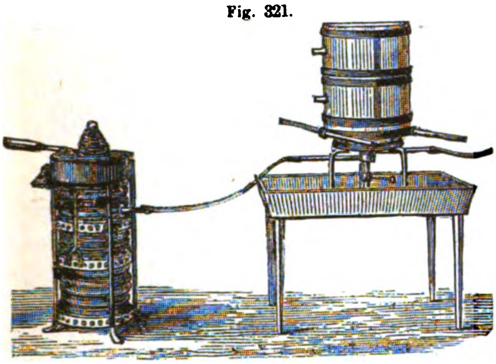
See the following references : —

Blast Furnaces.	
At Bessemer, Ill. .	* "*Engineering*," x
Batty	"*Scientific America*
Bethlehem, Pa. . .	* "*Iron Age*," xx., N
	* "*Scientific America*
	* "*Engineering*," xx
Buttgenbach, Prussia	* "*Blake's Report*, *tion*," iv. 82 +
Carinthian	* *Ibid.*, * iv. 21, *et se*
Cedar Point . . .	* "*Engineering*," xx
Clausthal	* "*Engineering*," xx
Durham, Pa. . . .	* "*Engineering*," xx
Hof, Bavaria . . .	* "*Engineering*", xx
Japanese	"*Iron Age*," xvii. A
Lonsdale, Br. . . .	* "*Engineering*," xx
" Lucy Iron Works "	* "*Engineering*," xx
" Lucy," Ironton .	* "*Engineering*," xx
Mariazell, Styria .	* "*Blake's Report*, *tion*," iv. 43 +.
Meier Iron Co., Ill. .	* "*Engineering*," xx
Of Great Britain . .	"*Scientific America*
On the form of . .	"*Iron Age*," xvii.,
Stephens	* "*Iron Age*," xx., N
Warwick	"*Iron Age*," xxii.,
Weimer	* "*Engineer*," xlii. 2
Furnace Charger . .	* "*Scientific America*
Weimer & Berkenbine	* "*Engineering*," xx
	* "*Polytechnic Rev.*,
Williamson, Br. . .	"*Iron Age*," xxi.,
Furnace Feeder, *Moore*	* "*Iron Age*," xx., O
Furnace Fuel, Anthracite.	
Lebanon, Pa. . . .	* "*Engineering*," xx
	* "*Scientific America*
Hydro-carb., *Cassell*	* "*Iron Age*," xix.,

Liquid Fuel . . .	* "*Scientific American Sup.*," 47.
Natural gas . . .	* "*Iron Age*," xxvii., Feb. 17, p. 1.
Petroleum in, Belg.	"*Scientific American*," * xxv. 88.
Furnace Hearth.	
Lurmann	* "*Eng. and Min. J.*," xxi. 128.
Furnace Lines.	
Hartman	* "*Iron Age*," xxv., March 4, p. 1.
Blast Furnace Plant.	
Crown Point, N. Y. .	* "*Engineering*," xxv. 220.
Cambria Iron Works.	* "*Engineering*," xxvi. 154.

Blast Gas Fur'nace. An apparatus used for the fusion of refractory metals, etc.

Fig. 321.



Griffin Blast Gas Furnace.

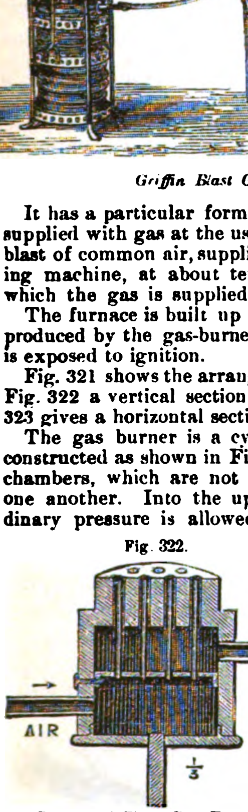
It has a particular form of gas-burner, which is supplied with gas at the usual pressure, and with a blast of common air, supplied by bellows or a blowing machine, at about ten times the pressure at which the gas is supplied.

The furnace is built up round the flame that is produced by the gas-burner, and the crucible that is exposed to ignition.

Fig. 321 shows the arrangement of the apparatus, Fig. 322 a vertical section of the burner, and Fig. 323 gives a horizontal section of the burner.

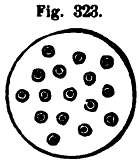
The gas burner is a cylindrical iron reservoir, constructed as shown in Fig. 322. It contains two chambers, which are not in communication with one another. Into the upper chamber, gas at ordinary pressure is allowed to pass by the tube marked GAS. Into the lower chamber, air is forced by the tube marked AIR.

Fig. 322.



Burner of Blast Gas Furnace.

Fig. 323.



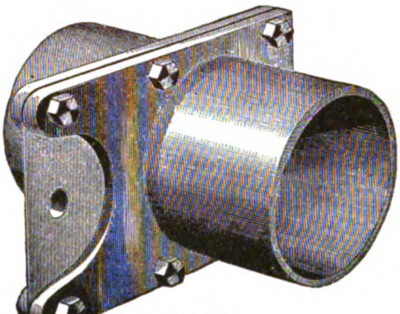
Section of Blast Gas Furnace.

The upper part of the burner is an inch thick in the metal. Through this solid roof holes are bored for the escape of the gas. The air passes from the lower chamber through a series of small tubes placed in the center of the gas-holes, and continued to the surface of the burner, so that the gas and air do not mix until both have left the gas-burner, and then a current of air is blown through the middle of each jet of gas. The bottom of the gas-burner is made to unscrew, and the division between the two chambers, which carries the air-tubes, is removable, for the purpose of being cleaned. The gas has usually had a pressure of 0.5″ of water, and the blast of air about ten times that pressure. The quantity of gas used in an hour is about 100 cubic feet.

When the gas is lighted and the blast of air is put on, the flame produced by the gas-burner is quite blue and free from smoke. It is 2″ in diameter and 3″ high, and the point of greatest heat is about 2″ above the flat face of the gas-burner. Above this steady blue flame there rises a flickering, ragged flame, several inches in height, varying with the pressure of the gas. In the blue flame, thin platinum wires fuse readily.

Blast Gate. The stop-cock or valved aperture of a blast-pipe.

Fig. 324.



Blast Gate.

Blast-heat'ing Stove. A stove or oven for heating air for blast furnaces.

Durham, Pa. . . .	* "*Engineering*," xxvii. 151.
Lonsdale, Br. . .	* "*Engineering*," xxxii. 480.

Blast'ing. Rending by exploding substances.

Blasts	"*Sc. American*," xl. 391.
Blasting Cartridges . .	"*Sc. American*," xxxiv. 391.
Blasting Explosives . .	"*Sc. American Sup.*," 2018.
Blast at Hell-gate . . .	"*Van Nostrand's Mag.*," xv. 476.
Blasting, Principles of .	* "*R. R. Gazette*," xxii. 217, 229.
Dynamite under water .	* "*Engineer*," xliii. 251.

Noted effective blasts: —

Glendon Iron Quarry, Easton, Pa., 12,000 lbs powder, displacing 60,000 tons of rock.

Reservoir Ditch Co., Yuba Co., Cal., 50,000 lbs. Judson powder, displacing 250,000 tons of gravel.

Consult: —

Drinker's "*Tunneling, Explosive Compounds, etc.*," New York, 1878.

Andre's "*Rock Blasting*," London, 1878.

General Newton's Annual Report "*On Removal of Obstructions at Hell-gate*," 1873-76.

Williamson & Heuer's "*Report on Removal of Blossom Rock.*"

General Burgoyne's "*Blasting and Quarrying of Stone and Blowing-up of Bridges.*"

Blast'ing Com'pound. Huetter's gun-cotton and nitrate of baryta.

"*Chemiker Zeitung.*"

"*Scientific American Supplement*," 2800.

See, also, list under EXPLOSIVES.

Blast'ing Gel'a-tine. A new explosive agent, discovered by M. Nobel. This substance, called in England, "*Blasting Gelatine*," is formed by dissolving collodion cotton in nitro-glycerine in the proportion of 10 per cent. of the former to 90 per cent. of the latter. The result of the solution is a gelatinous, elastic, transparent, pale-yellow substance, having a density of 1.6, and the consistence of a stiff jelly. The new explosive is in itself much less easily affected by blows than ordinary kieselguhr-dynamite; but it may be rendered far more insensible to mechanical impulse by an admixture of a small proportion (from 4 to 10 per cent.) of camphor. Experiments have been carried out, the result of which is to prove that the new explosive possesses, weight for weight, 25 per cent., and bulk for bulk, 40 per cent. more explosive power than ordinary dynamite. With moist gun-cotton, gelatine compares nearly as favorably.

See article by H. Baden Pritchard in "*Nature;*" reproduced in "*Scientific American Supplement,*" 2869.
See, also, "*Engineering and Mining Journal,*" xxvi. 271.

Blast Lamp. One with an artificially produced draft of air to aid combustion.

Lavender, * "*Engineer,*" xlii. 309.

Blast Noz'zle. The opening of the blast-pipe at the foot of the smoke-stack of a locomotive.

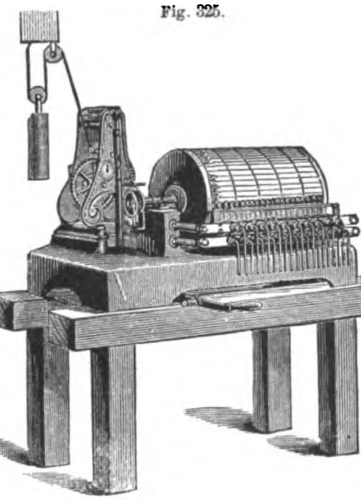
Annular, *Mallet*, Fr.	* "*Engineering,*" xxv. 221.
Annular, *Brown*, Winterthur .	* "*Engineering,*" xxv. 170.
Noise suppressor, *Aveling* . .	* "*Engineer,*" xlii. 41.
Shaw . . .	* "*Engineer,*" xlii. 41.

Blast-Re-cord'er. An instrument for keeping a record of the time a hot-blast oven is in blast. The ovens, of the Whitwell class, for instance, are used alternately, the work of each being intermittent, as is the case also with the Siemens' and Ponsard regenerators, and the punctual shifting of the blast to the respective sides of the twin stoves is important. See REGENERATOR, GAS GENERATING FURNACE, etc.

In the illustration, Fig. 325, the recorder is adapted to indicate the performance of twenty-one pairs of ovens, each of which has its iron pencil which records the performance on the paper, in manner following: —

A pipe leading from the blast pressure terminates at a cross-bar opposite the drum, to which the pencil mechanism is fastened; when the blast comes on a small piston is caused to project forward forcing the pencil upon the paper; the joint

Fig. 325.



Bailey's Blast-Recorder.

is made air-tight by means of an elastic diaphragm, about an inch in diameter. The diagram completes a revolution by clockwork once a week, and the number of hours worked by each oven can be at once seen by the length of the stroke which its pencil has made upon the paper.

See "*Engineer*" . . . . * xlv. 30.
"*Scientific American*" * xxxviii. 181.

Blast Reg'u-la'tor. Hoge's blas
for grain separators, has a blast-regula
automatically adjusted by means of an
or piston suitably connected to it, the l
actuated by the difference in pressure o
and the external air. Patent, No. 138,5

Bleach'e-ry Boil'er. The bleach
of Lawrie, of Glasgow, are shown in Fi
ticle "*Blanchiment,*" *Laboulaye's* "*Dicti
Arts et Manufactures,*" Tome iv., ed. 187

See also KEIR and BUCKING KEIR
Dict."

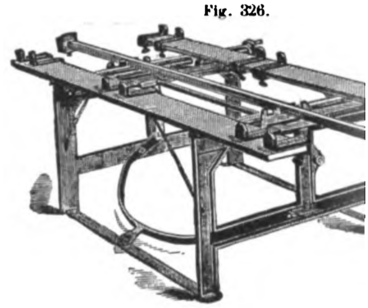
Blende. (*Mining*) An ore of zinc
of zinc and sulphur.

Blind. A window screen. Made
forms: a series of slats strung upon co
dow shutter with slats in the panels; a
iron slats wound upon a roller and letti
front of a store window to protect it at n

Blinds, metallic.
Hayes . . . . . . * "*Manuf. and Bui*
* "*Manuf. and Bui*

Blind Clamp. A machine on whic
of a blind are brought together and p
shape. In the example, Fig. 326, this i
single motion.

Fig. 326.



Blind Clamp.

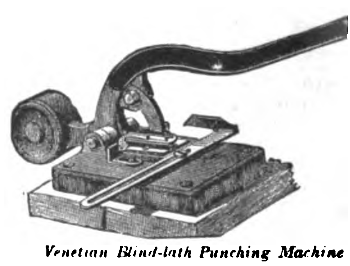
Carpenters' and joiners' clamps and
vices for boxes, sash, doors, etc., are
under their respective heads

Blind'-fast. The fastening of a bl
ter.

Blind Ink. Invented by Edison. A
at first makes a grayish-white mark, but
up into relief on the paper, so as to b
the touch of the fingers.

Blind'-lath Punch'ing Ma-chi
chine for perforating the slats of Ve
for the running cord by which they a

Fig. 327.



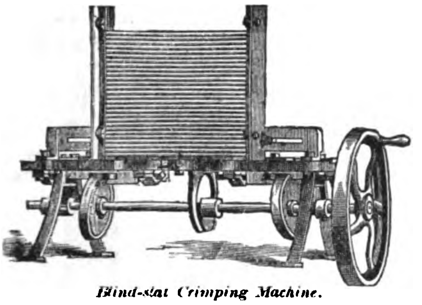
Venetian Blind-lath Punching Machine

Beneath the lever is a curved cutter, o
tion, like the opening to be punche
327.

Blind′-rel′ish-ing Ma-chine′. See SASH-RELISHING MACHINE.

Blind′-slat Crimp′ing Ma-chine′. A ma-

Fig. 328

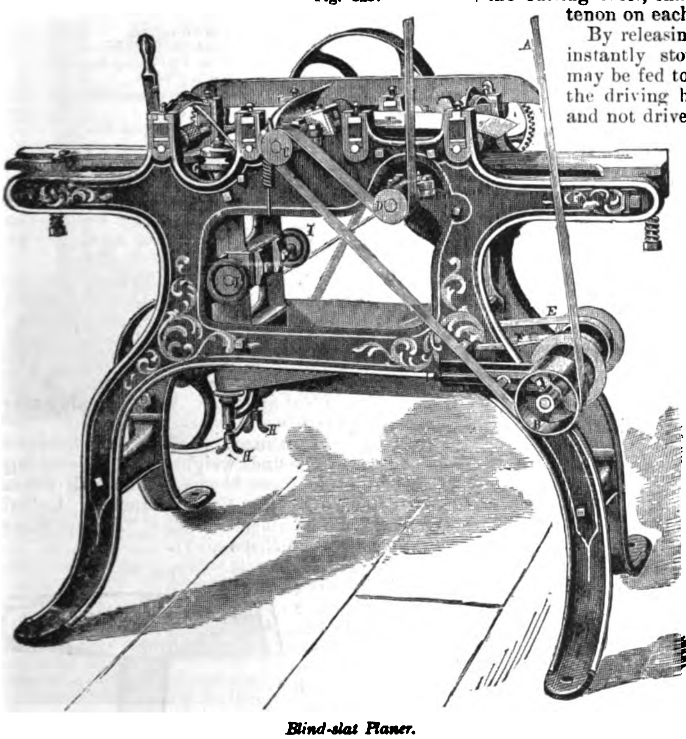


Blind-slat Crimping Machine.

chine used for compressing the ends of stationary blind slats so as to fit and fill the mortises. It may be operated by hand or power. The slats are placed in a hopper, or receiver, at the top of the machine, and the rotary motion given to the balance wheel operates the dies by a combination of cams, and this motion will drop a slat, carry it to the dies, compress both ends, and throw it off.

Blind′-slat Pla′ner. A planing machine for finishing slats for window-blinds, doing the work on both sides, and rounding the edges simultaneously. *I I* are hand-wheels by which the edge-cutters *G* are regulated to any width of slat. The table is regulated by screws underneath. *C D* are the pulleys of the upper and lower cylinders, each of which has four cutters. The machine has four sets of feed-rolls. *F E* are bands from pulley *B*, leading to the edge-cutter arbors.

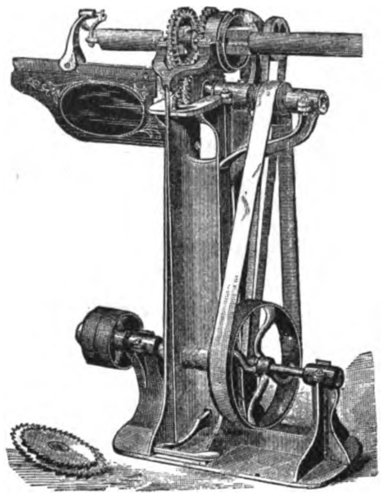
Fig. 329.



Blind-slat Planer.

Blind′-slat Ten′on-ing Ma-chine′. A machine which operates upon long rods which have been dressed to the shape for slats. The slat is fed endwise through rotating chucks, the shoulder being pressed against an adjustable gage for regulating the length of slat. By the peculiar con-

Fig. 330.



Blind-slat Tenoning Machine.

struction of the revolving cutting tools, two tenons are cut and divided with one cutter head simultaneously at one operation. A pressure upon the treadle causes a rotation of the slat and at the same time depresses the chucks carrying the slat against the cutting tools, enabling them to form a perfect tenon on each end.

By releasing the treadle the chucks are instantly stopped, in order that the slat may be fed to the gage, at the same time the driving belt is slackened, so as to slip and not drive. It will work any length of slat from 1¾″ up to 24″, and will make any size of tenon desired. See also Blind Machinery on pp. 298–300, "*Mech. Dict.*"

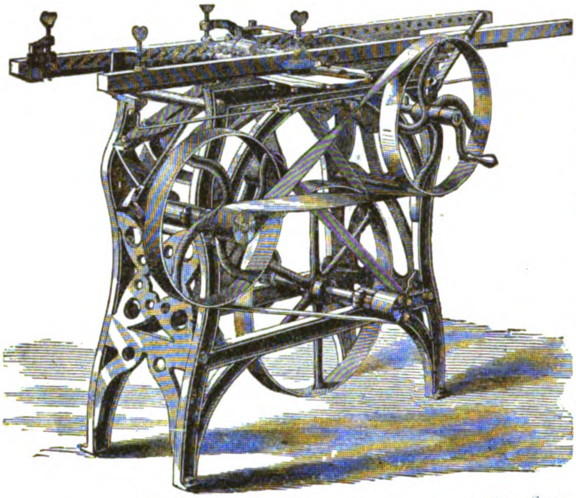
Blind′-stile Bor′er and Mor′tis-er. This machine acts upon two stiles at once, and will make mortises of any length, from a round hole up to 2½″; or it will bore stiles with round holes for rolling blind slats. See Fig. 331.

Blind′-stile Rout′er. A machine for cutting the recesses for blind-rods; in fact, a boring machine for the tenons of slats which occupy each an oblique mortise in the stile. See Fig. 332.

Blind Stitch. (*Harness.*) An ornamental stitch placed upon the outside cover to a blind or strap, the under side of which is covered by the lining. A stitch that is shown on one side only of the leather.

Blind-wir'ing Ma-chine'. This machine (Fig. 333) has guides for conducting the staple to the rod ; a device for feeding the staple between the guides, a driver for forcing them into the rod, and

Fig 331.

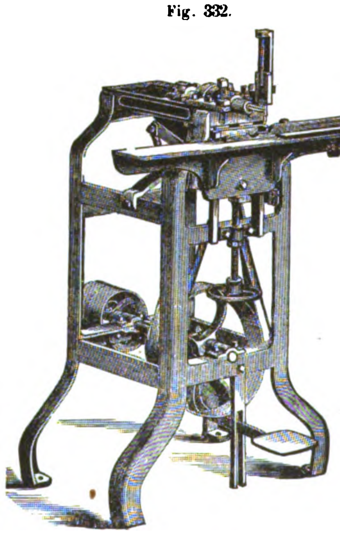


Blind-stile Borer and Mortiser.

a device for moving the rod forward any required distance as each staple is driven.

It is mounted on a substantial iron column and worked by foot, leaving the operator free with both hands to manipulate his work. It will space off, and set and drive at the rate of 80 staples per minute.

Fig. 332.



Blind-stile Router.

Blis'ter Steel. (*Metallurgy.*) Another name for cement steel; made from wrought iron in a cementation furnace. Figs. 1197, 1198, p. 509, "*Mech. Dict.*"

Block. 7. (*Add.*) An engraved wooden stamp, used for printing fabrics before the invention of the roller printer.

Block-printed linen was produced in Flanders in the fourteenth century. See BLOCK-PRIN 303, "*Mech. Dict.*"

8. (*Arch.*) A plain or enriched projectii ion in an entablature.

9. (*Pulleys.*) *Bouche*, the metallic bushing of th

Channel, the opening in the shell to hold the sheave.

Cheeks, the sides of the shell.

Coak, the bushing of the sheave.

Gorge, the groove around the sheave.

Pin, or *Pintle*; on which the sheave runs.

Score, the grooves on the body to hold the strap.

Sheave, the groove-edged wheel for the rope.

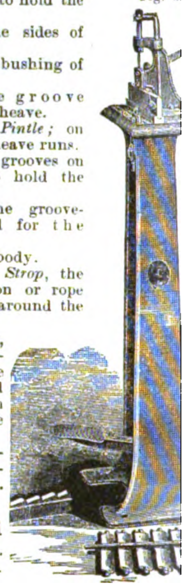
Shell, the body.

Strap, or *Strop*, the band of iron or rope which goes around the block.

Swallow, the space between the sheave and shell in which the rope runs.

Block-making machinery. See p. 303, *"*Mech. Dict.*"

Fig. 3



Blind-wiring M

Blocks and Rope'-lead-ers. See under the following heads : —

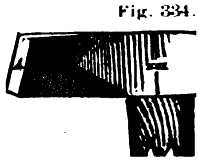
Angle block.
Anti-friction block.
Awning block.
Becket block.
Boom-sheet block.
Bull's eye.
Buntline leader.
Cargo block.
Chain pulley-block.
Clothes-line block.
Davit block.
Dead eye.
Deck block.
Differential block.
Differential pulley block.
Dock block.
Eye block.
Gin block.
Heart.
Hoisting block.
Hook and swivel block.
Horse hay-fork block.
Iron strapped block.
Jib-sheet block.
Lizard.
Loose-hook block.
Man-rope eye.
Match-hook bloci
Open-sheave bloc
Parrel-truck.
Peak halliard blo
Power hoisting-b
Pulley block.
Roofing block.
Rope eye.
Rope-strapped bl
Sheave.
Sister-hook bloci
Snatch block.
Stiff-hook block.
Swing-block.
Swivel-block.
Swivel-hook blo
Tackle block.
Thimble.
Thimble-eye blo
Top-mast truck.
Traveler rope.
Truck.
Well-wheel bloc
Wire rope thimi

Block'er. (*Hat Making.*) A hat bl chine. See BLOCKING MACHINE.

Block'ing Ham'mer. 1. A ste from one to two pounds weight, used masses of flint to form blocks from w can be detached by the *flaking* hamm also a *quartering* hammer. — *Evans'* "*A Implements of Great Britain,*" 17.

2. A hammer used in straightening saws. The face at *A* is slightly rounded, and its shape, combined with its line of motion, gives it a sort of draw blow, which spreads the

Fig. 334.



Blocking Ha

force of the displacement of material in a given direction, and not merely equally on all sides. — "*Scientific American*," * xxxvi. 259.

Block'ing Ma-chine'. A machine in which the crude cone-shaped hat-body is brought to shape.

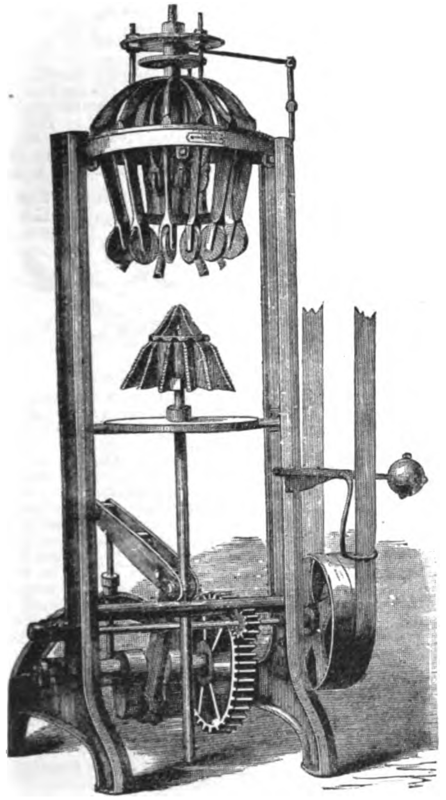
The operation consists in pulling out the edge to develop the brim, and widening out the upper part to form the tip and the side crown.

It is necessary, in order to stretch the hat, to soften the felt in boiling hot water, and the handling is exceedingly difficult.

The first machine for the purpose was invented by D. Beard, of Guilford, N. C., and patented May 28, 1816. It was a blocker made of a number of pieces hinged at their lower ends to a bench and spread from the center by a treadle, while the hat body was held on the block by the operator. This was the only invention in this part of the hat manufacture until that of W. A. Fenn, of Danbury, Conn., patented April 21, 1857.

In Fenn's machine, two pairs of conical rollers were put into a frame so arranged that the upper pair could be pressed upon the lower ones. The forward pair of these rollers revolved at a slightly faster speed than the other pair, and,

Fig. 335.



Eickemeyer's Hat-stretching Machine.

when the edge of a hat body was clamped between the lower and upper rollers, that part of it which was between the two pairs was drawn out, and the hat body thus gradually stretched around the edge until sufficiently flattened to form the brim See also his patents, April 14, 1857; January 19, 1858.

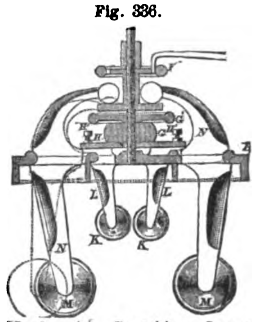
A number of machines of this kind came into use, but, their action being slow and doing but part of the work, the machines did not prove of sufficient advantage to bring them into general use.

The first machine which performed the stretching of a hat body successfully, on wool as well as on fur hats, was the corrugation stretcher invented by R. Eickemeyer, and this machine in its various modifications to suit the different kinds of work is now almost exclusively used in the hat factories of this country.

The machine illustrated in Fig. 335 represents a stretcher now in use in the wool hat factories.

A ribbed and recessed former is mounted upon an upright spindle, which receives motion through a walking-beam and connecting-rod from the crank-shaft. Upon the cast-iron side frames the head of the machine is supported; in this head the stretching devices are suspended. The details are more clear in some respects in the sectional view, Fig. 336.

Fig. 336.



Head with Stretching Levers (Hat-stretching Machine).

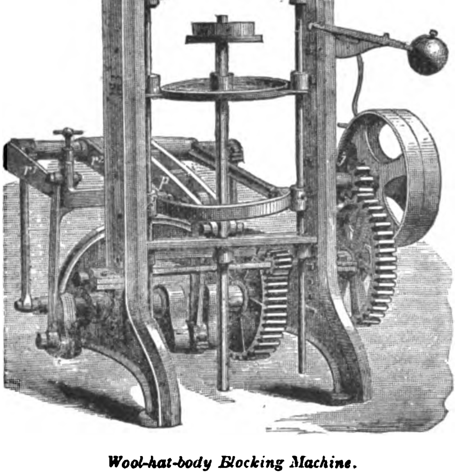
A series of levers, *L*, corresponding in number with the recesses in the upper part of the *former*, *D*, is suspended upon bearings and held in position by a plate, *H*, upon which a rubber spring, *G*, is pressed by a screw-wheel, G^1. In the lower ends of the forked levers smooth rounded rollers have their bearings.

Another series of rollers, *M*, with levers, *N*, and corresponding in number with the ribs in the lower part of the former, is also suspended from this head, and these latter levers are adjustable by a hand-wheel, *F*, nearer to or farther from the center of the machine, as shown in dotted lines on one side of the sectional view.

A hat body properly wetted with hot water, or by steam, is placed upon the *former* while the machine is in motion. The former moving upward brings the hat body in contact with these rollers which enter the recesses between the ribs of the former, and the hat body is thus readily stretched. Five or six upward motions are required to develop the tip and brim fully, the operator shifting the hat body around the center every time the former is at its lowest position, to present other parts of the hat body for contact. The hat having been stretched, it now remains to make what is called in the trade the *band*, namely, the sharp angle formed by the junction of the brim and side-crown.

This operation is performed on the blocking machine, of which Fig. 337 is a perspective view, while in Figs. 338, 339,

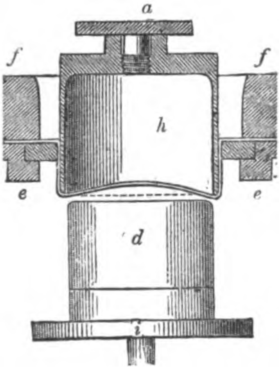
Fig. 337.



Wool-hat-body Blocking Machine.

and 340 the action of the machine upon the hat is illustrated. The machine consists of a frame, in which an upright sliding-spindle is centrally mounted. Upon this spindle, which is operated from the crank-shaft by the walking-beam, is the block *d* (Fig. 338, etc.), upon which the hat to be drawn is placed. A supporting plate, *e*, which receives motion through two rods from a lever, r^2, from the adjustable crank on the side of the machine, receives the hat. When the plate *e* is raised, a plate, *f*, which rests upon brackets on the frame, clamps the hat brim, and the two, continuing to move up, draw the hat body over the banding shell *h*. The block-carrier *i*, with the block *d*, has in the mean time also moved up to position shown in Fig. 338.

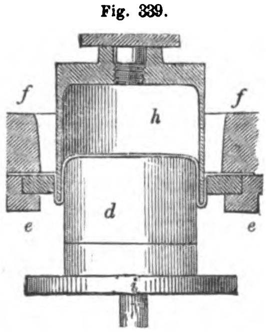
Fig. 338.



Banding Machine. First Position.

The clamping plates *e f* now commence to descend, while the block *d* continues to move up, and enters the banding shell, drawing the side-crown over the round edge of the shell *h*, as seen in Fig. 339.

Fig. 339.



Banding Machine. Second Position.

These motions continue until the plates *e f* rest upon the flange of the block-carrier *i*, and the hat is drawn perfectly smooth upon the block *d*, as shown in the last of the sectional diagrams, Fig. 340.

The spindle now begins to move down, when the clamping-plate *f* is left upon the brackets of the frame, the hat and block are removed, and the operation repeated on the next hat.

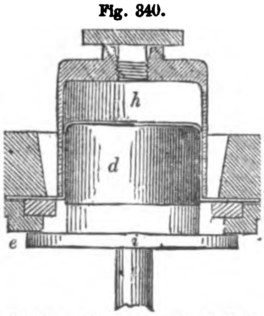
With the use of the stretcher, Fig. 337, and one of the blockers here described, 20 dozen of wool hats can be stretched and blocked per hour by two operators.

To adapt the principle of stretching by corrugation to fur hats, a number of modifications were required. It was found advantageous to separate the *brim-stretcher* from the *tip-stretcher*, and to substitute round-edged bars for the round-edged rollers.

See BRIM-STRETCHER, TIP-STRETCHER.

For the finishing-blocker, see HAT-SHAPING MACHINE.

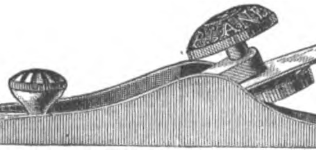
Fig. 340.



Banding Machine. Third Position.

Block Plane. A plane, the bit of which is set at a very acute

Fig 341.



"*Victor*" *Block Plane*

angle to the working surface, to enable it to plane across the grain of the wood: as di from a *smooth* plane, which see and com

Block Sys'tem. A system used more than one train from occupying a between stations at the same time.

By this system a train is not allow station *A* until the signal-man at *A* the signal-man at *B* that the precedin reached *B*, or that the line is clear bet *B*.

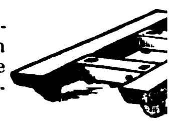
The system is confounded in some ca interlocking system of switches and a latter, however, is used only in com switches at stations, junctions, etc, an ing to do with the movements of tra stations.

See the following references: —

Block signaling . .	* "*Telegraphic Journal*
	* "*Telegraphic Journa*
	"*Telegraphic Journa*
Automatic	* "*Engineering*," xxi.
	* "*Railroad Gazette*,"
	"*Engineer*," xli. 359
Needle disk signaling instrument.	
Spagnoletti . . .	* "*Telegraphic Journa*
Semaphore three-wire signaling instrument.	
Preece	* "*Telegraphic Journa*
Preece's single wire instrument.	
	* "*Telegraphic Journa*
Saxby & Farmer .	* "*Railroad Gazette*,"
Tyer & Norman .	* "*Telegraphic Journa*
Walker's semaphore	* "*Telegraphic Journa*
Whyte	"*Amer. Railroad Jo*
	"*Van Nostrand's M*
.	"*Scientific American*

Block Truck. A small strong truck for single heavy packages.

Fig. 34



Block Tr

Blo m'a-ry. (*Metallurgy.*) 1. A form of furnace for the extraction of malleable iron from ore.

The term may be held to include the various native processes not yet disused entirely i practiced from time immemorial in Asia and 5220, p. 2221, "*Mech. Dict.*"). These furnace scale, open at top, and are frequently made c with openings below for the tuyeres of tl used to urge the fire. Iron sand, or rich pu heated with charcoal, and the metal agglutin (*loup*), which is hammered to remove dross, a *bloom*. The heat of the furnace is not suffic metal. The Catalan furnace is a notable ex lan Furnace, Fig. 1185, p. 502, "*Mech. Dict.*" form is found in Silesia and Bohemia, as v iron countries of Europe, as a ready metl rich ores where wood is abundant, and wi pense for plant.

The description by Diodorus Siculus of t in the island of Elba in his time is quite luc ment that it forms an iron *sponge* brings l accord with the metallurgists of to-day; or us say.

In the Catalan furnace the ore is princ upon a sloping wall of the furnace opposite the rest of the cavity filled with charcoal. to the bottom, and the agglomerated mas intervals of time.

In the German blomary the furnace is fill ing charcoal, and the broken ore is placed newed from time to time as it sinks down th until enough has gathered at bottom to fo is withdrawn and forged into a *bloom*.

The German blomary has been somewha troduced into the United States, and the n by, the *Champlain forge*, *Jersey forge*, in and classes of ores upon which it has b used. The Northern New York blomari amounts of metal for the Pittsburg steel

The original forges among rude nations w clay-walled structures; refractory stone w iron boxes are now frequent, lined with ref

The French Catalan forge is about 40″ ×
The German blomary forge is about 21″ ×
The Northern New York, 28″ × 32″, 36″

The figures vary very much, but these are approximate.
At the Moisic works, on the Lower St. Lawrence, the magnetic iron sands are worked in a German blomary, with a hot blast at 600° Fah., and the slag is withdrawn from above the iron by tapping.
Pig-iron is converted into blooms in 58 blomaries, which are mainly located in Pennsylvania.

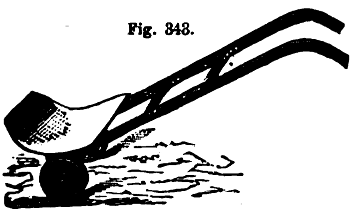
Blooming mill, Springfield, Ill. * "*Engineering*," xxix. 372.

2. A furnace in which pig-iron is purified, and made fit to be forged into a *bloom* of malleable iron. A *puddling* furnace.

Bloom. (*Leather.*) A yellowish deposit upon the grain-side of a hide or skin derived from the bark used in tanning. Its ease of removal depends upon the hardness of the water used by the tanner. The softer the water the more readily can the bloom be removed.

Bloom Truck. A small iron truck on two

Fig. 343.

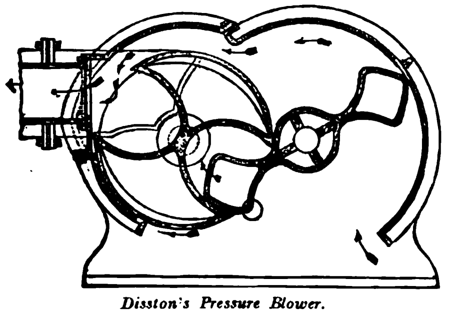


Bloom Truck.

wheels, for carrying blooms or fagots of iron from the furnace to the hammer or squeezer.

Blot'ting Pa'per. Description of the grades, makes, and methods of manufacture of various blot-

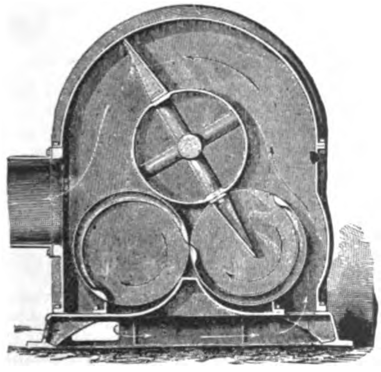
Fig. 344.



Disston's Pressure Blower.

ting papers. — "*Paper Trade Journal,*" reproduced in "*Scientific American Supplement,*" p. 266.

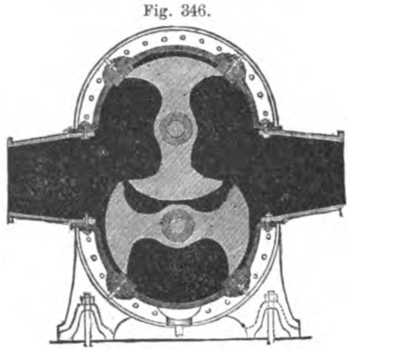
Fig. 345.



Baker's Pressure Blower.

Blow. (*Founding.*) A casting is said to *blow* when, in consequence of the dense nature of the sand or the inadequate *vent* provided by the molder,

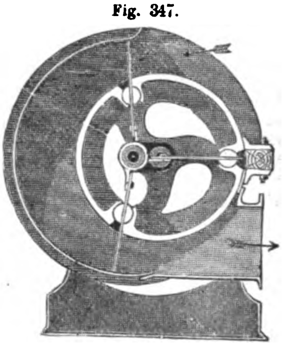
Fig. 346.



Root's Pressure Blower.

the gases and steam force their way through the molten metal instead of passing quietly off. This takes place occasionally with great violence and noise, masses of the fluid metal being thrown from the mold.

Fig. 347.



Mackenzie's Pressure Blower. (*Smith, Sayre & Co.*)

Blow'er. 1. Additional to the forms of duplex rotative pistons (shown on p. 1985, "*Mech. Dict.*") acting in concert and forming what are known as pressure blowers, — inasmuch as the air inclosed is absolutely driven, — are some other forms, which do not need specific detailed description, as the sectional views will be readily comprehended.

Fig. 348.

Enfer's Piston Bellows (*French*).

Root's mine ventilator is a form of blower. See "*Scientific American Sup.,*" x. 1588.

The terms *blower*, *blowing engine*, *blowing machine*, though perhaps readily distinguishable, are used somewhat indiscriminately. The *blowing engine* is properly a machine having the power within itself, and in this respect the air-compressing machine (which see) is closely allied. They are all forms of air-pumps, and mechanical ventilators are congeners. *Insufflators*, *injectors*, *ejectors*, *atomizers*, *aspirators*, also have many features in common with blowers. *Bellows*, perhaps, are the most common examples of the class.

Emery's Report, "*Centennial Reports*," vol. vi., Group XX., contains notices of —

Fig. 348 is a French form of blower, the rotative motion of the hand-wheel being converted by crank and pitman into a reciprocating motion of the piston in a cylinder. It is double-acting.

Fig. 349 shows a blowing machine for the laboratory or assay office, to be used in connection with a blast gas-furnace (which see), or similar apparatus.

2. (*Mining.*) A strong discharge of gas from a hole or fissure.

Blow′-gun. A tube with a missile propelled by the breath.

Blow′ing En′gine. The reciprocating piston-blower, driven by beam-engine, is shown in Figs. 3, 4, article "*Machines Sufflantes*," tome ii., *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," ed. 1877.

Fig. 349.

French Circular Bellows.

The same article has the trompe, bellows, tympanum, helix, etc. See under the following references also: —

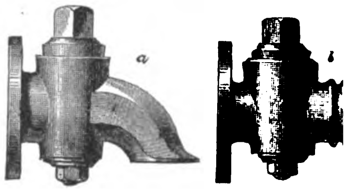
Blow′ing Fur′nace. (*Glass.*) One which the melted glass is worked, after been previously fused in a *melting* furnac then transferred to the *blowing* furnace; tl tents of the melting-pots being transferred cession. This is the preferable practice wh is cheap. In America the glass is usually direct from the melting furnace.

Blow′ing Ma-chine′. See Blower; ing Engine.

Blow′ing Tools. (*Mining.*) A small blasting instruments.

Blow′-off Cock. A faucet to allow a

Fig. 350.



Blow-off Cocks.

a. Blow-off bib-cock. *b.* Blow-off ho

the contents of a boiler to escape to get ri sediment, or saturated salt water.

Blow′-pipe. The following refere be consulted: —

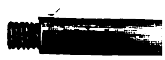
The blow-pipe for glass working is described in "*Dictionnaire des Arts et Manufactures*," tome "*Souffler le Verre.*" Blow-pipe of combustible v Fig. 398, tome i., Article "*Chalumeau.*"

See, also, *Plattner's* "*Blow-pipe Analysis;*" "*Blow-pipe Analysis.*"

Blow′-pipe Furnace. One in whi combustible, and sometimes steam the blown into a metallurgic furnace for s ducing, or vaporizing metals. *Duryea'* ore-furnace is an example.

Blow′-through Cock. A fauc passage to steam from a cylinder or other chamber in the process of heating the same and expelling the air by blowing steam through it.

Fig. 35



Blow-through

Blub′ber Min′cing Ma-chine′. A machine for cutting up whale blubb out.

The blubber knife, blubber hook, and bl used in preparing and handling the blubber.

Blue Bronze. A blue powder fo a prepared adhesive surface.

Mix powdered mica with a blue pig mixture to varnish, and lay on with a

See "*Manufacturer & Builder*," vi. 299: viii

Blue Glass. Glass colored with ganese, etc. Has some peculiar effec tive growth, and the same is claimed to be true in respect of animal growth.

See Gen. A. J. Pleasanton's Patent, September 26, 1871.
"*Scientific American*," xxxvi. 113.
"*Iron Age*," xix., February 22, p. 3.
Mang. and Chrome . "*Sc. American Supplement*," 2080.

Blue Pro'cess for Cop'y-ing. A mode of copying tracings in lieu of re-tracing them.

On a board as large as the tracing lay two thicknesses of blanket to give a yielding backing; lay on this the copying paper, sensitized side upward, and upon this the tracing, which is covered by a glass plate to hold all smoothly. Expose in sunlight for from six to ten minutes, or under a sky-light for thirty minutes. Remove the paper, drench it with water, and hang by one corner to dry.

For the sensitizing solution, take in vessel: —
1¼ oz. citrate of iron and ammonia.
8 oz. clear water.
In another vessel: —
1¼ oz. red prussiate of potassa.
8 oz. water.
Mix solutions, and keep in yellow bottle or away from light. The solution is applied with a sponge, and the paper laid away in the dark. When dry, the paper is yellow or bronze; after exposure, a darker bronze; after washing, the blue tint appears with lines in white.

Blu'ing. A fine blue tint is obtained by boiling iron or steel articles in the following mixture: — Dissolve 4 oz. hyposulphite of soda in 1¼ pint of water, and then add a solution of 1 oz. acetate of lead in 1 oz. of water.

Blun'ger. (*Ceramics.*) A revolving bar in which the materials for pottery are incorporated.

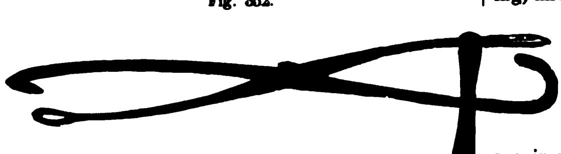
The materials, with sufficient water to form a *slip*, are agitated by paddles, on a horizontal axis which revolves in the box. The slip is run off to the *strainer* or *consolidator* (which see).

Blunt Gor'get. (*Surgical.*) A lithotomic instrument for forcing an opening through the prostate gland, in place of cutting.

Fig. 139, Part III., Tiemann's "*Armamentarium Chirurgicum.*"

Blunt Hook. (*Surgical.*) One for grasping

Fig. 352.



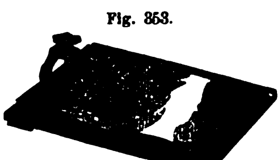
Obstetric Blunt Hook.

without piercing. Used in various operations. The figures refer to *Tiemann's "Armamentarium Chirurgicum."*

Staphylorraphy hook	. . . .	Page 10, Part V.
Trachea hook	. . . .	Page 93, Part II.
Obstetric hook	. . . .	Page 112, Part III.
Vesico-vaginal hook	. . . . .	Page 68, Part III.

Board Clip. A device for holding paper on a board. Especially intended for telegraph dispatch blanks which are written upon the top blank of a pile and then torn off.

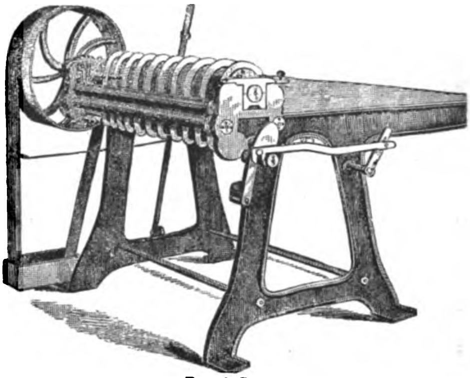
Fig. 353.



Board Clip.

Board Cut'ter. 1. (*Bookbinding.*) A machine with circular shears for cutting binders' board into sizes for use. The frame and bed are made of cast iron, the shears and shaft of cast steel. The board is first cut into long strips, and then, by the adjustment of a latch, the bed carries in the strips for cross-cutting.

Fig. 354.



Board Cutter.

Board Cut'ting Ma-chine'. 2. A machine for cutting thin boards from balks or squared logs.

A powerful machine of this character, invented by Bartlett, has an oblique knife the length of the log, and the boards are shaved off in the manner of a veneer.

"*Scientific American*," * xxxviii. 143.

For the various machines used in Veneer cutting and working, see Figures 6937–6952, pp. 2699–2702, "*Mech. Dict.*"

Board'ing. (*Leather.*) Doubling the leather with the flesh sides together, and driving the fold forward and drawing it backward by the graining-board. It makes the leather supple and raises the grain.

Board'ing Knife. (*Whaling.*) For cutting the *blanket piece* of blubber; the long piece which is flensed or peeled from the sides of the whale.

Board Scale. A weighing balance for assorting, and for ascertaining the number of sheets of pasteboard to make up bundles of 50 pounds.

Board Sea'son-ing Ma-chine'. A machine in which boards are subjected to heat and pressure in order to dry them straight. A large machine of this character has large, flat, steam-heated boxes, which are in vertical series, and pressed together by hydraulic power.

Pfeffer . . * "*Scientific American*," xxxvii. 143.

Boat. For boats, parts, fittings, etc., see

Back board.	Mast hinge.
Boat lowering apparatus.	Nautilus.
Bottom board.	Oar.
Canoe.	Painter.
Cat boat.	Poppets.
Cat rig.	Portable boat.
Center board.	Portable raft.
Clamp (for mast).	Rowing gear.
Collapsible boat.	Rowlock.
Davit.	Rudder lanyard.
Ducking boat.	Skiff.
Folding boat.	Slings.
Grapnel.	Sneak box.
Gunwale.	Steadying line.
Head sheet.	Step.
Ice boat.	Stern benches.
Kyak.	Stern sheets.
Launch.	Stretcher.
Launch engine.	Surf boat.
Lazy painter.	Thwarts.
Life boat.	Well sneak.
Life raft.	Yawl.

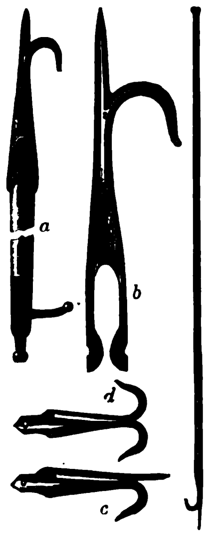
See, also: —

Building	* "*Scientific American Sup.*," 1066.
Cheap	* "*Scientific American Sup.*," 1088.
Collapsing, *Berthon*, Br.	* "*Engineer*," xlviii. 162.
	"*Van Nostrand's Mag.*," xix. 94
	* "*Engineer*," xlviii. 162.
Folding, *Osgood* . . .	* "*Scientific American*," xl. 38.
Berthon . . .	* "*Scientific American Sup.*," 1327.
Duplex, *Berthon* . . .	* "*Engineer*," xlix. 438.
Collapsible, *Crispin* . .	* "*Scientific Amer.*," xxxviii. 343.
Folding	"*Iron Age*," xx., July 19, p. 1.
Murray & Baker	* "*Scientific American*," xliii. 98.
Ancient Lacustrine . .	* "*Scientific American*," xxxix. 41.
Lowering apparatus.	
Brice	* "*Scientific American*," xxxv. 150.
	* "*Scientific American*," xli. 412.
Donovan, Br. . . .	* "*Engineer*," l. 401.
Lawrence, Br. . . .	* "*Engineer*," xliv. 430.
Lawrence	"*Engineer*," l. 281
Hydraulic, *Pinker* .	* "*Engineer*," xlii. 165.
Model, "Sharpie" . .	* "*Scientific American Sup.*," 2817.
Non-heeling	* "*Engineer*," xlii. 357.
Propeller, *Fetherston* .	* "*Scientific Amer.*," xxxviii. 166.
Rigs	* "*Scientific American Sup.*," 2586.
	* "*Scientific American Sup.*," 2085.
Sectional, *Berthon* . .	* "*Scientific American Sup.*," 3823.

The "Nautilus" crossed the ocean in 1878 in 45 days. She was 19′ long, 6′ beam, 2′ 3″ depth, and drew 6½″ water. "*Scientific American Supplement*," * 2300.

Boat Hook. One used in navigating a boat among other craft, or at a landing.

Fig. 355.



Boat Hooks.

a has an indicator on the staff which shows how the hook stands when in the water out of sight.

b c are two modes of making the hook of usual form.

d is a double hook.

Boat Knot. (*Nautical.*) A hitch, shown at 23, 26, Fig. 2777, p. 1240, "*Mech. Dict.*"

Boat Low′er-ing Ap′-pa-ra′tus. Davit apparatus for launching a boat from on ship-board.

The apparatus for detaching boats from their davits, invented by *Albert Magnus*, of Gothenburg, is shown in "*Scientific American Supplement*," * 2543.

The apparatus of *E. G. Lawrence*, of Dundee, Britain. *Ibid.*, * 1728.

See, also, *Shaw's* apparatus, patented April 1, 1873, and Figs. 745-749, pp. 313, 314, "*Mech. Dict.*," and p. 678, *Ibid.* Also DAVIT, *infra*.

Boat Plug. Removed to allow rain-water to pass out of the boat which is secured on deck. The plug is

Fig. 356.

Boat Plug.

replaced before swinging the boat by the davits to launch it overboard. The two flanges have holes for securing the socket to the outer and inner skin of the boat. Many a boat's-load has been swamped by the loss of the boat plug in the hurry of launching.

Boat′swain's Tog′gle. A pin of wood, crosswise, at the end of a rope; acting instead of a hook when the object to be attached has a loop or bight through which the toggle may be rove.

Boat Yoke. A tiller secured on top of the rudder, and having holes for attaching the steering ropes. See Fig. 357.

Bob′bin Wind′er. A machine fo conical bobbins. The yarn guide is on

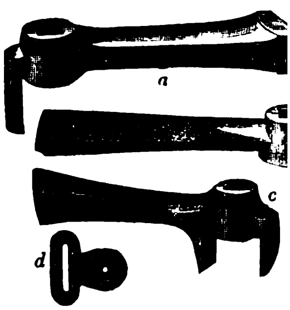
Fig. 357.

Steering Yoke.

which has a certain range of vertical build up the shape; when the set size is cone on the sleeve which carries th brought into contact with the cap, and guide so as to bring its excursions t level. *Dornan Bros.* See, also, KNI CHINE.

Body Loop. The iron which s body of the vehicle to the running gears

Fig. 358.



Body Loops.

a. Single-lip body loop. *c.* Double-li
b. Ordinary body loop. *d.* Strap loop

Bo′gie. 1. A wheeled swiveling tr a locomotive.

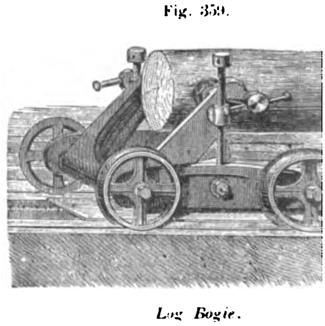
The terms
Double bogie locomotive (two pair wheels
Single bogie locomotive (one pair wheels),
Leading bogie locomotive (bogie in front).
Bogie tank locomotive (bogie under tank
indicate the character of the position of the sw

See

Bogie and axle boxes, oscillating.	
Haswell, Austria	* "*Engineer*,"
Car truck.	
Gt. Western Railway, Br. .	* "*Engineer*,"
Tank locomotive, N. E. Railway	* "*Engineer*,"
Truck, Japanese	* "*Engineerin*

2. (*Saw Mill.*) A small carriage r transverse track on a log carriage, to

Fig. 359.



Log Bogie.

sition of a log relatively to the saw in line not coincident with that of the See SAW MILL.

Bo-he'mi-an Glass. (*Glass.*) Consists of a silicate with potash and lime base; a small quantity of alumina, from the pots, and of oxide of iron impurity from the materials. Potash is often replaced for common ware by soda, owing to the lower cost of the latter. Carbonate of potash, as pure and as rich as possible, is preferred, free from soda. It is chiefly extracted from wood ashes, but in Austria the refuse of the beet manufacture yields a good deal. Also known as *Lime glass*.

Boil'er. See the following references to boilers, setting, attachments, etc.: —

Air and steam injector.
Matthews . . . . . * "*Scientific American*," xl. 227.
Casing and setting, *Reilly* * "*Scientific Amer. Sup.*," 682.
Cleaner, *Cronin* . . . . * "*Scientific Amer.*," xxxvi. 130.
Hotchkiss . . . * "*Manufac. & Builder*," xii. 247.
* "*Scientific Amer.*," xliii. 291.
Kemp . . . . * "*Mining & Sc. Press*," xxxiv. 1.
* "*Scientific American*," 351.
Clothing . . . . . . "*Scientific Amer. Sup.*," 266.
Corrugator. See FLUE CORRUGATOR.
Covering, *Ashcroft* . . . * "*Scientific Amer.*," xxxiv. 163.
Beamish . . . "*Scientific Amer. Sup.*," 292.
Burgess . . . * "*Scientific Amer.*," xlii. 182.
Drilling and turning machine
Butterfield, Br. . . . * "*Engineering*," xxix. 398.
Drilling machine.
Garvie, Br. . . . . * "*Engineering*," xxx. 167.
Harvey . . . . . . * "*Engineering*," xxviii 136.
Tweddell, Br. . . . . * "*Engineering*," xxvii. 340.
Bowker . . . . . . * "*Scientific Amer. Sup.*," 4105.
Bowker, Br. . . . . * "*Engineer*," l. 307.
Kendall & Gent, Br. . . * "*Engineering*," xxix. 434.
* "*Scientific Amer. Sup.*," 1047.
Economizer, *Reilly*, Br. . * "*Engineering*," xxii. 18.
Explosions in 1877 . . . * "*Iron Age*," xxii., Nov. 28, p. 15.
Feeder, self-acting.
Cohnfeld . . . . . . * "*Scientific Amer. Sup.*," 2209.
Feeder, automatic.
Fromentin . . . . . * "*Scientific Amer. Sup.*," 3880.
Feed regulator, *Pope*, Br. * "*Scientific Amer. Sup.*," 2050.
Feeder, *Rice* . . . . . * "*Scientific Amer.*," xxxviii. 6.
Flue corrugator, *Fox* . . * "*Engineer*," xlv. 213.
* "*Scientific Amer.*," xxxviii. 67.
Flue tester, Br. . . . * "*Engineering*," xxv. 260.
Fountain, *Hamper* . . . * "*Engineer*," xliii. 32.
Pontifex, Br. . * "*Scientific Amer. Sup.*," 606.
Furnace, hot blast, *Pike* . * "*Scientific Amer.*," xlii. 323.
High pressure.
Adamson, Br. . . . . "*Scientific Amer. Sup.*" 917.
Indicator.
Lethuillier & Pinel, Fr. "*Scientific Amer. Sup.*," 2751.
Making machines, Centennial.
"*Iron Age*," xviii., Aug. 3, p. 5.
Setting, *Reilly*, Br. . . . * "*Engineering*," xxii. 18.
Shell tester, *Tangye*, Br. . * "*Engineer*," xli. 10.
Smith, *Campbell & Hunter* * "*Engineer*," l. 229.
Stays, machinery for fixing.
Allan, Br. . . . . . "*Engineer*," l. 193.
Tester, *Howard* . . . . * "*Scientific Amer.*," xxxiv. 246.
Tube cleaner, *Titcomb*. . * "*Scientific Amer.*," xlii. 294.
Washer, *Hayes* . . . . * "*Railroad Gazette*," xxxiii. 364.

Boil'er Clamp. A form of clamp for holding parts in apposition while being drilled or riveted. That shown opens 4″ in the jaw and runs back 4½″.

Fig. 360.

Le Count's Boiler Clamp.

Boil'er Cov'er-ing. The Chalmers-Spence covering has a dead air chamber of one inch or more between the covering and the surface covered.

This is secured by taking a wire cloth to which is fastened every 4″ or 6″ a stud of an inch or more in length which keep the wire that distance from the surface of the object covered. A non-conducting composition is plastered over the wire. Patents, 80,709, Aug. 4, 1868; 96,738, Nov. 9, 1869.

Asbestos fiber in sheets, or mixed with some cement, is used with advantage.

Sawdust mixed with flour paste. — "*Textile Manufacturer*."

See also references under BOILER, *supra*.

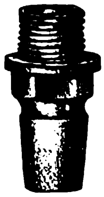
Boil'er Feed'er. Cook's automatic boiler-feeder is operated primarily by the uncovering of the open lower end of a vertical pipe which projects downward into the boiler. The water sinking below the open end of the pipe allows steam to pass upward and operate the devices which supply water until the level rising closes the pipe opening.

The boiler feeders of Pratt & Whitney, of Hartford, Conn., and Macabie's *Alimentateur Automoteur*, made by Voruz, of Nantes, France, act by means of a head of water and a float in a chamber governing the valved steam passages.

See also: —
Self-acting, *Cohnfeld* . * "*Scientific American Sup.*," 2209.
Automatic, *Fromentin* * "*Scientific American Sup.*," 3880.
Regulator, *Pope*, Engl. * "*Scientific American Sup.*," 2050.
Rice . . * "*Scientific American*," xxxviii. 6.
See also FEED-WATER HEATER, etc.

Boil'er Fer'rule. A tubular bushing for a hole in a domestic heating boiler, affording means of attachment for a pipe of supply or discharge.

Fig. 361.



Boiler Ferrule.

Boil'er Fit'tings. Those portions or attachments which are additional to the mere shell. The term includes the following, but they may not all be present in every boiler: —

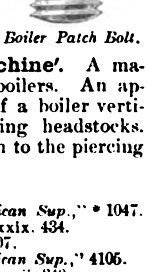
Bearers.	High water indicator.
Blow-off cock.	Injector.
Damper.	Low water indicator.
Dead plate.	Man-hole cover.
Economizer.	Mud-hole cover.
Feed valve.	Safety valve.
Feed-water apparatus.	Steam-pressure gage
Furnace front.	Stop valve.
Fusible plugs in tubes.	Tube plate.
Gage cocks.	Ventilator.
Grate bars.	Water gage.

Boil'er In'di-ca'tor. The electric boiler indicator of *Lethuillier & Pinel*, of Rouen, shown in Paris in 1878, consists of a float and stem, the latter making electric connections at various heights, which are communicated by wire to an indicator-tablet, like an annunciator, fixed anywhere, say in an office, or at the rooms of the boiler inspector.

"*Scientific American Supplement*," * 2751.

Boil'er Patch Bolt. A peculiar form of bolt for securing a patch to a boiler. It is threaded into the boiler, the chamfer rests against the patch and the square is for the application of the wrench.

Fig. 362.



Boiler Patch Bolt.

Boil'er-plate Clip'per. A shears specially arranged for sheet-iron. In that of Fisher, the plate lies upon a table traversing a track, and the shears work at such an angle as to give the proper calking bevel to the edge of the sheet. The tail of the lever which works the movable shear is worked by a cam.

Boil'er Shell Dril'ling Ma-chine'. A machine for drilling rivet holes in boilers. An approved form drills on both sides of a boiler vertically suspended above the standing headstocks. The shell is rotated for presentation to the piercing and countersinking drills.

Kendall & Gent, Br. * "*Iron*."
* "*Scientific American Sup.*," * 1047.
* "*Engineering*," xxix. 434.
Bowker, Br. . . * "*Engineer*," l. 307.
* "*Scientific American Sup.*," 4105.
Tweddell, Br. . . * "*Engineering*," xxvii. 340.
Harvey, Br. . . . * "*Engineering*," xxviii. 136.
Garvie, Br. . . . * "*Engineering*," xxx. 167.
Butterfield, Br. . . * "*Engineering*," xxix 398.

Boil'er Smith. A machine for flanging boiler plates.

Campbell & Hunter, "*Engineer*," * l. 229.

Boil'er Test'er. A machine for proving boilers. See

Flue testing, Br. . . . . . * "*Engineering*," xxv. 260.
Shell testing, *Tangye*, Br. . . * "*Engineer*," xli. 115.
Testing machine, *Howard* . . * "*Sc. Amer.*," xxxiv. 246.

See also p. 320, Fig. 763, "*Mech. Dict.*"

Boil'er Wash'ing Ap'pa-ra'tus. The system of washing locomotive boilers of S. J. Hayes, Superintendent of Motive Power, of the Illinois Central Railroad, is shown and described in "*Railroad Gazette*," * xxiii. 364.

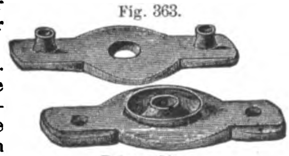
A 2¼" pipe hung from the roof trusses of the round-house is carried completely around it in a line directly over the back dunes of the engines as they stand in the pits, and provided with a stop valve at each pit. A steam pump supplies water under heavy pressure. Each engine has a crown wash-pipe and an attachment for washing the cylindrical part of the boiler. The operation is performed after every round trip.

Bo-la'ta Gum. A substitute for gutta-percha. It is the milky sap of the bully tree on the banks of the Orinoco and Amazon rivers in South America. The operation of winning the gum is similar in every respect to that employed with caoutchouc and gutta-percha. It much resembles gutta-percha, but has, however, some superior qualities. It is tasteless, has an agreeable odor on being warmed, can be cut like gutta-percha, is tough and leathery, is more elastic than gutta-percha, and consequently more flexible. It becomes soft, and may be joined together at about 120° F., but requires 270° F. before melting, higher than gutta-percha. It is completely soluble in benzole and carbon bi-sulphide in the cold. It becomes strongly electrified by friction, and is a better non-conductor of heat and electricity than gutta-percha.

Also known as *balata*.

Bol'ster-plate. A plate in a wagon where the front bolster turns on the axle or the sand board.

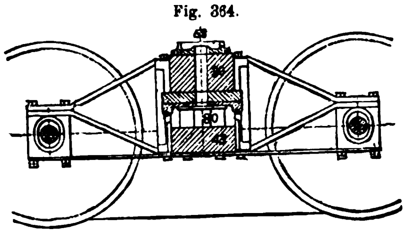
Fig. 363.



Bolster Plate.

Bol'ster Spring. 1. (*Railway.*) One (80, Fig. 364) interposed between the transverse beam (43) of a truck and the truck-bolster (30) which receives the weight of the car on the center plat (63).

Fig. 364.



Railway Truck Bolster Spring.

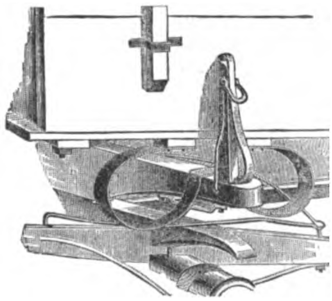
2. (*Wagons.*) *a.* A caoutchouc spring between the bolster and axle to give a degree of elasticity to the bed.

b. Fig. 365 shows a steel spring interposed between the wagon-bed and its bolster to absorb the jar and make the riding more easy.

"*Iron Age*," * xxii., Dec. 5, p. 9.

Bolt. (*Fire Arm.*) 1. The sliding piece in a needle-gun which drives home the cartridg carries in its axial recess the firing pin.

Fig. 365.



Wagon Bolster Spring.

2. The part which in a snap-gun passes *lump* of the barrel, to hold the barrel into tion when the gun is closed.

3. (*Mining.*) A passage leading from road into a side of work.

For machinery and hardware bolts see, —

Acorn-head bolt.
Bevel-head bolt.
Bridge bolt.
Boiler patch bolt.
Button-head bolt.
Carriage bolt.
Clip king bolt.
Cone-head bolt
Countersunk - head square shank bolt.
Cultivator point bolt.
Elevator bolt.
Elliptic-head bolt.
Eye bolt.
Felly-joint bolt.
Flour bolt.
Flush bolt.
Guard bolt.
Hanger bolt.
Key bolt.
Key-head bolt.
King bolt.
Knob screw.
Lag bolt.
Loop bolt.
Machine bolt.
Plow bolt.
Railway-truck bolt
Ring bolt.
Round countersun
Round countersu head bolt.
Safety bolt.
Shackle bolt.
Shaft bolt.
Ship ring-bolt.
Shoe bolt.
Sink bolt.
Sleigh-shoe bolt.
Square countersu
Square head bolt.
Square shank bolt
Steeple head bolt.
Step bolt.
Stove bolt.
Tap bolt.
Tire bolt.
Track bolt.
U-bolt.
Whiffletree bolt.

Bolt Clean'er. A machine or attac cleansing the bolting cloth of mills of th flour and offal.

Collins's automatic cloth cleaner is a to bolts precisely, but to the sieves of purifiers. It has beaters of soft leather in spiral form on a shaft beneath the siev as when revolving to slap the cloth lightly.

"*American Miller*," * viii. 369.

The Cogswell & Finn flour-bolt cleaner has a brush suspended over the reel by arms secured to a shaft which projects through the side of the chest, so that the brush can be lifted and dropped as desired. A coil spring prevents the brush jumping when passing over the ribs of the reel.

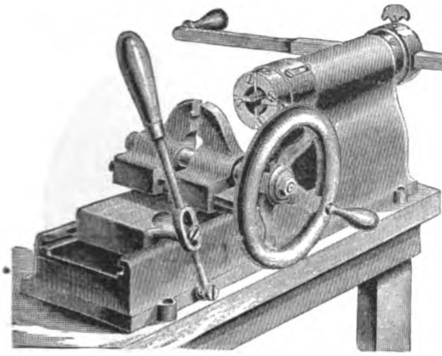
Bolt Clip'per. A double lever tool for cutting off the superfluous length of bolt beyond the nut. The nut *E* lies in a square of the jaw *D*, and the bevel edge of the jaw *C* is brought against the bolt. The tool is of cast steel except the handles, *A*, *B*, and the catches in the arm *F* give different ranges of leverage.

Fi

B

Bolt Cut'ter. A machine for threading bolts. Fig. 367 is Pratt & Whitney's hand bolt-cutter.

Fig. 367.

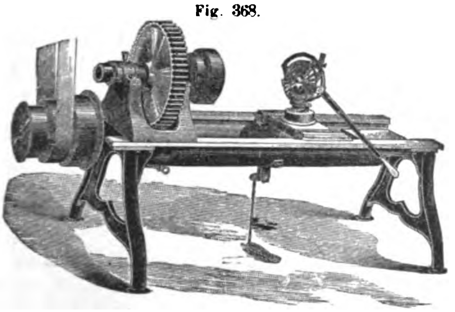


Hand Bolt-cutter.

The bolt is held in the vise, which has a right and left-hand screw, and is tightened by the hand-wheel. The die is revolved to cut the thread, and the bolt is advanced by the lever, which moves the vise slide in the shears. The machine is placed on a bench, and is intended for carriage and jobbing shops. The crank is lengthened or shortened at will; for tapping, the collet on the spindle is replaced by a tap-chuck, and the nuts are held in the vise.

Schlenker's stationary die bolt-cutter is shown in Fig. 368. The bolt is held and revolved in the

Fig. 368.



Stationary Die Bolt-cutter.

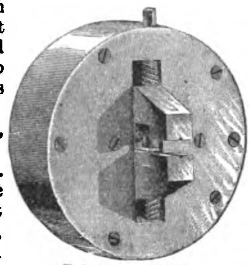
head chuck, which is hollow, so that a rod can be advanced axially to have a thread cut on its end. The arrangement of the dies is such that as soon as they begin to cut they will close as far as the stop will allow them, and a series of bolts may thus be cut of the same size. As soon as the bolt is cut the required length, the dies are opened by the lever and the bolt taken out without running the die off the thread. The action of the dies is similar to that of a lathe tool.

The "National" double head bolt-cutter is an open-die machine in which the bolt-cutter head is advanced to the bolt, the latter being held and rotated in the hollow lathe-head and chuck. The bolt is instantly released when threaded; the die blocks contain chasers made on the interchangeable system.

See the following references: —
Revolving die.
Howard Iron Works • "*Am. Manuf.*," June 11, 1880, p. 8.
"National" . . . • "*Scientific American*," xxxix. 404.
• "*Am. Manuf.*," Jan. 3, 1879, p. 13.
Pratt & Whitney . . • "*Scientific American*," xxxiv. 115.
• "*Scientific American Sup.*," 594.
Pratt & Whitney . . • "*Engineer*," xlii. 42.
• "*Am. Manuf.*," Oct. 31, 1879, p. 12.
Nut tapper, *Schlenker*. • "*Iron Age*," xvii., Jan. 29, p. 1.
• "*Iron Age*," xxii., Nov. 7, p. 1.
Wiley & Russell . . • "*Scientific American*," xxxviii. 54.
• "*Iron Age*," xxi., April 11, p. 3.
Wood & Light . . . • "*Manufacturer & Builder*," xi. 5.
Trimmer, *Butler* . . • "*Scientific American*," xli. 310.
Table of preparations of nuts and.
"*Scientific American*," xxxv. 53.

Bolt-cut'ter Chuck. A chuck for holding a bolt to be cut in a turret-head machine. In these machines the bolt is held in a chuck and advanced alternately to one or other of the dies in the turret head.

Fig. 369.

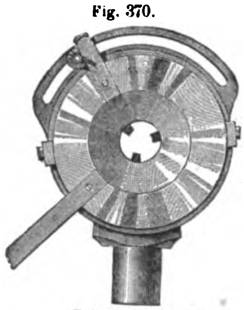


Bolt-cutter Chuck.

See Fig 6824, p. 2665, "*Mech. Dict.*"

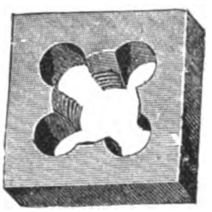
Bolt-cut'ter Head. Fig. 370 shows the die of the Schlenker bolt cutter. It is stationary, the bolt being revolved and advanced to the cutter, see Fig. 368. The chasers are simultaneously advanced or receded in the head by means of a lever which has an adjustable stop, so as to limit their penetration in making a number of bolts of similar size.

Fig. 370.



Bolt-cutter Head.

Fig. 371.

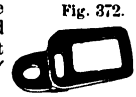


Bolt Die.

Bolt Die. A nut with a thread chased in it, used for cutting threads on bolts and rods. Fig. 371.

Bolt Dog. Used in chucking bolts to be turned or chased. It is bolted to the face plate, spans the center, and has a square to engage the bolt head. Made in sizes from $\frac{5}{16}''$ to 2″ inclusive. Fig. 372.

Fig. 372.



Bolt Dog (Le Count's).

Bolt Feed'er. An apparatus to feed the meal to the flour bolt in equable quantities. *D*, Fig. 373, is the case, *E* the spout leading to the bolt, and *B* the lever for lifting the screw *A*.

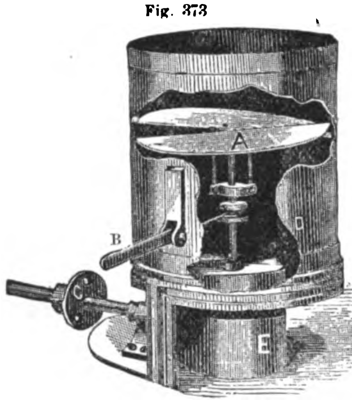
Bolt For'ging Ma-chine'. A machine for forging iron bolts.

Burdict's bolt-forging machine is operated without clutch gear, cam, or springs, the main shaft, slide, and forging dies are in constant motion, and the blank is advanced to the dies by means of a connecting-rod, pawl, shaft, and toggle, and the blank is automatically discharged when headed. The blank rests against a stop, and is only guided centrally by the holding dies while being forged, thus leaving them full size under the head. The machine is capable of making from 3,000 to 8,000 square head blank bolts in 10 hours, according to size.

The Abbe bolt forging machine is a machine of similar capacity and quality

Bolt-head'ing Ma-chine'. Another name for the bolt-forging machine, which see. The Brit-

Fig. 373



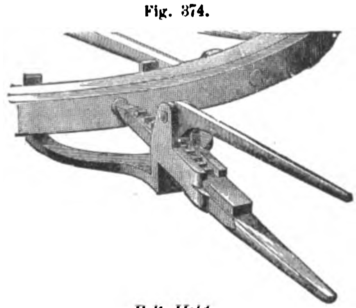
Bolt Feeder.

ish machine of *Greenwood & Batley*, Leeds, is vertical in its action.

A vertical fast-moving screw, with three square threads, raises the work-holder to the die, the latter be'ng stationary. The hot bolt-head is thus brought into the die, and swaged to form. The bolt-holder has a dwell at its upper position, and, as it descends, a pin beneath pushes out the bolt.

Bolt Hook. (*Manége.*) A check-rein hook; the base or point by which it is attached sets flat upon or passes between or under the plates of the saddle-tree, and is secured by a bolt.

Fig. 374.



Bolt Holder.

Bolt Hold'er. A clamping tool to hold the head of a bolt to prevent its turning while the nut is being screwed on. It is a frame containing a sliding bar, having on one of its sides a rack which is engaged by a sector lever. It is shown as applied to put on a tire bolt.

Bolt'ing-cloth Clean'er. See BOLT CLEANER.

Bolt'ing Mill'stone. A French invention by M. Aubin.

The lower millstone has panes with screening cloth of wire gauze, to allow the meal to escape before reaching the skirt.

The device is shown at Fig. 375. Starting from the bosom of the stone, every other furrow is suppressed, and a metallic box inserted containing the wire gauze. A knocker is suspended in the box to hasten the sifting.

Aubin's. Safford's Report "*Centennial Exhibition Reports*," * Group I., vol. iii., p. 180.

Bolt'ing Saw. A machine in which stuff is sawed out of the log or balk to *bolts* or pieces of a size, adapted for working into the object required.

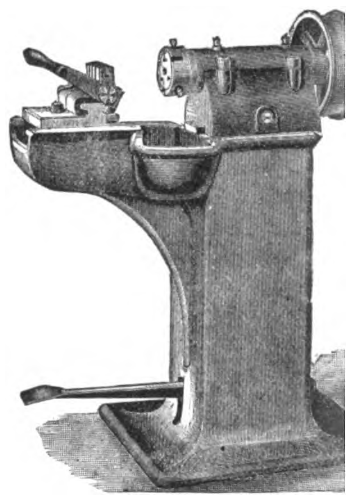
Bolt-point'ing Ma-chine'. A ma pointing or shaping the ends of bolts of fı 1″ diameter.

Fig. 375.

Bolting Millstone.

The bolt to be pointed is held in the vis adjustable on the column of the machine erated by a lever and right- and left-ha

Fig. 376.



Bolt-pointing Machine.

The head, arranged to slide on the brought to the bolt by action of the foo bolt passing through a bushing to ste the revolving cutter is doing its work. short to reach from the vise to the cu head may be held in a socket.

Bolt-turn'ing Lathe. A lathe adapted for cutting large bolts; smalle on the lathe principle, are bolt-cutters.

Bom-bar'don. (*Music.*) A low v ment without keys, and with three cylin quality differs but little from the ophicl

Bomb Har-poon'. A harpoon v plosive, to be ignited inside the whale. U. S. Patents under HARPOON.

Bomb Lance. A lance containin be exploded in the whale. It is genera always, projected from a gun.

See list of United States Patents under HARP Bomb lance, *Pierce.* * "*Scientific American*

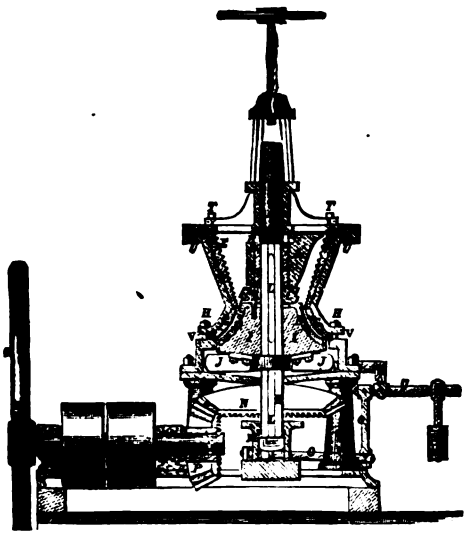
Bone Black. Calcined bones, used in filters for sirups, etc.

See: —

Testing, *Bartlett*	"*Scientific Amer.*," xxxiv. 260.
Washer, Automatic . . .	* "*Scientific Am. Sup.*," * 4052.
Revivifier, Fr., *Schreiber* .	"*Dept. Agric., Special Report*," xxviii., Pl. XXXI.

See also Animal Charcoal, *supra*.

Fig. 377.



Baugh's Grinding Mill for Bones, etc.

A is the top breaker fitting on the vertical mill-shaft *K*. The breaker is varied with the kind of work to be performed.
B is the nut which secures the breaker.
C, circular grinder or middle breaker with holes for stud bolts, to tighten the grinding sections *DD* on cone *I*.
F, stationary grinding plates. *G*, lower cylinder sectional plates, held by nuts *HH*.
O, lighter lever, etc., for adjusting upward pressure of cone *I* and its plates *DD*, against the concave *G*.
JJ, wipers to discharge ground stuff.
L, feathers on upright shaft *K*.
M, step. *N P*, driving gear.
R R, fast and loose pulleys.
S, fly-wheel. *TT*, bolts holding cover.

Bone Black, Ar'ti-fi'cial. Woody matters impregnated with phosphate of lime dissolved in hydrochloric acid. The phosphates are thus distributed as they are in natural bones. The mass thus prepared is ignited. The difficulty consists in obtaining products of a sufficient density and mineral richness, and free from foreign salts. The charcoal obtained has to be washed in excess of water to remove chloride of calcium, if poor coprolites have been employed. — *M. Melsens.*

Bone Glass. A semi-translucent glass used for lamp-shades and globes. A proportion of bone dust is added to the frit, and it is supposed that the phosphate of lime remains suspended in the glass. *Philip Fischer* in "*Glashutte.*"

The result resembles the cryolite glass, otherwise known as fused porcelain. See Cryolite.

Bone Hold'er. (*Surgical.*) A bone-grasping forceps, in some cases combined with a *rongeur*, or bone-gnawer.

Dr. Darby's, Fig. 79, p. 24, Part I., *Tiemann's* "*Armamentarium Chirurgicum.*"

Bone In'stru-ments. (*Surgical.*) Those used in osteotomy, and in some cases of fracture and necrosis.

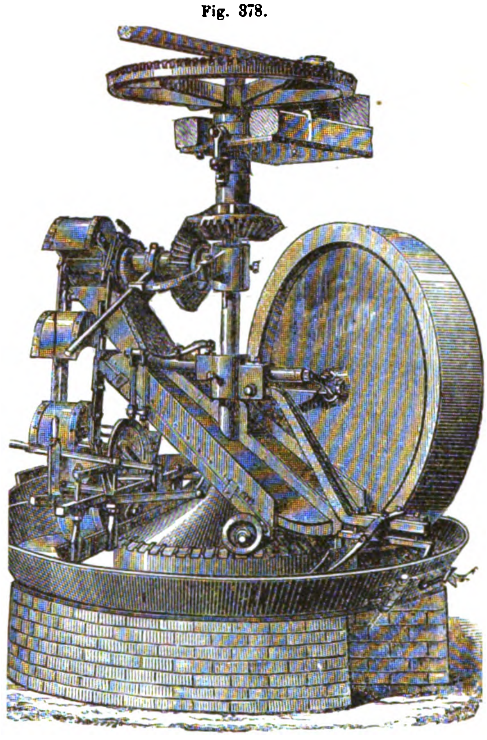
Among them are the following, which see: —
Bone drills.
Periosteotomes.
Exsection instruments.
Saws: Amputating, exsecting, subcutaneous, bow, circular, Hey's, metacarpal, head, trephine, antrum drill, etc.
Osteophor; forceps of various kinds and sizes.
Bone cutters, bone staffs, hooks and levators.
Trepanning elevator and raspatory.

Bone Mill. A machine for crushing bones for use, as animal charcoal in sugar processes, or for a fertilizer.

Fig. 377 is a vertical sectional view of Baugh's mill for crushing, grinding, and pulverizing bones, phosphatic rocks, minerals, ores, slags, etc.

Fig. 378 is a French bone mill on the Chilian principle. It resembles some forms of oil-mills, amalgamators, and cement mills, having an edge

Fig. 378.



Bone Mill. Jannot fils, Treil (*Seine et Oise*).

stone and scrapers. It has also an elevating device which lifts the stuff from the annular pan and discharges it down a screen and in front of the stone.

In the machine of Picksley, Sims & Co., of Manchester, England, the bones intended to be ground are thrown into the hopper, and after falling upon the cutting bed, they are pressed by feed rams against the teeth of a revolving cylinder in rapid motion. The reduced bones fall into an oscillating or revolving riddle attached to the mill, which separates them into two qualities, namely, dust, and half-inch bones. At the first operation the following proportions are obtained:

Dust	45 per cent.
Half-inch bones	30 per cent.
Coarser sample (to be re-ground) . .	25 per cent.

Davids' bone-mill is a disintegrator on the same principle precisely as the disintegrator (*Carr's*), Fig. 1655, "*Mech. Dict.*"

See the following references: —

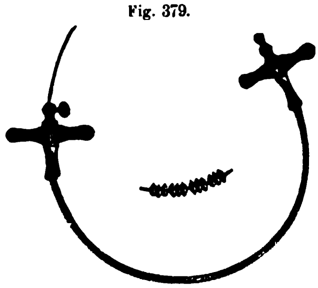
Hull, Br.	* "*Engineering*," xxx. 57.
Saville St. Foundry Co., Br. .	* "*Engineering*," xxvi. 295.

See also article "*Engrais*," *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," Figs. 766, 767. Tome ii., ed. 1877.

See also Fertilizer Mill; Grinding Mill; Ore Mill; Disintegrator; Chilian Mill, etc.

Bone Saw. Stohlmann's bone saw, for surgical purposes, shown at Fig. 379, is a substitute for the chain saw, and consists of two handles connected by a wire of cast steel, on which is strung a series of steel beads with sharp cutting edges.

Fig. 379.



Stohlmann's Bone Saw.

Bone Por'ce-lain. (*Ceramics.*) A ware into the composition of which enters phosphate of lime in the form of bone dust.

Bone'si-late. A compound with a base of bone dust and an aggregating cement; used in place of ivory, real or artificial, or hard rubber, for buttons, door-knobs, billiard balls, etc.

It can be polished and colored, and is harder than celluloid.

It is much like the French material known as EBURINE, which see, refer to —

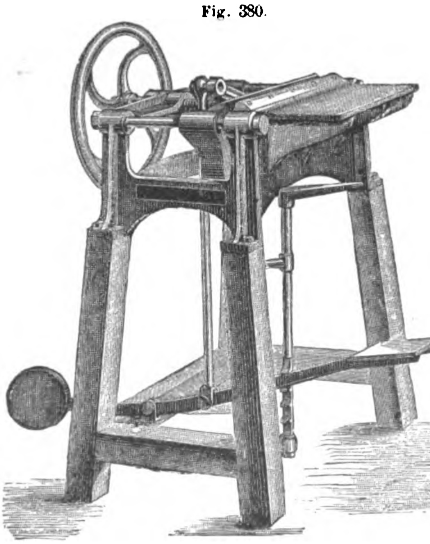
"*Scientific American*"	xlii. 345.
"*Manufacturer and Builder*" . .	xii. 111.
"*Iron Age*"	xxv., May 20, p. 26.
"*Van Nostrand's Eng. Mag.*" . .	xxiii. 263.

Bone Staff. (*Surgical.*) A director or retractor instrument with a curved end: serving to hold a bone while o erating subcutaneously, or to replace fragments.

Figs. 63, 63 *b*, Part I, *Tiemann's* "*Armamentarium Chirurgicum.*"

Book Back'ing Frame. (*Bookbinding.*) A frame or vise in which a sewed book is placed to

Fig. 380.

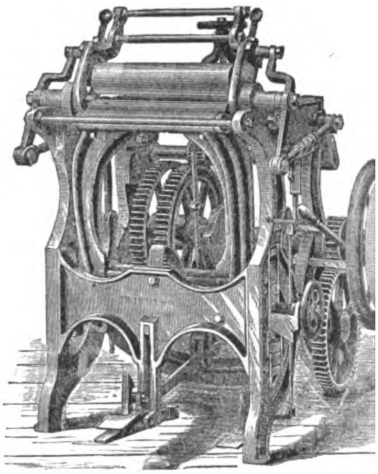


Book Backing Frame. (*Pierron et Dehaitre, Paris.*)

have the back rounded before being cased or covered. The jaws are brought together by pressure on the treadle, and the book back is rounded by the beating-hammer. The machine shown is French.

Book Back'ing Ma-chine'. A machine for rounding the backs of books before casing or cov-

Fig. 381.



Power Book-backing Machine.

ering. An improvement on the hand-r chine in respect of obviating the labor att the process of backing, excepting the placi book between the jaws and bringing a pressure upon the treadle; the power then the jaws, the roller passes over till the b completed, the jaws relax, and the book out.

Book'bind-ing. Bookbinding machi sists of sheet folding, signature sewing, ting, back-rounding machines, presses, etc

See list on pp. 330, 331, "*Mech. Dict.*"

See references: —

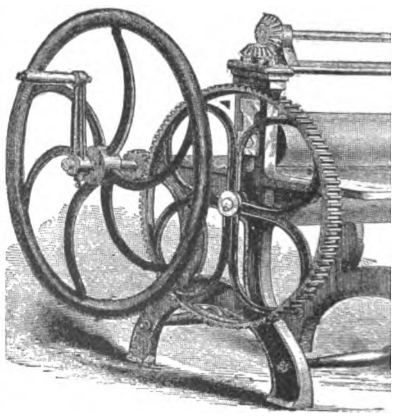
Schmitz	* "*Sc. Amer.*,"
Corner protector, *Way & Rankin.*	* "*Sc. Amer.*,"
Book factory	* "*Sc. Amer.*,"
Sewing machine. *Singer*	* "*Sc. Amer.*,"
Sulsberg	* "*Relieure*," " *Dict.*," iii
Stitching machine, *Neidlinger* .	* "*Sc. Am. S*

See *Nicholson's* "*A Manual of the Art of Book-*

Book'ing Ma-chine'. A machine f up tobacco leaves into piles and packages

Book Roll'ing Ma-chine'. A m

Fig. 382.

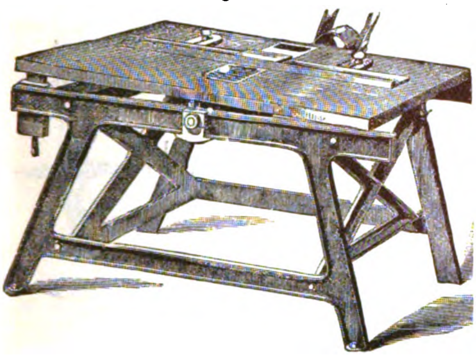


Book Rolling Machine.

rolling folded sheets instead of pressing folded signatures being laid upon the run between the rollers. The upper r tically adjustable, equally at both ends, by means of the hand-wheel and bevel-gearing.

Book Saw'ing Ma-chine'. A machine for sawing channels in the back of a pile of signatures

Fig. 383.



Book Sawing Machine.

to hold the cords to which the separate signatures are sewn. See SEWING PRESS, Fig. 4884, p. 2124, "*Mech. Dict.*"

The machine, Fig. 383, has a frame of cast iron, and a spindle of cast steel running in composition boxes. It has 5 saws adjustable on the mandrel to any length of book, and there firmly held by nut. The bed is planed smooth and hung on journals at one end, the free end being elevated to such degree as to give the required protrusion of the saws through the slots in the table. The fence or guide is adjustable, and held by set screws.

Book Sew'ing Ma-chine'. A machine for sewing signatures on to a band or cord for binding.

The book sewing machine of the Swiss inventor, Sulzberg, is described under article "Reliure," tome iii., Fig. 2231, *Laboulaye's "Dictionnaire des Arts et Manufactures,"* ed. 1877.

It folds by successive action between rollers in pairs, as in the ordinary folding machines; then pierces and sews the signature.

The Singer book-sewing machine takes sheets already folded and stitches them along the line of the final fold which is given them by a pair of rollers between which they are passed.

"*Scientific American*" . . . * xxxv. 223.

It is adapted for the stitching of signatures, but does not appear to be adapted to sewing them together to common bands or cords.

Smyth's sewing machine has as many stitches as cords, each being independent. The signatures are hung upon the horizontal arms of a four-arm reel which presents them, then drops, makes a quarter revolution, rises, and presents the next signature which hangs upon the next arm in succession. The signature is clamped, the row of needles come into operation, secure the signature, and the arm then drops away, and another is presented as before.

The Wheeler & Wilson book-sewing machine produces a book, the signatures of which are firmly united by loops of the band-thread, secured by a metallic pin within the center of each folded signature, each loop being so formed as to completely encircle the metallic securing pin.

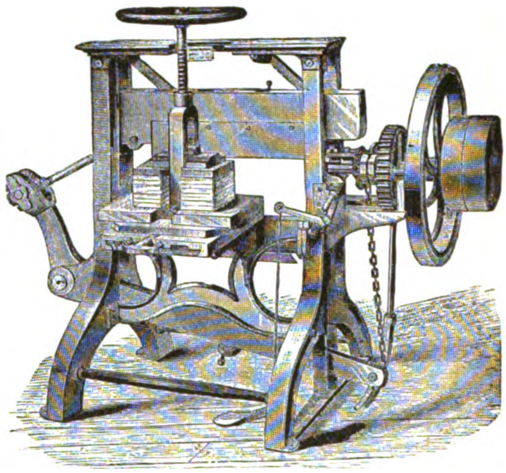
To operate the machine, the table in front of the bed is raised to its full height, the driving-wheel turned until the needles are above the throat-plates, the signature (opened) is then placed upon the needles, the pressers then force the signature firmly to the throat-plates, the needles recede, forming loops into which the material to form the securing pin is passed and severed; the needles now recede quickly, and by the loops of thread draw the securing pin down to the center of the signature, and the signature firmly upon the table in front of the bed. During this operation the arms above the bed recede far enough to permit that part of the signature which lay under them to be closed by means of a folder (placed in the rear of the needles), upon the part already drawn upon the table. This folder is provided with a projection from its lower front edge, which forces down the table upon which the signature is folded to a distance equal to the thickness of the signature last closed upon it, so that the top of the last signature is always in the same relative position to the bed and needles as was its predecessor during the time of sewing. To secure firmness of stitch, each thread is provided with tension devices, as is common to all sewing machines, and operates in a similar manner.

Book Stitch'ing Ma-chine'. Neidbruger's stitching machine for bookbinders is shown in "*Scientific American Supplement,*" * 1748. It operates on single signatures.

See also WIRE BOOK-SEWING MACHINE, Heyl's machine for fastening signatures to bands by means of wire staples.

Book Trim'mer. A machine for squaring the

Fig. 384.



Book Trimmer.

top, bottom, and front edge of a pile of books unbound. In the machine, Fig. 384, two of such piles are shown in the clamp, the backs of the books towards each other, so as to expose the other edges of each of the piles. The carriage being pushed up to position, the foot is pressed upon the treadle, when the knife quickly descends, making a draw-cut, and then at once returns to its starting-point. The pile is then withdrawn, rotated 90° to bring a new face to the knife, the cutting action repeated, and so on for each of the four faces.

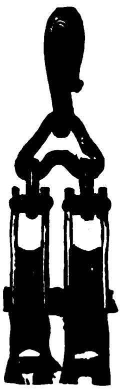
The Standard Machinery Co.'s Steam Power Automatic Book Trimmer operates as follows: — Books are placed on the table, and clamped as with other trimmers; upon moving the shipper, the table advances to the knife, and the cut on one side is made, thereupon the table recedes, makes a quarter turn, advances again to the knife, again recedes, and so continues in operation till all four sides are cut, when the machine stops, the books can be removed, and a fresh lot substituted. As the table works perfectly free while cutting, and needs no attention, the operator is at liberty to get ready another lot of books, thereby saving a large proportion of time.

Boom. (*Lumbering.*) An artificially inclosed bay, in which logs are collected to prevent their drifting away by a current or tide.

The boom is usually made of spars or timbers chained together at the ends, and so anchored or staked as to inclose an area of water. A *boom* is found at each end of a *slide*, which is a chute to help logs over falls, rapids, or shoals. See, also, SHEER-BOOM.

Boom Sheet Block. The block through which the sheet of the boom is rove. In the example, Fig. 385, the block is double.

Fig. 385.



Double Block for Boom Sheet.

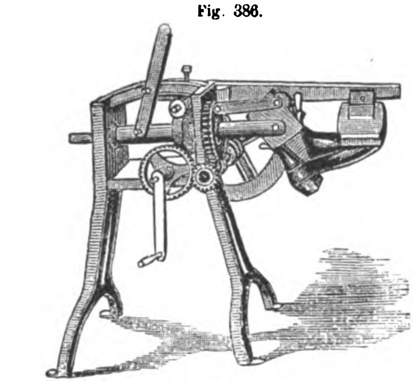
Boom Tack'le. (*Nautical.*) A tackle consisting of a double and single block and fall, used in rigging out or in a studding-sail boom.

Boot. 1. (*Surgical.*) Junot's dry cupping boot is a gum boot with an air-tight band on its upper border, and an air-pump to exhaust the air from around the leg. See DEPURATOR, "*Mech. Dict.*"; and AËROTHERAPY APPARATUS, *supra*.

2. (*Manége.*) A covering for any portion of a horse's leg; made of leather, or of felt and leather.

Boot Clean'ing Ma-chine'. A machine with expansible last to suit different sizes of boots, and with means for rotating the boot while the brush is briskly reciprocated upon it. The motions are obtained by turning the handle,

Fig. 386.



Boot Cleaning Machine.

and the position of the boot is modified by the motion of the lever.

Kent's Boot cleaning machine. "*English Mechanic.*"
"*Sc. Amer. Sup.*," 660.

Boot Sew'ing Ma-chine'. See SHOE MACHINERY; SOLE; HEEL, etc., and pp. 335–337, "*Mech. Dict.*"

Bor'der Knife. A knife for cutting the edges of grass plats, of grass borders to walks, of beds cut out of sod. Fig. 387.

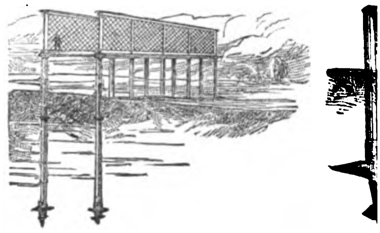
Fig. 387.

Border or Edging Knife.

Bor'ing An'chor. A method of setting piles for foundations or for anchorage by giving them a screw point or shoe, Fig. 388, which is sunk into the earth by rotation. See SCREW-PILE, "*Mech. Dict.*"

Bor'ing and Turn'ing Mill. A machine-tool which has its operative tools above while the work is chucked on a revolving bed below. It is a vertical drill or boier, or izontal lathe. The boring bars operate at gles and have a quick return motion.

Fig. 388.

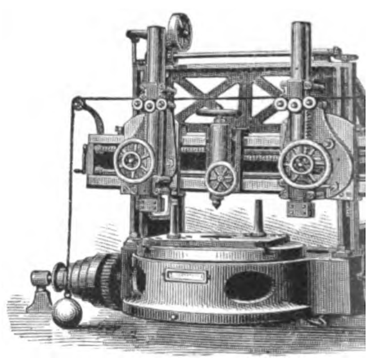


Bohlken's Boring Anchor.

The counterweight acts on a line directly throug ter of the tool-holding bar. The swing of the larg chines is 120′′. The feeds are automatic in every a disk driving a friction wheel, operates them, tl of the feed is controlled by moving the friction w out on the surface of the disk, and the greate change can be made instantaneously; and by rer friction wheel across the center of the disk, the versed. The tool-holder admits of the tool being way; it can be removed from the bar and any substituted. The face-plate rests in an annular l der its extreme outside edge; it has also a center s in diameter, and 5′ long, provided with a steel st key passes beneath this step, and the amount strain on the outside bearing can be regulated b screw (the head of which is seen at the bottom of this is quickly accomplished, and is a valuable p setting work, boring and turning on smaller when a heavy or large piece of work is once se turn of the screw communicating with the tape the face-plate to its outside bearing, and the ma with all the steadiness of a heavy planer and all ion of the most accurate lathe.

The pulley turning attachments consist of the the equalizing driving plate with the two carrier the table), and the tail stock (shown on the cros

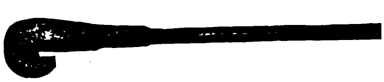
Fig. 389



Boring and Turning Mill. (*Niles' Tool*

Bor'ing-bar Wrench. A wrench to fit the square of the boring bar o It is to rotate it, and to hold it on occ

Fig. 390.

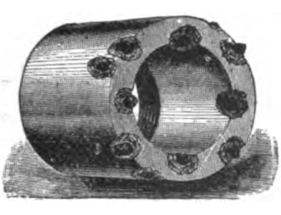


Boring-bar Wrench.

collar of the rod may rest on the wren upon the platform. See WELL-BOI pp. 2757, 2758, and Plate LXXIV. "*I*

Bor'ing Head. A collet or head shod with black diamonds, and used in drilling bore-holes in rock. See DIAMOND DRILL, "*Mech. Dict.*"

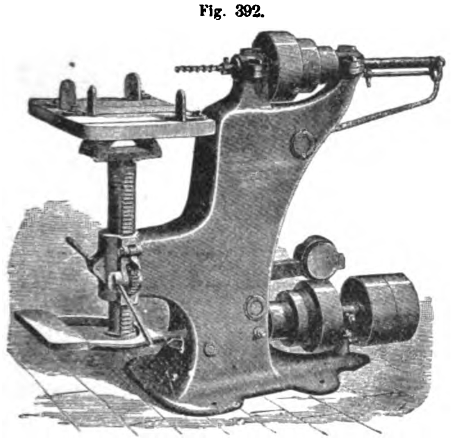
Fig. 391.



Annular Boring Head.

Bor'ing Ma-chine'. Fig. 392 shows a boring machine which has three different speeds for large, medium, and small holes; can be adjusted to any angle or position, raised, lowered, and turned on its axis, inclined or revolved.

Fig. 392.



Universal Horizontal Boring Machine.

The following notices of machines may be consulted: —

Lathe attachment . .	* "*Scientific American*," xl. 404.
Rice	* "*Scientific American*," xxxix. 86
Drilling, etc., *Bement* .	* "*Engineering*," xxii. 270.
	* "*Railroad Gazette*," xxi. 15.
Universal, *Bentel & Co.*	* "*Engineer*," xli. 412.
Horizontal, *Fay & Co.*	"*Thurston's Vienna Rept.*," iii. 264.
New, Br.	* "*Engineering*," xxii. 397.
Carpenter's, *Phillips* .	* "*Iron Age*," xxi., May 2, p. 42.
Richards & Atkinson.	* "*Iron Age*," xxiv., July 31, p. 1.
Jig-saw. *Robinson*, Br	* "*Engineer*," xlv. 276.
Vertical, *Walker Bros.*	* "*Scientific American*," xxxvii. 326.
And spacing, *Colburn.*	* "*Manuf. and Builder*," xii. 235.
Tapers, boring . . .	* "*Scientific American*," xxxvii. 389.
And turning, *Bement* .	* "*Engineering*," xxiv. 254.
Bement	* "*Scientific American*," xxxvii. 306.
And grooving, *Atock* .	* "*Scientific American Sup.*," 356.
Cylinders, vertical . .	*Laboulaye's* "*Dict. des Arts et Manuf.*," i., Fig. 86, article "*Alesoir.*"

Bor'ing Rod. The rod which carries the drill in deep boring. Usually in sections united by screw-coupling or by socket and key. The illustration, Fig. 583, shows the latter method. See Plate LXXIV., opposite p. 2759, "*Mech. Dict.*"

DEEP BORES AND SHAFTS.

Artesian well, Pottsdam, Mo.	5,500 feet.
Salt spring, Sperenberg, Prussia	4,175 feet.
Coal shaft, Viviers-Remus, Belgium . . .	3,542 feet.
Adelbert shaft, Pribram, Bohemia . . .	3,280 feet.

See the following references: —

Food carrier for imprisoned miners,	
British	* "*Engineer*," xliv. 69.
Electric, *Planté* . . .	"*Telegraphic Journal*," vii. 120.
Europe, deep, *Jefferson* .	"*Van Nostrand's Mag.*," xix. 310.
Drawing rods	* "*Scientific American Sup.*," 1153.
Rod grapnel, *Allison*, Br.	* "*Engineer*," xliii. 165.

Bor'ing Tool.

See AUTOMATIC BORING-TOOL, for the Persian drill.

An expansion boring tool, in which a cutter is thrust out laterally for under-cutting, coring-out boxes, sweeps and curves, is shown in "*Scientific American*," * xxxviii. 181.

Van Haagen's expansion tool, instead of extending laterally at right angles, as in the one just mentioned, has a sweep upon an axis at right angles to that of the stock in which it is held.

Fig. 393.

Boring Rod.

Bor'ing Tools.

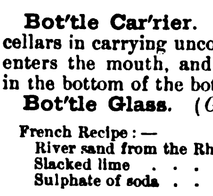
See under the following heads: —

Angle boring machine.	Expansion hollow-auger.
Angular bench-drill.	Fluted tap.
Angular bit-stock.	Gas-main drill.
Antrum trephine.	Gimlet.
Auger.	Gimlet bit.
Auger bit.	Gouge chisel.
Automatic boring tool.	Hand drill.
Barrel busher.	H drill.
Bench drill.	Hollow auger.
Bit.	Lip auger.
Bit brace.	Marlinespike.
Blacksmith's drill.	Nerve canal reamer.
Bodkin.	Nerve cavity instrument.
Boring tool.	Perforator.
Bow-drill stock.	Pin-bush.
Brace.	Plugger.
Breast drill.	Post auger.
Bung-hole borer.	Post-hole auger.
Chisel.	Post-hole digger.
Churn-drill.	Pricker.
Clutch drill.	Pump auger.
Combination auger.	Quick-speed hand-drill.
Corkscrew.	Ratchet brace.
Countersink.	Ratchet drill.
Crank rachet brace.	Reamer.
Dental drill.	Ship's auger.
Differential rachet brace	Sinus probe.
Drill.	Slot borer.
Drill bench.	Spiral auger.
Drilling press.	Tap.
Earth borer.	Taper tap.
Equilibrium tool.	Track drill.
Excavator.	Treenail auger
Expanding drill.	Twist-drill.
Expanding reamer.	Worm auger.
Expansion bit.	

Bo'som Staff. An instrument used in testing the straightness of the faces of mill-stones.

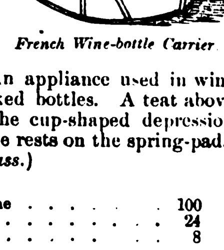
The bosom of the mill-stone is a central depression, and the staff is adjustable to test the symmetry of the concavity.

Fig. 394.



Bosom Staff.

Fig. 395.



French Wine-bottle Carrier

Bot'tle Car'rier. An appliance used in wine cellars in carrying uncorked bottles. A teat above enters the mouth, and the cup-shaped depression in the bottom of the bottle rests on the spring-pad.

Bot'tle Glass. (*Glass.*)

French Recipe: —

River sand from the Rhône	100
Slacked lime	24
Sulphate of soda	8

Belgian Recipe: —

Sand from near Charleroi	10
Peat ashes from Holland	20
Sulphate of soda	15
Limestone	5
Cullets (broken glass)	50
	100

France produces annually 100,000,000 to 120,000,000 bottles, representing a value of \$4,000,000. The price is from \$2.50 to \$3.50 per 100 bottles of from 21 oz. to 2 20 pounds. Champagne bottles having to bear the pressure of the wine, cost from \$4.60 to \$5.60, according to quality.

The operation of blowing the bottle is as follows : —

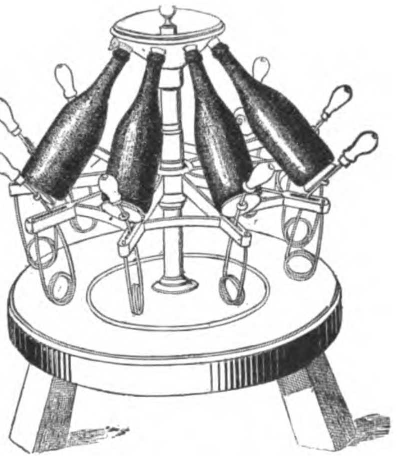
A piece of metal (melted glass) is gathered on the end of the *ponty*, is blown, swung, and rolled till brought to a given size (according to the description of bottle) and shape : then placed in a two-part mold (generally of iron), and by means of a compressing piston expanded against the inside of the mold which shapes it. When withdrawn from the mold the bottom is *pushed* (for some kinds of bottles); is detached from the *ponty* by cracking the glass by means of a piece of cold iron. The bottom of the bottle is put in a spring-tool; the neck is re-heated and the mouth properly shaped by a pincers which has forming blocks and fits the inside and outside of the mouth.

Sometimes the bottom alone is formed in the mold.

A furnace in France generally consumes about 374 pounds of coal for every 100 bottles of 28.80 ounce weight, or 1,820 pounds of coal for 220 pounds of bottles.

Bot'tle Hold'er. A stand for holding bottles, either in the bin or the rack — full or empty.

Fig. 396.

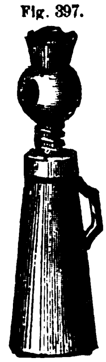


Bottle Holder. (*Vins Mousseux.*)

Fig. 396 is a French bottle-holder for holding the champagne bottles before wiring (*tourniquet porte bouteilles*). Made by Tricout & Cie., Reims.

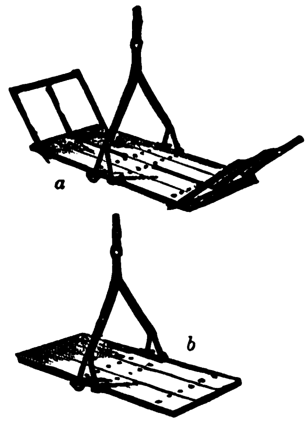
Bot'tle Jack. A portable screw-jack in form of a bottle. Fig. 397. Also known as a cotton screw, from being used in packing bales on board ship.

Fig. 397.



Bottle Jack.

Fig. 398.



Scale Bottoms.

a. Folding bottom, for weighing goods in sacks.
b. Plain bottom.

Bot'tling Ap'pa-ra'tus. See —

Aërated water.

Hayward. Taylor & Co., Br.	* "*Engineering*," xxvi. 351
Spencer & Gillman, Br. . .	* "*Engineer*," xlix. 235
Stopper, *Pochtler*, Austria .	* "*Sc. Amer.*," xxxi
Hart	* "*Sc. Amer.*," xliii
Washer, *Cody*	* "*Sc. Amer.*," xliii

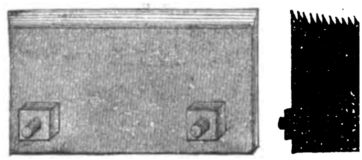
Bot'tom. 1. The support in a scale matter to be weighed. See Fig. 398.

2. (*Nautical.*) That part of a ship or bo the wales.

Bot'tom-ing Tap. One for carry thread of full size to the bottom of the ho Tap *c*, Fig. 6211, p. 2495, "*Mech. Dict.*"

Bot'tom Plate. (*Paper-making.*) T of knives forming the concave or bed ben

Fig. 399.



Bottom Plate for Paper Mills.

cylinder of a rag-grinding machine or pu gine. See Fig. 4020, p. 1824, "*Mech. Di*

Bot'tom-set Line. (*Fishing.*) A chored at the ends. See TRAWL LINE stance.

Bouche. (*Nautical.*) Of a block. ' ing for the pin, in the cheeks of a block. is the sheave bushing.

Bou'gie. (*Surgical.*) A smooth di strument for *meati*.

See Fig. 838, p. 346, "*Mech. Dict.*," and accom scription.

For varieties see the following, the figures r *mann's* "*Armamentarium Chirurgicum* :" —

Bougie à boule	page 9, 1
Bougie à trois nœuds	page 9, 1
Bougie conique	page 9,
Bougie conique à ventre	page 9,
Bougie filiform	page 9, 1
Bougie olivaire (olive shaped) . .	page 9,
Bougie olivaire à ventre	page 9, 1
Bougie, œsophageal	page 84,
Bougie ointment	page 21,
Bougie (Otis's) à boule	page 11,
Bougie, pile	page 124
Bougie, rectal	page 117
Bougie, urethral	page 6,

The terms *probe*, *dilator*, *divulsor*, *catheter*, et thrusting instruments of various forms used fo purposes. See list under SURGICAL INSTRUMENT

Boul'der Crack'er. A heavy iron in boring deep wells, to drop upon a bow may be accidentally encountered in the order to crack it and allow the boring to

Bou-lin'i-kon. A floor covering ; a for carpet or floor-cloth.

It is constituted entirely of animal and ve animal hair and wool entering largely into its and the whole being bound together by means the buffalo, reduced to its natural fibre. Th are formed into a thick cloth, and afterwards s a solution of vegetable oxide and coloring mat of which boulinikon is made almost as noisel while from the non-conducting nature of its warm and comfortable to the feet.

Bow Ab-dom'i-nal Sup-port'e *cal.*) One having a bow-shaped spring the abdomen, in place of obtaining the cincture.

Fig. 37, p. 16, Part IV., *Tiemann's* "*Armam rurgicum.*"

Bow'er. (*Nautical.*) One of the ing anchors at the *bow*. They are calle and *small* bower; not on account of size, but position.

The *best* bower is starboard.

The *small* bower is port.

Bowl. (*Fishing.*) The *pound*, *pot*, or *crib* of a weir or *pound net*. See POUND NET.

Bow'line Knot. (*Nautical.*) A combination of the reef-knot and carrick bend used for furnishing a bight that will hold upon a rope's end; as a bight on a boat's painter, to be thrown over a post on a wharf.

Fig. 400.

Bowline Knot.

A running bowline-knot has the knot made on the bight, instead of on the standing part, and makes a bight that travels upon the standing part.

Bow'line on a Bight. (*Nautical.*) A form of knot or bend. See 17, Fig. 2777, p. 1240, "*Mech. Dict.*"

Bow'sprit Shrouds. (*Nautical.*) Ropes or chains from the outer end of the bowsprit to the luff of the bow, giving lateral stay to the bowsprit.

Bow I'ron. One of the bow-shaped straps attached to the sides of a wagon body to hold the end of the bows on which the tilt is stretched and supported.

Fig. 401.

Bow Iron.

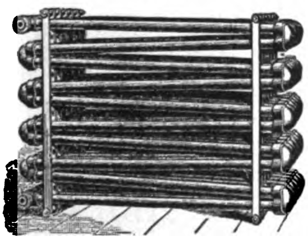
Bow Joint. One of the pieces concerned in the folding members of a carriage top.

Box Bar'row. A capacious, four-sided barrow, such as is used for carrying coke, saw-dust, etc.

"*Scientific American*" . . . * xxxix. 322, Fig. 7.

Box Coil. (*Heating.*) A steam or hot-water coil of many members, occupying a cubical space comparable in its proportions to a box.

Fig. 402.



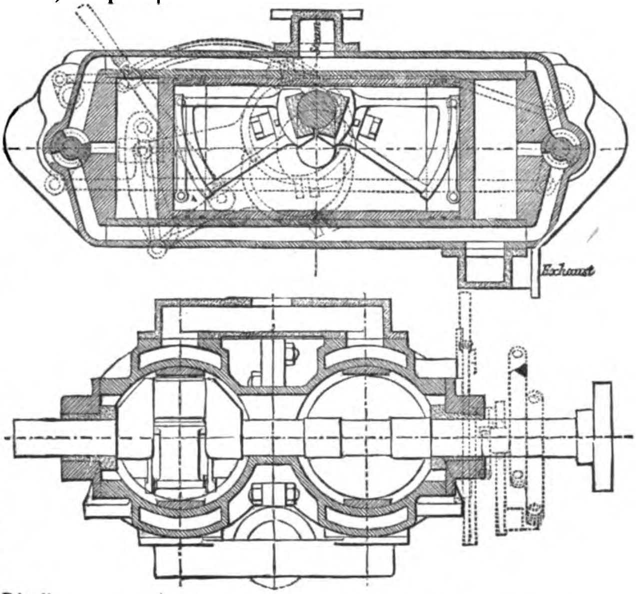
Box Coil with Return Bends.

Box En'gine. A peculiar form of engine in which the parts are all in compression, and which has but two joints. It is singularly compact, as a 25 horse-power engine, with steam at 65 pounds, occupies a space 14″ × 32″ × 13¼″, and weighs 364 pounds.

The engine consists of a cast-iron casing forming a cylinder traversed at the middle of its length by the crankshaft. The piston is formed of two rings connected by means of distance pieces, while a plate is secured to each end, and between these plates the sectors, which act as connecting rods, move freely.

The use of these sectors or quadrants in place of the ordinary connecting rods forms one of the features of the engine. The sectors roll on the inner faces of the piston plates, and are supported by bridle rods of wrought-iron, the wearing parts are case-hardened, and the pins on which they move are of steel. In the ends of the sectors are fitted the crank-pin brasses, so arranged that they may easily be set up until they are completely worn through; the motion of the arcs of the sectors being a rolling motion, there is practically no friction. The brasses of course are under the same conditions as those of an ordinary engine.

Fig. 403.



Outridge's Box Engine.

The valves used are of cylindrical form, having passages for the inlet and outlet of the steam, one valve being placed at each end of the cylinder. They are held between centers of hardened steel (as they do not bear on the shell there is very little if any wear) and are actuated by an eccentric attached to a rod connected to both by means of short levers; the motion of the eccentric causes the valves to vibrate. The engine is solely under the control of the reversing lever, and may be stopped, started, reversed, or linked up with the greatest ease, the valves always being in equilibrium.

The clearance spaces are small, the amount being only one fortieth part of the cubic contents of the cylinder, as compared to one twelfth part, which is the general practice in small engines of the ordinary type. This object is gained by the use of very short steam ports, the general practice being to make the ports ¾″ in length.

A lubricator is fitted on the steam-pipe and the oil is carried past the valves into the interior of the cylinder in the usual manner. An oil cup is also fitted to the hand-hole door, by means of which oil is introduced between the inner faces of the piston-plates; in this the crank-pin is partially submerged at each revolution, the splashing caused by the passage of the crank through the oil thoroughly lubricates all the working parts inclosed within the diameter of the cylinder, and oilways are cut in the bearing brasses, through which the oil constantly trickles and thereby reduces the chances of hot bearings. When once the lubricator has been charged and a proper quantity of oil placed between the piston-plates, the engine will run for twenty-four hours without attention.

See the following references: —

* "*Engineer*" . . . . xlv. 55.
* "*Engineering*" . . . . xxv. 52.
* "*Scientific American Supplement*" . . 1805.

Box Form'ing Ma-chine'. A machine for forming sheet-metal boxes, such as those for condiments, baking powder, cocoa, etc.

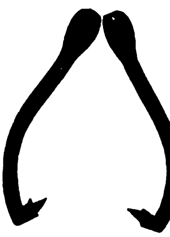
"*Iron Age*" . . . . . * xx., November 22, p. 1.

Box Hook. 1. A hook used in handling boxes; somewhat like a cotton-hook, which see.

2. A hook made on the plan of a cant-hook; used in closing boxes packed full of fish.

3. Hooks used in pairs in swinging boxes from a lifting-tackle. Fig. 404.

Fig. 404.

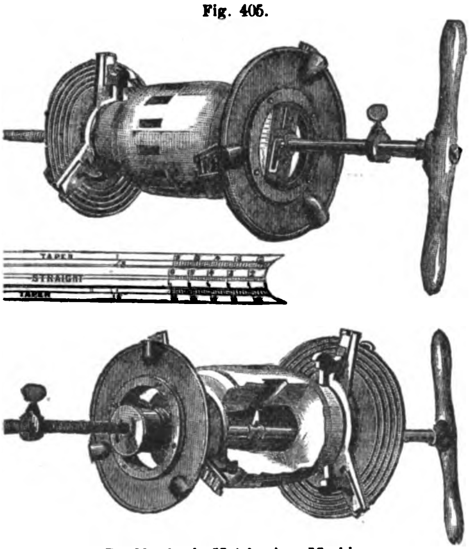


Box Hooks.

Box'ing Ma-chine'. A machine for boring out the boxes of hubs. Fig. 405. It is adjustable to bore either a straight or taper hole.

The upper figure shows the chuck for the larger end, with the device for varying the taper of the hole. The lower figure shows the chuck for the smaller end, and also shows the interior, a portion of the hub being broken away to expose it. The adjusting rule, shown between the figures, enables the operator to set the bits for cutting a straight hole or one with any required taper.

Fig. 405.



Double-chuck Hub-boxing Machine.

Box Man'gle. One of which the weight is formed by a box containing stones or blocks. Fig. 3043, p. 1383, "*Mech. Dict.*"

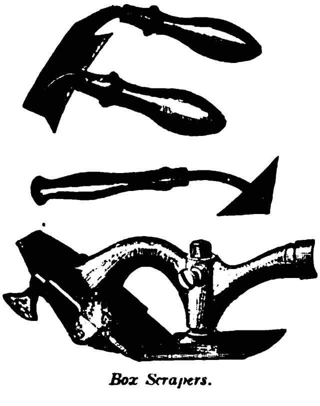
Box Pack'ing. Fibrous waste saturated with oil for the packing of axle boxes.

Box Re'lay. (*Electricity.*) A portable relay instrument which is inclosed in a box.

Box Scra'per. A tool for scraping names off boxes for re-addressing.

The illustration shows a double handle scraper, a single handle scraper, and an adjustable scraper with plane bit.

Fig. 406.



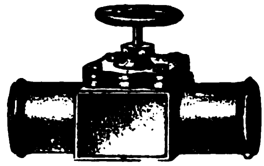
Box Scrapers.

Box Valve. A box section in a pipe containing a valve, and having a cover for access. Fig. 407.

Bra-bant' Plow. A peculiar form of plow, made either single, double, or turning-mold-board.

It is named from Brabant, in Flanders, and is rapidly spreading over the North of France. Whatever may be the peculiarity of the mold-board, one or more, the plow has always its beam adjustable in the standard of the avant-train.

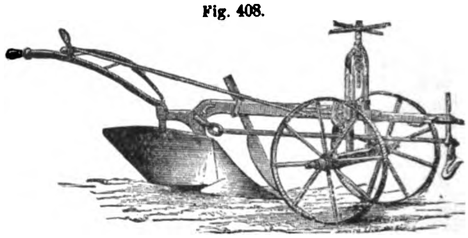
Fig. 407.



Greenhouse Box Valve.

See —
Knight's "*Report, Paris Exposition*," * v., Figs. 4, 25–28, 49.
"*Scientific American*" . . . . . * xxxix. 163.

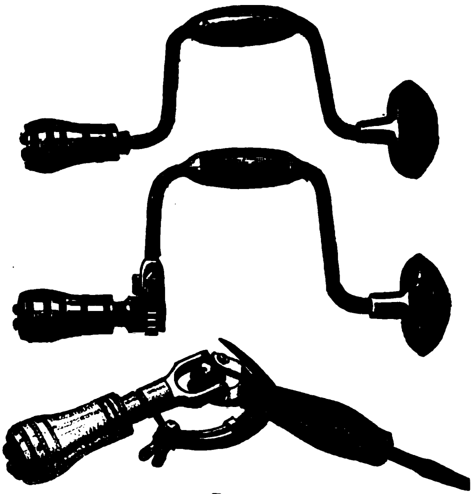
Fig. 408.



Brabant Single Plow.

Brace. 4. (*Add.*) A revolving tool-holder, of which three forms are shown in Fig. 409: Straight,

Fig. 409.



Braces.

Ratchet, Angular. An *extension* brace is one with a lengthening section for very deep holes.

8. (*Mining.*) (*Add.*) *b.* The platform over the mouth of the shaft or winze, and to which the tackle is hooked.

Brace Tre-pan'. (*Surgical.*) A trephine saw mounted on a brace: in effect, an annular bit in a brace.

Fig. 72, p. 20, Part I., *Tiemann's* "*Armamentarium Chirurgicum.*"

Brack'et Cock. One projecting from a wall in manner of a bracket, as distinguished from one on a post rising from the basin slab. Fig. 410.

Brack'et Cut'ting-off' Saw. A cross cutting saw mounted on a projecting bracket, its arbor traversing to and fro so as to carry the saw across the stuff which lies upon the table beneath. Fig. 411. The table has rollers to facilitate the endways motion of the timber between cuts.

Fig. 410.

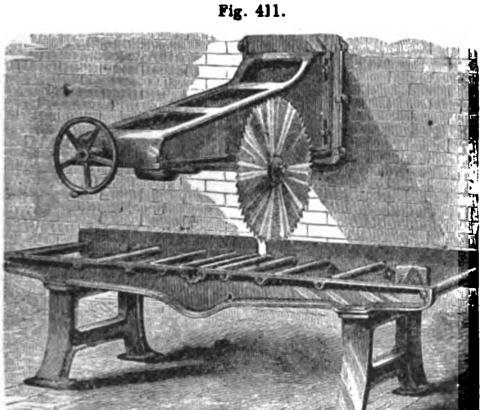
Bracket Basin Cock.

The machine is specially designed for car and bridge shops, ship-yards, etc. The bracket is adjustable vertically on the wall-plate, to compensate for the wear of the saw. The saw carriage is gibbed to the ways, and the traverse movement is by rack and pinion connected with the hand-wheel in front. The traverse is 38″; sawing capacity for boards is 30″ wide, and for timbers 12″ × 24″.

Brad Driv′er. An instrument, Fig. 413, especially designed for nailing moldings to the panels of doors. It has a brad-holder and a plunger driven by a mallet.

Bra-doon′. (*Manége.*) A small bit having loose rings; used as a second bit for bearing reins in curb bridles. *Gag bradoons* have holes in the rings through which a strap is passed, the ends of which are connected with the reins; when made in this way they are very severe, and are used only for riding bridles. *Link* and *T bradoons* are bits having links or T-s attached

Fig. 411.



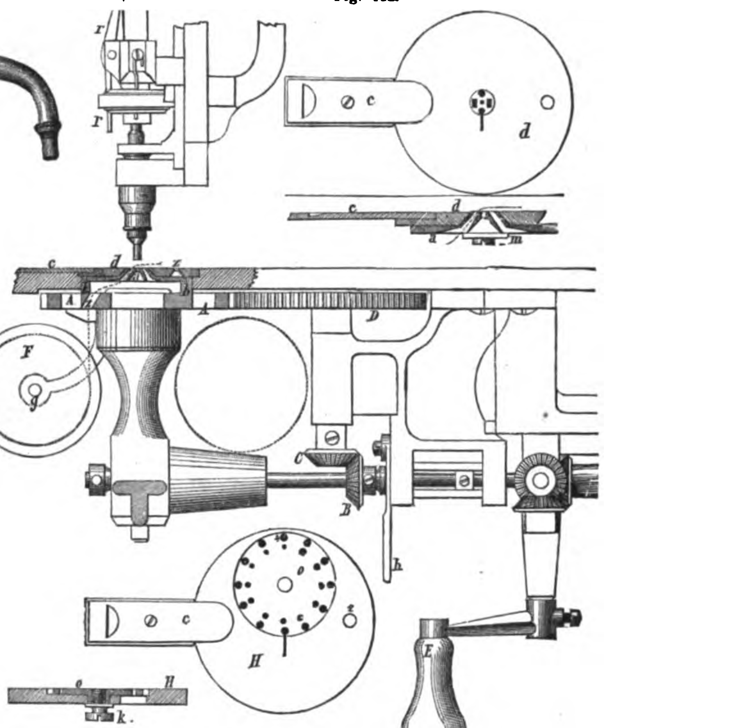
Bracket Cutting-off Saw, with Traversing Arbor.

to the rings, by which the head collar is attached; they are used only for military purposes; bradoons are made with stiff and with jointed mouths.

Braid′ing Ma-chine′. A machine which sews braid on to cloth. A species of embroidering machine.

Cornely's braiding machine (Paris) is founded upon the Bonnaz embroidering machine, having combined with the latter a braiding apparatus which presents the braid to the needle always in the direction of the feed, so that it will stitch it to the cloth in its center.

Fig. 412.



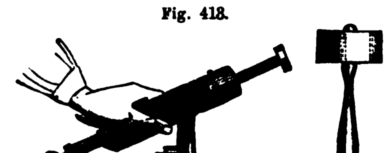
Cornely's Braiding Machine.

The braiding apparatus consists of a braiding disk *a*, which is fitted within the rim or crown of the large wheel *A*. Upon turning the crank handle *E*, the wheels *B*, *C*, *D* turn the wheel *A* and the braiding disk *a*, which presents the braid to the needle always in the direction of the feed.

To use the braiding apparatus a braiding guide must be selected, through which the braid can slide easily. Braiding disks are adapted for the respective sizes of braid.

Withdraw the slide *c*, raise the plate *d* by inserting the curved point of the hook knife into the hole, lift the end of the braid by means of the wire-hook through the slot *Z*, in wheel *A*, and draw it through the braiding guide. Place the spool *F* on its spool-holder, *g*, and the India-rubber washer upon the end of the spool-holder to prevent the spool from sliding off. Set the braiding disk *a* upon the rim of the wheel *A* and in such a manner that its projection *m* enters into one of the recesses of said rim.

Fig. 413.



Thorndike's Brad Driver.

It is very important that the guide from which the braid issues should always be in a true radial line with the feed lever *r* of the machine, and that the braid should fit nicely in said guide, or else it will not be stitched in its center; it should, however, not be too tight in the guide, as in that case it would draw and ruffle the material.

In case it should be necessary to adjust the braiding guide it can be done by adjusting the position of the wheel *A*. To accomplish this, raise the lever *h*, and push the wheel *B* to the right, thus the wheel C becomes free, and the wheel A can be turned independently of the crank handle E; adjust the braiding disk to its true position, push the wheel B against the wheel C and lock it by means of the lever h.

The braid should always pass from below the spool F into the passage Z, as shown in dotted lines, and never from above the spool, as it will bear against the side of the passage Z and thus draw or ruffle the material.

For embroidering purposes a plate, H, is supplied with each machine, and is to be used instead of the plate d.

To change the needle-hole in plate o, loosen the screw k, push the disk o out of plate H, turn it until the needle-hole to be used will be in the center of plate H, and push it home into the plate H, taking care that the tooth 4 enters one of the notches in the circumference of disk o, and tighten the screw k.

The *Wheeler & Wilson* new No. 10 sewing-machine is a perfect braider.

Brain Knife. (*Surgical.*) A knife used in making sections of the brain in *post-mortem* examinations and for microscopic purposes.

Fig. 326, p. 95, Part I., "*Tiemann's Armamentarium Chirurgicum.*"

Braize. Charcoal powder. It accumulates around charcoal works at furnaces, and is a source of danger. Suggested to be blown into the furnaces of the hot blast. — "*Mining Journal.*"

Brake. 1. (*Railway.*) See AIR BRAKE, VACUUM BRAKE, etc. For details of various car-brakes, see *Forney's* "*Car-builders' Dictionary.*"

2. In casemate and ships' guns: a compressor to check the recoil of a gun. See description on pages 500, 501, "*Ordnance Report,*" 1877.

3. (*Manége.*) A severe bit, formerly used in England. It is referred to by Nares.

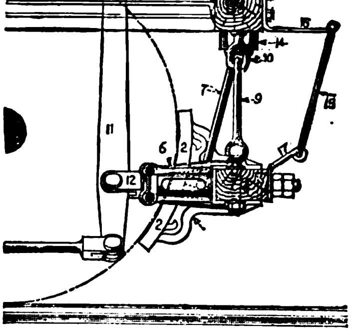
4. A form of testing device. See DYNAMOMETER; DYNAGRAPH, "*Mech. Dict.,*" *et infra.*

See, also: —

Automatic friction	
Becker, Austria	* "*Scientific American Sup.,*" 8996.
Car (for tests).	
Westinghouse	* "*Engineer,*" xlv. 380.
	* "*Engineer,*" xlv. 402.
Car for testing.	
Westinghouse	* "*Engineering,*" xxv. 470.
Continuous	* "*Engineering,*" xxiv 262, 363, 369.
Sanden	* "*Engineering,*" xxi. 241.
Railway, *Massauge*	* "*Van Nostrand's Mag.,*" xxii. 9.
For locomotives.	
Hickey	* "*Scientific American Sup.,*" 1600.

Brake Beam. (*Railway.*) The suspended beam to which the brake shoe is immediately attached. — *Forney.*

Fig. 414.



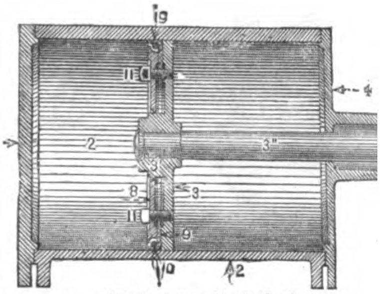
Trussed Brake Beam, Hanger, and Carrier.

The parts concerned are as follows: —

2. Brake-block.	11. Brake lever.
4. Trussed break-beam.	13. Brake lever-stop.
7, 9. Brake hanger and link.	15, 16. Parallel brake.

Brake Cyl'in-der. (*Railway.*) The air der of a brake arrangement; containing the against which the compressed air works to the brake lever. — *Forney.*

Fig. 415.



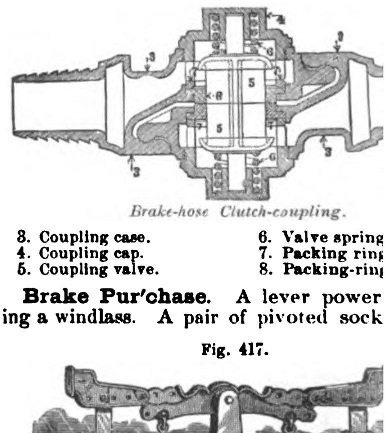
Westinghouse Car-brake Cylinder.

The parts are as follows: —

2. Cylinder.	9. Packing leath
3. Piston, 3'' piston-rod.	10. Packing expa
8. Follower-plate.	11. Follower bolt

Brake Hose-coup'ling Valve. (*R* In the clutch-coupling of the Westinghou A puppet-valve which is contained in a in a coupling-case to prevent the escape of the hose when the latter are uncoupled. —

Fig. 416.

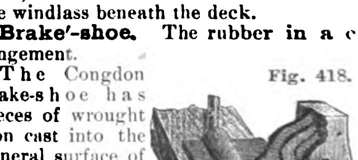


Brake-hose Clutch-coupling.

3. Coupling case.	6. Valve spring
4. Coupling cap.	7. Packing rin
5. Coupling valve.	8. Packing-rin

Brake Pur'chase. A lever power ing a windlass. A pair of pivoted sock

Fig. 417.



"*Amazeen*" *Beam.*

the handspikes and act alternately upon lever, which has rod connection to the the windlass beneath the deck.

Brake'-shoe. The rubber in a c rangement.

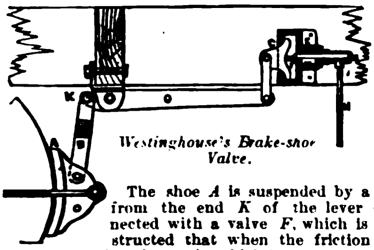
The Congdon brake-shoe has pieces of wrought iron cast into the general surface of the cast iron shoe, to give it greater adherence.

Fig. 418.

Brake-sho

Brake'-shoe Valve. A valve arranged to be operated by the brake shoe when the friction on the brake-shoe exceeds the amount sufficient to skid the wheels.

Fig. 419.



Westinghouse's Brake-shoe Valve.

The shoe *A* is suspended by a link *B* from the end *K* of the lever *C*, connected with a valve *F*, which is so constructed that when the friction of the brake-shoe, or rather the strain which it exerts on the link *B*, exceeds an amount assumed to be sufficient to skid the wheels, the valve will release some of the air in the brake cylinder, and thus reduce the pressure on the piston and on the brake-shoes When the car is running in one direction the strain on the link *B* will of course be downward, and when running in the opposite direction the strain will be upward.

"*Railroad Gazette*" . . . . * xxiii. 99.

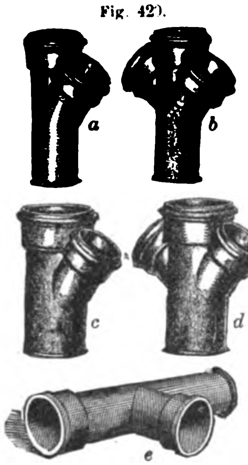
Branch. A bifurcated pipe, known as a Y, from the similarity of form to that letter.

a. Branch or Y.
b. Double Y.
c. Reduced Y; one of the arms being of smaller diameter.
d. Reduced double Y; both the subsidiary pipes being of smaller diameter than the main stem.
e. T-branch.

When it leads to lateral water-closet hoppers, it is known as a *soil branch*, which see.

See also Bend, Hub, etc., and list on page 1708, "*Mech. Dict.*"

Fig. 420.



Pipe Branches.

Bran Ma-chines'. For clearing flour from bran, for packing, baling, etc.

See the following references: —

Baler, *Kennedy*	* "*American Miller*," viii. 198.
Cleaner, *Davario*, Switz. .	* "*Engineering*," xxx. 250.
Mills	* "*American Miller*," vii. 209.
Dresser, *Lanton & Arndt* .	* "*American Miller*," viii. 197.
	"*American Miller*," viii. 332.
	"*American Miller*," vii. 188.
Duster, *Bradfield & Oliver* .	* "*American Miller*," v. 54.
Dresser	"*American Miller*," vi. 108.
Duster, *Hughes*	* "*American Miller*," vi. 77.
	"*American Miller*," vi. 144.
Rakes	* "*American Miller*," viii. 115.
Package	"*American Miller*," viii. 377.
Packer, "Eureka," *Mattison*	* "*American Miller*," v. 93.
	"*American Miller*," v. 88.

Brass. An alloy of copper and zinc. See pp. 358, 359, "*Mech. Dict.*"

A native brass is found on the south fork of the Yuba River, California, analyzing as follows (*Stillman*): —

Copper	85.02
Zinc	11.02
Antimony	3.82
Iron	0.09
	99.05

"The specimens are in the form of small, somewhat flattened, concretionary masses, from ½ to ¼ centimeters in diameter, and destitute of apparent crystalline structure. Color, from dark reddish-brown to yellowish-white; streak, faint yellowish-white; specific gravity, 8.33; somewhat brittle; slightly incrusted with green carbonate of copper." — "*Mining Record.*"

See *Larkin's* "*Practical Brass and Iron Founder's Guide*," 12mo.

Recipes: —

	Tin.	Zinc.	Copper.	Lead.
Hard. *Chantrey's*	5	5	82	-
Castings	-	16	32	3
Lathe	2	33	65	-
Malleable	-	43	57	-
Button	-	15	24	-
White	1	2	16	-
Red	-	1	9	-
Red. *Hegermuhl*	-	2	11	iron.
Nails	-	16	20	2
Red sheet	-	2	9	old br
Gear wheels	3	-	32	2
Turning	4	-	32	3
Pumps	3	1	32	-
Sheathing and bolts	-	4	6	-
Soldering	-	6	16	-

On brass, *Kirk*	"*Iron Age*," xxi., Mar. 14, p. 5.
Blackening	"*Sc. American*," xxxiv. 386.
Brassing, Electro	"*Iron Age*," xxii., Dec. 5, p. 3.
Coloring	"*Scientific Amer.*," xxxiv 276.
Thurston's expts. in . . .	"*Sc. American*," xxxvii. 65.
Furnace	* "*Iron Age*," xxi., Mar. 28, p. 5.
Filings separator	"*Eng. & Min. Jour.*," xxx. 91.
Malleable	"*Scientific Amer. Sup.*," 2662.
Manufacture, *Benedict, et al.*	* "*Scientific Amer.*," xlii. 271.
Coloring and finishing . .	"*Scientific Amer.*," xli. 281.
Works, *Scoville Co.* . .	* "*Scientific Amer.*," xli. 375.
Brazing furnace	* "*Sc. American*," xxxviii. 404.
Brazing burner	* "*Iron Age*," xxv., May 27, p. 3.

Brass Black'ing. A dead black color; used freely with French optical instruments.

Make a strong solution of nitrate of silver in one dish, and of nitrate of copper in another. Mix the two and plunge the brass. Remove, and heat evenly until the required dead blackness is obtained.

Brass Col'or-ing. Surface coloration by lacquer or chemical action.

To obtain —

Browns of all shades, immerse in solution of nitrate or perchloride of iron, the strength of the solution determining the depth of the shade.

Clean the brass, leave in damp sand, then polish with a dry brush.

Violet: Dip in solution of chloride of antimony.

Chocolate: Burn on the surface of the brass moist red oxide of iron, and polish with graphite.

Olive Green: Make the surface black by means of a solution of iron and arsenic in muriatic acid, polish with a black-lead brush, and coat, when warm, with a lacquer composed of one part of lac varnish, four of turmeric, and one of gamboge.

Green and light coating of Verdigris: Dilute acid, followed by spontaneous drying.

Orange, inclining to gold: Polish, and plunge for a few seconds in a warm, neutral solution of acetate of copper.

Grayish Green: Dip in a bath of copper.

Moire: Solution of sulphate of copper.

Steel-gray Bronze: Dilute boiling solution of chloride of arsenic.

Blue Bronze: Strong hyposulphite of soda.

English Brass Color: Heat to redness, dip in sulphuric acid, then in dilute nitric acid, wash, dry in saw-dust.

Black Bronze: Coat with solution of platinum, or chloride of gold mixed with nitrate of tin.

Japanese Bronze: Solution of sulphate of copper, alum, and verdigris.

Black: Polish with tripoli, wash with solution of nitrate of tin, 1; chloride of gold, 2.

Or, dip in bath obtained by dissolving copper filings in nitric acid; then heat over charcoal; repeat to develop color.

Or, mix a strong solution of nitrate of silver in one dish and nitrate of copper in another, mix the two, plunge the brass, heat to develop color.

The following is a recipe which gives to brass a variety of shades, according to the length of the exposure or the amount of the application. First appears a light color, then all shades successively from red, dark blue, light blue, and finally brown: Dissolve 60 grains bitartrate of potassa in a liter of water, to which add 30 grains tin salt (protochloride of tin) dissolved in a fifth of a liter, heat to boiling, and allow the resulting precipitate to settle. The clear liquid is now to be poured, under constant stirring, into a solution of 180 grams of hyposulphite of soda in one fourth liter of water, and again heated to boiling, during which operation a quantity of sulphur will be separated. The resulting clear solution is then ready for use.

Old German Recipe: The sulphide of copper produces similar effects.

Brass Fin'ish-ing.

See article from "*Ironmongers' Review*" (Br.) on Brass Finishing, including —

- Turning.
- Spinning.
- Burnishing.
- Coloring.
- Bronzing.
- Lacquering.
- Etc.

Reproduced in "*Iron Age,*" xxi., May 9, p. 7.

Brass'ing. Electro-brassing is done by first washing in hot potash bath, then pickling the article to obtain a clean metallic surface, free from oxide, and removing the black scale by scouring, and then exposing in the depositing bath with strong battery power.

The methods employed for brassing cast iron, zinc, steel, are detailed by Mr. Alex. Watt, and reproduced in "*Scientific American Supplement,*" 2610.

Brass Lac'quer-ing. A means of preserving brass from tarnishing without giving it an artificial color. (For the latter see BRASS COLORING.)

The brass is pickled, scoured, and washed; dipped in nitrous acid for an instant, washed in clean water, dried in saw-dust. Then dipped an instant in nitric acid, washed in a weak solution of argol, and dried in warm saw-dust.

"So prepared, the goods are conveyed to the lacquer room, where they are heated on a hot plate and varnished.

"The varnish used is one of spirit, consisting, in its simple form, of one ounce of shellac dissolved in one pint (imperial) of methylated spirits of wine. To this simple varnish are added such coloring substances as red sanders, dragon's blood, and annatto, for imparting richness of color. To lower the tone of color, turmeric, gamboge, saffron, Cape aloes, and sandarach are used. The first group reddens, the second yellows the varnish, while a mixture of the two gives a pleasing orange.

"A good pale lacquer consists of three parts of Cape aloes and one of turmeric to one of simple lac varnish. A full yellow contains four of turmeric and one of anuatto to one of lac varnish. A gold lacquer, four of dragon's blood and one of turmeric to one of lac varnish. A red, 32 parts of annatto and eight of dragon's blood to one of lac varnish.

"Lacquers suffer a chemical change by heat and light, and must, therefore, be kept in a cool place and in dark vessels. The pans in use are either of glass or earthenware, and the brushes of camel's hair, with no metal fittings." — *Ironmongers' Review*

Lacquer for small arms and bright work of ordnance is made of turpentine, oil, and beeswax, sometimes with the addition of litharge or of resin. In the latter cases the compound is really a paint or a varnish, and the term lacquer is a misnomer.

Fig. 421.

Brazing Blow-pipe.

Brat'tice Cloth. A cloth used in a mine in place of a brattice of plank.

Proposed to be made of wire cloth, so as to prevent being burned by explosion or other accident.— "*Mining Journal.*"

"*Scientific American Supplement,*" 948.

Bray'-plank (*Grain Mill.*) The beam supporting the adjustable end of the bridge-tree.

Bra'ziers' Hearth. An open fire used by braziers.

For particulars and suggestions, see *Kirk's* article in "*Iron Age,*" xxi., May 9, pp. 3, 5.

Braz'ing Blow-pipe. A brazing blov used by Dr. Cryer in his lectures on conti gum and other dental work, is shown in Fig.

In this bench apparatus the blow-pipe a ment is connected with the main tube by a s ing gas-joint. The air is admitted at *A*, p through a small tube enclosed in the gas-pi The supply of gas is regulated by the stop-c

See article by Edward Kirk, "*Iron Age,*" xxi., May

Braz'ing Tongs. A flat, heavy jawed used in brazing band-saws. The tongs, being in the furnace, is clapped upon the scarfed the saw, between which a slip of solder See Fig. 199.

Bread Sli'cer. A guillotine knife, w in a guide, to cut slices from a loaf. Th SHAVER (which see) is a similar implement.

Athearn's bread slicer descends in oblique guides make a draw-cut.

Anderson's is a detached knife with guides, whic direct it vertically.

Break. 4. (*Architecture.*) (*Add.*) *b.* A wall projecting, to destroy the continuity versify the line.

(*Add.*) 7. (*Mining.*) A fissure or crac in the vicinity of old workings, caused by sidence of the strata.

8. (*Electricity.*) An opening in the cir venting the passage of electricity.

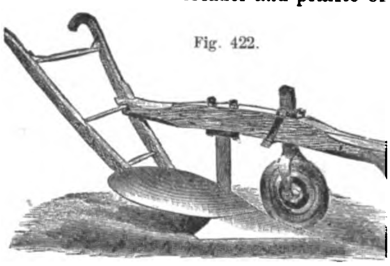
Break'-cir'cuit. (*Electricity.*) An ment on an electro-magnetic or magnet instrument, by which an operator can ope the circuit at pleasure.

Break'-down Van. A British na wrecking car, sent to clear and repair after derailment of a train or cars.

Break'er. A plow adapted for brea ground, as distinguished from a stubble sod plow.

The timber laud breaker and prairie br

Fig. 422.



Deere's "Prairie Queen" Breaker.

essentially different, the former more proximating the normal plow. The latte in Fig. 422. In construction it is light and, like plows of its class, turns a flat f has a slip-share, wrought frog, and ad horse clevis.

Break'er Card. The first cardin which receives weighed quantities of its feeding apron and forms it into a lap ond carder is the *finisher*.

Break'ing-down Ma-chine'. (
A machine used in the manufacture of to break the lumps of crude powder int of division, to facilitate the operation o

The breaking-down machine consists gun-metal, cylindrical rollers, groove nally. They are placed side by side horizontal and parallel. The journal roller are adjustable, and held in p weight. They revolve in opposite dir break the powder into a meal. A second pair completes the operation.

See "*Ordnance Report*," 1879, Appendix I., Plate III., Fig. 6, and description on p. 102.
* "*Engineering*," xxv. 95.

Break Lathe. (*Mach.*) One having a gap in its bed to increase the *swing*, or capacity for turning objects of large radius. In the Whitworth self-acting break-lathe, a very large face plate is used, and the tail stock is mounted on a supplementary bed, and has the usual adjustments. See also GAP-BED LATHE.

Break'wa-ter.

See the following references: —
Block Island . . "*Scientific American*," xl. 342.
Bruggeman . . * "*Scientific American Supplement*," 397.
St. Michael, Azores "*Scientific American Supplement*," 210.

Breast Rope. (*Nautical.*) A band fastened between the shrouds for the safety of the man in the chains when sounding. He leans against it when reaching over to let the lead swing clear.

Breath Bat'te-ry. (*Electricity.*) A thermo-electric battery adapted to be used as a transmitter in a telephone circuit.

"*Scientific American Supplement*" . . . . * 2552.

Breach'-load'ing Fire'-arms. Norton's report in quarto on American breech-loading fire-arms, contains notices of the following arms (* illustrated): —

Breech loader. Temp. Henry II., of France.
Matchlock revolver. Temp. Henry II., of France.
Snap-hammer self-loading petronel. Temp. Charles I., Britain.
Breech-loading rifles. Temp. Henry VIII., Britain.
Breech-loading arm. Hall, Britain, 1664.
Breech-loading arm. Hall, United States, 1811.

Breech-loader, —	Breech-loader, —
Ferguson,* 1776.	Earnest.*
Remington.*	Milbank.*
Peabody.*	Spencer.*
Ward-Burton.*	Maynard.
Springfield.*	Hammond.*
Joslyn-Tomes.*	Roberts.
Berdan,* converted.	Ball-Lamson
Berdan,* bolt.	Broughton.
Whitney.*	Meigs.*
Revolver, Smith & Wesson.* Colt.	Machine gun, Gatling.*

The following guns were subjected to the tests of the Board of Ordnance. See Ordnance Memoranda, No. 15, where they are described and illustrated.

LIST OF ARMS.

No. 1.	Wooden model	Edwin Sleeper.
2.	Musket, cal. .50	B. S. Roberts.
3.	Carbine	W. T. Scott.
4.	Magazine-carbine	W. R. Evans.
5.	Musket, cal. .50	Sharps' Rifle Co.
6.	Wooden model	F. W. Worrell.
7.	Musket, cal. .50	Peabody Rifle Co.
8.	Musket, cal. .433	Peabody Rifle Co.
9.	Carbine, cal. .50	Peabody Rifle Co.
10.	Musket, cal. .50	E. Whitney.
11.	Musket, cal. .50	E. Whitney.
12.	Musket, cal. .50	E. Whitney.
13.	Musket, cal. .50	E. Whitney.
14.	Musket, cal. .42	J. D. Greene.
15.	Carbine, cal. .42	William Morgenstern.
16.	Musket	Frederick Wohlgemuth.
17.	Musket	Frederick Wohlgemuth.
18.	Musket, cal. .50	John Broughton.
19.	Musket, cal. .50	E. Remington & Sons.
20.	Musket, cal. .50	E. Remington & Sons.
21.	Musket, cal. .50	E. Remington & Sons.
22.	Musket, cal. .50	E. Remington & Sons.
23.	Musket, cal. .50	E. Remington & Sons.
24.	Musket, cal. .50	W. H. Elliot.
25.	Musket, cal. .50	A. T. Freeman.
26.	Musket, cal. .50	Ward-Burton.
27.	Carbine, cal. .50	Ward-Burton.
28.	Carbine, cal. .50	B. S. Roberts.
30.	Musket, cal. .50	C. M. Spencer.
31.	Musket, cal. .50	E. Remington & Sons.
32.	Musket, cal. .50	W. S. Smoot.
33.	Musket, cal. .50	Oscar Snell.
34.	Musket, cal. .42	S. F. Van Choate.
35.	Musket, cal. .52	W. H. Robertson.
36.	Musket, cal. .50	Capt. J. M. Whittemore.
37.	Musket, cal. .50	John L. Kirk.
38.	Musket, cal. .50	Smith & Chamberlain.
40.	Musket, cal. .50	B. F. Joslyn.
41.	Musket, cal. .43	E. Remington & Sons.
42.	Musket, cal. .50	Updegraff.
43.	Musket, cal. .50 (Ryder extractor)	E. Remington & Sons.
44.	Musket, cal. .50	James F. Thomas.
45.	Musket, cal. .50	John Broughton.
46.	Musket, cal. .42	Wesley Richards.
47.	Musket, cal. .50	Schofield-Remington.
48.	Musket, cal. .50	Springfield, mod. 1870.
48½.	Carbine, cal. 50	Springfield.
49.	Wooden model	Alfred Beals.
50.	Musket, cal. .50	J. M. Milbank.
51.	Musket, cal. .50	J. M. Milbank.
52.	Magazine-musket, cal. .44	Stetson.
53.	Musket, cal. .50	James Lee.
54.	Musket, cal. .50	James Lee.
55.	Wooden model	G. R. Remington.
56.	Revolving carbine	Helm.
57.	Musket, cal. .42	Berdan-Russian.
58.	Magazine-carbine, cal. .45	Ward-Burton.
59.	Musket, cal. .50	A. T. Freeman.
60.	Musket, cal. .58	Mont-Storm.
61.	Musket, cal. .50	James Lee.
62.	Musket, cal. .50	Oscar Snell.
63.	Musket, cal. .50	Peabody.
64.	Musket, cal. .50	B. S. Roberts.
65.	Musket, cal. .50	Earnest.
66.	Musket, cal. .50	Springfield-Stillman.
67.	Musket, cal. .50	Remington-Ryder.
68.	Musket, cal. .50	Springfield-Allin.
69.	Musket, cal. .50	Springfield.
73.	Carbine, cal. .50	Springfield.
74.	Wooden model	J. B. Rumsey.
75.	Carbine, cal. .50	B. S. Roberts.
76.	Musket, cal. .50	A. T. Freeman.
77.	Carbine, cal. .50	E. Whitney.
78.	Repeating musket, cal. .45	Winchester.
79.	Musket, cal. .42	John Broughton.
80.	Carbine, cal. .50	W. H. Elliot.
81.	Musket, cal. .50	Sharps' Rifle Co.
82.	Locking rifle, cal .50	Remington.
83.	Musket, cal. .50	Merrill.
84.	Musket, cal. .50	William Conroy
85.	Navy rifle, cal. .50	Remington.
86.	Musket (Ryder extr.) .45	Remington.
87.	Magazine-musket, cal. .42	William Gardner.
88.	Musket, cal. .45	Springfield.
97.	Magazine-musket, cal. .45	Ward-Burton.
99.	Musket, cal. .45	Springfield.

Brew'ing. Consult arrangements in the following references: —

Australian . . . . * "*Engineer*," l. 346.
Fountain, *Pontifex & Wood*, Br. . * "*Engineering*," xxix. 34.
Machinery, vats, coolers, etc., Br. * "*Engineer*," xlviii. 259.
Austrian brewery plant (48 figs.) * "*Engineer*," l. 266, 303, 404, 458, 462.
Sectional view, *Cannock Co.*, Br., * "*Engineer*," xlix. 68.
Steam "Phœnix," New York . . "*Sc. Am. Sup.*," 952.
See *Byrn's* "*The Complete Practical Brewer.*"
Erne's "*Theoretical and Practical Chemistry of Fermentation.*"
Schützenberger "*On Fermentation.*"

Brew'er's Fau'cet. A faucet with two brass cocks.

A double faucet: that is, two faucets from a single stem which enters the barrel or vat, and a small faucet at the fork for sampling. A RACKING FAUCET, which see.

Brick Bar'row. A flat-bottomed, sideless, high front board wheelbarrow, for off-bearing bricks, and conveying baked bricks to the kiln. The wheel is set farther back than usual, and the bricks piled in ranks on each side.

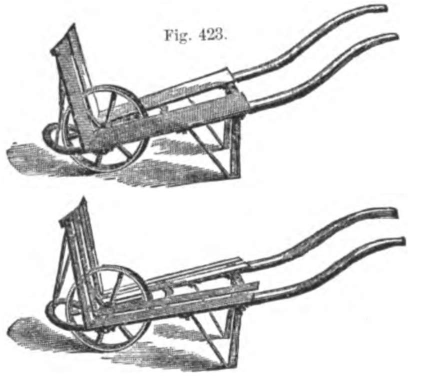
Brick, Hol'low. A brick with cells, for ventilation or to prevent passage of moisture. See Figures 897–899, "*Mech. Dict.*"

French hollow bricks are made by Gaillon, Levallois-Perret, and Hugede, Faubourg St. Honore, Paris. See also article "*Briques Creuse*," and Figs. 3438–3441, *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," vol. iv., ed. 1877.

Brick Kiln. Two systems of continuous kilns for burning bricks, tiles, etc., have come into prac-

tical use — the French system of Colas, also known as that of Borie (Fig. 901, p. 371, "*Mech. Dict.*"); and the German system of Hoffmann, the well-known annular kiln or Ringoven (Fig. 903, *Ibid.*).

Fig. 423.



Brick Barrows.

The principle of the kilns of Colas, Borie, and their imitators, consists in placing the air-dried bricks on small railway trucks forming a long train. This is slowly moved through an arched chamber, provided in its center with fixed fireplaces for burning the bricks; the fire in these kilns is stationary, while the bricks are moved forward. The principle of the Hoffmann kiln is just the reverse; here the bricks are stacked in an annular burning chamber, and remain stationary while the fire travels through them, leaving burnt bricks in the rear and advancing into and among the green bricks. The annular shape of the burning chamber allows a continuous operation of the kiln, the fire progressing in the circuit without interruption, while the burnt bricks behind the fire are continually replaced by green bricks. The first-named system is also worked continuously, the train being supplied in the rear with trucks containing green bricks, at the same rate as trucks with burnt bricks are withdrawn in the front.

On the *Colas* principle is the *Dueberg* kiln described in —

"*Engineer*" . . . . * xlvi. 191.
"*Scientific American Supplement*" * 2358.

The Foster kiln, for which see —

"*Engineer*" . . . . * xlvi. 385.
"*Scientific American Supplement* . * 2071, 2546.

Of kilns on the Hoffmann principle are the *Lancaster*, "*Scientific American Supplement*," * 2357.

Hoffmann, "*Vienna Exposition Report*," vol. iv., p. 20.

Hoffmann, *Laboulaye's* "*Dictionnaire*," i., art. "*Briques*."

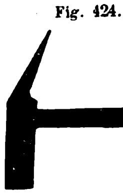
See also "Continuous Brick Kiln" (Br.), "*Engineer and Mining Journal*," xxv. 348.

Hamilton's perpetual brick kiln has a number of compartments arranged in a line and divided by a sheet-iron door, capable of being raised or lowered, so as to let the heat pass from one to the other.

Adams' Brick kiln (patent July 21, 1868) has steam introduced into the furnaces to distribute the heat through the interstices of the stack of bricks.

Brick'lay-ers' Ham'mer. A hammer for trimming bricks for caps, lintels, quoins, etc. The art of ornamental brick-work can be scarcely said to exist in the United States. Such edifices as exist in Turin and other cities in Northern Italy have no parallel on this side of the Atlantic.

Fig. 424.



Bricklayer's Hammer.

Bricklaying machine.
Franke . "*Sc. Amer. Sup.*," 149.

Brick Ma-chine'. A machine for molding bricks.

See Report of Gen. *Q. A. Gillmore*, "*Centennial Exhibition*," vol. iii., Group II., p. 184.

The subjects are divided into: —

Dry clay machines.	Tempered clay machines.
Crude or moist clay machines.	Slush or mud machines.

Includes description of the machines of

Garretson . . . . * p. 186.
Morand . . . . * p. 187.
Chambers Bros & Co . . . . * p.
Tiffany . . . . * p.
Durand & Marais . . . . * p.
Schlickeysen . . . . * p.
Gard . . . . * p.
Gregg . . . . * p.
"Peerless" . . . . * p.
"Combination" (*Gregg*) . . . . . . * p.
"Excelsior" (*Gregg*) . . . . * p.
"Triple Pressure" (*Gregg*) . . . . . * p.
Aiken . . . . *

See also Figures 908-920, pp. 371-378, "*Mech. Dict.* brick machines of three classes and six sub-vari described and illustrated. Branches of the subject considered under Pug-mill, Clay-mill, Tiles, etc.

A short *resumé* is in "*Scientific American*," xxx

See also "*Guide du Briquetier*," par *M. E. Lejeun*

Ancient bricks, "*Builder*," "*Van Nostrand's Ma* 353, and page 368, Figures 895, 896, "*Mech. Dict.*" *Wilkinson, Rawlinson, Lepsius*, etc.

See "*Brick and Tile Making*," Dobson.

"*Bricklayers' Tables*," Laxton.

The following references to Brick Machines ma consulted: —

	* "*Iron Age*," xxi., February
English	* "*Scientific American*," xxx
Allemand	* "*Scientific American Sup.*,"
Armitage & Itter, Br.	* "*Engineer*," xlix. 342.
Boulet Bros., Fr .	* "*Scientific American*," xli.
Bradley & Craven, Eng.	* "*Scientific American Sup.*,"
Brownhill, Br. . .	* "*Engineer*," xliii. 299.
Brownhill	* "*Scientific American*," xxx
Brownhill, Eng. . .	* "*Scientific American Sup.*,"
Craven, Eng. . .	* "*Scientific American Sup.*,"
Durand & Marais .	* "*Engineering*," xx. 261.
Durand & Marais .	* "*Scientific American Sup.*,"
Gard	* "*Scientific American*," xxx
Gregg	* "*American Manf.*," April 4,
Gregg, Br. . . .	* "*Manufacturer and Builder*.
	* "*Scientific American Sup.*,"
	* "*Polytechnic Review*," Apr
Gregg Represser .	* "*Scientific American*," xl.
Marhen Rotary . .	* "*Scientific American*," xxx
Newbold, Fr. . .	* "*Iron Age*," xix., March 29
Peerless Brick Co. .	* "*Manufacturer and Builde*
Penfold, Eng. . .	* "*Scientific American Sup.*,
Stubbs, Br. . . .	* "*Engineering*," xxii. 251.
Talcott	* "*Scientific American*," xlii.
Vanier	* "*Scientific American*," xxx
Warner & Lee, Br. .	* "*Engineering*," xxvi. 302.

Bridge. See the following data and to technical journals of the period, 1876–8

Tay Bridge, Scotland, commenced 1871, finished tially destroyed by a gale. Total length, 10,321′ the 13 over the channel 245′ each, and 88′ above

Syzran and Orenburg Railway Bridge over Total length 4,732′ feet; 13 spans of 364′ each. high above the water. Ice cutters 35′ high. Cost

Forth Bridge, Scotland (projected). Total le Two suspension spans 1,600′ each over deep chan are united by 2 spans of 165′ each, and each b anchorage towers, which are connected respecti north shore by 9 spans, and the south by 14 s spans, 33. The channels are 186′ and 210′ deep. towers, 597′ high. The suspension spans 150′ water.

Railway Bridge in British India. Total le 64 spans of 142′ each. Brick and iron.

Poughkeepsie Railway Bridge over the Hudson 4 piers, two of which are founded, respectively below the surface. Piers 130′ above the wate truss 60′. Railway track 190′ above the water.

Cincinnati Southern Railway Bridge, over Kent Total length, 1,125′. Three spans 300′, 375′, 300′. 150′ each. Height above water, 275′.

The height of the Niagara Railway Bridge trac water is 250′.

A Swiss bridge with a span of 154′ is 254′ high

One on the Andes has a span 125′, and is 252′

"Albert," Montreal, St. Lawrence (propo nearly 3 miles; one span between 500′ and 600′; above high water; estimated cost, $4,000,000.

"Victoria," St. Lawrence, Montreal. Tub length, 10,380′. Two abutments and 24 pier Channel span, 330′; the others, 242′ each. 60′ a level of water. Cost, $1,250,000. Commenced 1859.

Wesel Bridge, over the Rhine, has a total leng including 4 spans of 313′ each.

The Graudenz Bridge, over the Vistula, has 300′.

See list of 22 suspension bridges, p. 2464, "*Mech. Dict.*"

The following are the lengths of longest spans of the iron, tubular, and girder bridges cited : —

Place.	Feet.	Builder.
Tay	245	
Susquehanna River	307	Phœnix Bridge Co.
Vistula, Graudenz	300	
Rhine, Wesel	313	
Lessart, France	314	
Ohio River, Steubenville	319	J. H. Linville.
St. Lawrence River	330	Rob't Stephenson.
Ohio, Parkersberg	342	J. H. Linville.
Rhine, Mayence	345	Gerber.
Volga, Orenburg Railway	364	
Ohio, Louisville	368	Albert Fink.
Kentucky River	375	C. S. Smith.
Ohio, Louisville	396	Albert Fink.
Vistula, Dirschau	397	Lentze.
Conway, N. Wales	400	Rob't Stephenson.
Ohio, Cincinnati	415	J. H. Linville.
Inn, Passau	420	
Saltash	455	I. K. Brunel.
Menai Straits	460	Rob't Stephenson.
Hudson, Poughkeepsie	500	
Lek, Holland	515	G. Van Diesen.
Ohio, Cincinnati	518	J. H. Linville.

To this may be added the list of bridges over the Mississippi, between Winona and St. Louis.

At	When built.	No. Spans.	Longest Span, feet.	Draw.
Winona	1871	16	240	160
La Crosse	1876	10	240	160
Prairie du Chien	1875	–	Pontons	–
Dubuque	1868	8	240	160
Clinton	1865	14	180	118
Rock Island	1871	7	250	160
Burlington	1868	10	200	160
Keokuk	1870	12	240	160
Quincy	1868	24	160	160
Hannibal	1871	8	240	160
Louisiana	1873	11	256	200
St. Louis	1874	3	515	None

The following notices may be consulted : —

Arched Masonry . . . . . . "*Sc. Am. Sup.*," 664.
Ashtabula, Railway . . . . . * "*R. R. Gaz.*," xxi. 86.
Ashtabula, Railway . . . . . "*Sc. Am. Sup.*," 961.
Bascule . . . . * "*Man. & B.*," xi. 29.
Beaver, Penn., Truss . . . . * "*R. R. Gaz.*," xxiv. 540.
* "*Engineer*," l. 498.
Belgium, Revolving . . . . . * "*Sc. Am. Sup.*," 744.
Blackwall, Railway . . . . . * "*Engineer*," xli. 408.
Bosphorus, *Eads & Lambert* . . "*Technologiste*," xl. 38.
Brisbane, Australia, Truss . . * "*Engineering*," xxi. 553.
"*Sc. Am. Sup.*," 152.
Brooklyn, "Clefbridge," Béton * "*Man. & B.*," x. 29.
Chinese, Suspension . . . . "*Sc. Am. Sup.*," 691.
Canada, Credit Valley . . . * "*Engineering*," xxx. 154.
Derwent, England, Iron Arch . * "*Sc. Am. Sup.*," 2830.
Douro, Portugal, Truss Arch * "*Eng'ing*," xxi. 110, 149.
* "*Engineering*," xxv 457, 463, 485.
* "*Eng'ing*," xxvi. 39, 416.
* "*Engineer*," xlv. 409, 446.
* "*Engineer*," xlvi. 39, 94.
* "*Sc. Amer.*," xxxix. 103.
* "*Sc. Am. Sup.*," 1425.
* "*Eng. & Min. J.*," xxv. 308.
Dublin, Arch . . . . * "*Sc. Am. Sup.*," 1264.
E. River, N. Y., Suspension, Cost * "*Sc. Amer.*," xxxvi. 64.
Footway . . . . * "*Sc. Amer.*," xxxvi. 143.
Serving the cable . . . . * "*Sc. Amer.*," xxxix. 287.
Cable drums, etc. . . . . * "*Sc. Am. Sup.*," 754.
* "*Sc. Am. Sup.*," 899.
East River, Blackwell's Island . * "*Sc. Am. Sup.*," 1172.
Forth, Railway, Proposed, *Bouch* * "*Engineer*," xlviii. 314.
1600′ span . . . . * "*Eng'ing*," xxix. 153, 173.
Hamburg & Harburg Ry. . . * "*Engineer*," xlix. 104.
Hudson River . . . . . . "*Sc. Am. Sup.*," 627.
Iwakuni, Japan . . . . . . * "*Sc. Amer.*," xxxvii. 151.
Kennebec, Me. . . . . . . * "*Engineering*," xxvi. 8.
Kentucky River, *Bouscaren* . . * "*R. R. Gaz.*," xxi. 408, 413, 423, 433.
* "*Sc. Am. Sup.*," 1503.
"*Technologiste*," xxxix. 119.
Kuilenburg, Holland, Truss . * "*Am. Manuf.*," June 25, 1880, p. 8.
Laughery Creek, Ind., Truss . * "*Engineering*," xxix. 222.
Lee, Cork, Lifting Span . . . * "*Engineering*," xxix. 450.
Louisville . . . . * "*Engineer*," xlii. 360.
Manawater, New Zealand . . . * "*Sc. Am. Sup.*," 1542.
Manchester, Eng., *Fowler* . . * "*Sc. Am. Sup.*," 1094.
Salford, Eng. . . . . . * "*Engineer*," xlix. 442.
* "*Sc. Am. Sup.*," 1204.
Manchester, Br. . . . . . . * "*Engineer*," xliii. 148.
* "*Engineer*," xliii. 233.
Marseilles, Swing . . . . . * "*Engineer*," xlvi. 206, 222.
Matina River, Costa Rica . . * "*Eng'ing*," xxix. 24, 48.
Medway, Engl. . . . . . . * "*Sc. Am. Sup.*," 1540.
Montreal, "Royal Albert" . . * "*Engineering*," xxi. 256.
"*Engineer*," xli. 149, 174.
"*Sc. Am. Sup.*," 17.
Nile, *Kohé* . . . . * "*Engineering*," xxviii. 132, 144.
Orange Riv., Cape of Good Hope * "*Engineering*," xxvii. 371.
Oxley Creek, Queensland . . . * "*Engineer*," xlii. 414.
Penn. Railway, examples . . * "*Engineering*," xxiii.
Freight transfer . . . . . * "*Eng'ing*," xxiv. 22, 28.
Philadelphia, Callowhill St. . . * "*Sc. Am.*," xxxiv. 271.
Carriage, 40th St. . . . . * "*R. R. Gaz.*," xxi. 75, 109.
Girard Avenue . . . . . * "*Sc. Am. Sup.*," 28, 49.
Lansdowne Valley, Fairmont * "*Engineering*," xxi. 90.
* "*Sc. Am. Sup.*," 674.
Over Penn. R. R. . . . . * "*Sc. Am. Sup.*," 1055.
Pittsburg, Arched truss . . . * "*Engineering*," xxi. 528.
Iron . . . . * "*Sc. Am.*," xxxv. 143.
Monongahela, *Wilson* . . * "*Eng'ing*," xxx. 274, 290.
Suspension . . . . . . * "*Sc. Am. Sup.*," 533.
Plattsmouth, Neb., Mo. . . . * "*R. R. Gaz.*," xxiv. 640.
Portage, N. Y. . . . . . . "*Sc. Am. Sup.*," 458.
St. Charles R. R. . . . . . . * "*Sc Am.*," xxxiv., 162.
St. Louis & Illinois . . . . . * "*Sc. Am.*," xli. 379.
* "*Sc. Am. Sup.*," 125.
St. Maurice, Can. . . . . . * "*Eng'ing*," xxvi. 175, 182.
Sarpsfos, Norway . . . . . * "*Eng'ing*," xxv. 10, 26, 61.
Severn, England . . . . . . * "*Engineering*," xxxviii. 314, 322.
"*Sc. Am. Sup.*," 1490.
Susquehanna, Penn., Railway . * "*Engineering*," xxx. 490.
Sutlej, India, "Empress" . . * "*Eng'ing*," xxvi. 454, 486.
Tay, Scotland, Entire, broken . "*Engineer*," xlix. 1.
Site . . . . * "*Engineer*," xlix. 21.
Piers . . . . * "*Engineer*," xlix. 26, 30, 230, 264.
Piers . . . . * "*Iron Age*," xxv., Jan. 29, p. 1.
10,321′ . . . . "*Man. & B.*," ix. 120.
* "*Engineering*," xxii. 531.
* "*Engineering*," xxix. 88.
"*Sc. Am. Sup.*," 713.
"*Sc. Am. Sup.*," 1541.
Thames, New, London . . . . * "*Sc. Am.*," xxxviii. 329.
* "*Sc. Am.*," xxxviii. 361.
Old, London, history, etc. "*Sc. Am. Sup.*," 290.
Proposed, Tower . . . . * "*Engineering*," xxiii. 457.
* "*Engineer*," xlv. 217, 220.
* "*Engineering*," xxvii. 411.
High level . . . . . . * "*Engineering*," xxviii. 50.
London . . . . "*Van Nostrand's Mag.*," xxiii. 434.
Vescorali, Rome, Treatise on . "*Van Nostrand's Mag.*," xxiii. 331.
Volga, Syzran, Rus., Railway . * "*Engineering*," xxx. 4, 626, 30, 52, 72.
Wear, Eng., Railway . . . . * "*Engineer*," l. 368.
Yardleyville . . . . * "*Sc. Am. Sup.*," 615.
Zwartkops River, S. Africa . . * "*Eng'ing*," xxviii. 477.

Also : —

American iron . . . . . . "*Sc. Am. Sup.*," 500.
On historical, "*Building News*" * "*Van Nostrand's Mag.*," xxii. 425.
Military . . . . * "*Sc. Am. Sup.*," 480.
Piers on, *Smith* . . . . . . "*Sc. Am. Sup.*," 310.
Large span Railway . . . . . "*Sc. Am. Sup.*," 2436.
Spar . . . . * "*Sc. Am. Sup.*," 1128.
Temporary, *Bouilliant*, Fr. . * "*Sc. Am. Sup.*," 3802.
Metallic arches for tunnels . * "*Sc. Am.*," xxxviii. 70.
Iron bridge of long span . . "*Sc. Am.*," xlii. 53.

The following works may be consulted : —

Haupt's "Theory of Bridge Construction."

Fairbairn's "Application of Cast and Wrought Iron to Building Purposes." New York, 1864.

Fairbairn's "Britannia and Conway Tubular Bridges," London, 1849.

McMaster's "*Bridge and Tunnel Centers.*"
Cain's "*Maximum Stress in Framed Bridges.*"
Dempsey's "*Tubular and Iron Girder Bridges.*" (Weale's Series.)
Buck's "*Practical and Theoretical Essay on Oblique Bridges.*"
Buck's "*Modern American Bridge Building.*"
Haskall's "*Railway Construction for the East.*" London.
Haskall's "*Examples of Bridge and Viaduct Construction.*" London.
Humber's "*Practical Treatise on Cast and Wrought Iron Bridges and Girders.*" 58 plates. Imperial 4to.
Humber's "*Complete Treatise on Cast and Wrought Iron Bridge Construction.*" 2 vols. 4to. London, 1870.
Humber's "*Record of the Progress of Modern Engineering.*" 4to.
Bender's "*Proportions of Pins used in Bridges.*"
Bender's "*Continuous Bridges.*" New York, 1876.
Merrill's "*Iron Truss Bridges.*" New York, 1875.
Shreve "*On Bridges and Roofs.*" New York, 1873.
Whipple "*On Bridge Building.*" New York, 1873.
Roebling's "*Bridges.*" New York, 1869.
Chanute's "*Kansas City Bridge.*" New York, 1870.
Jenken's "*Bridges, Treatise on Construction of.*" Edinburgh, 1878.
Cullum's "*Military Bridges.*"
Haupt's "*Military Bridges.*" New York, 1864.
Pope's "*Treatise on Bridge Architecture.*" 1811.
Gaudard's "*De divers Systèmes de Ponts en Fer.*" Paris, 1865.
Baker's "*On Long-span Railway Bridges.*" Philadelphia, 1867.
Boller's "*Iron Highway Bridges.*" New York, 1876.
Unwin's "*Wrought Iron Bridges and Roofs.*" 1869.
Woods's "*Construction of Bridges and Roofs.*" New York, 1876.
Conrolle's "*Les Pont de l'Amerique du Nord.*" Paris, 1878.

2. A plank to cover the gap between the platforms of two connected cars.

Bridge, safety, *Frazer* . . * "*Scientific American,*" xxxv. 5.

3. An arrangement for measuring the resistance of an element in the circuit, Fig. 1840, p. 779, "*Mech. Dict.*"

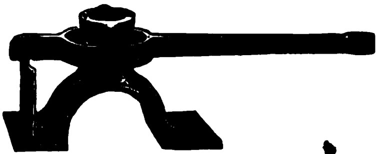
Meter resistance, *Hockin* . . . * "*Teleg. Journal,*" v. 239.
Wheatstone . . * "*Teleg. Journal,*" v. 288.

Bridge Guard. A suspended system of ropes used to warn train-men of bridges which are not high enough to permit them to stand on top of the cars. To a horizontal arm which projects over the track wires are attached, and to these pieces of rope. The height from the top of the car to the lower end of the wires is sufficient to allow a man to stand upright, but if he does so in passing under the guard he is struck by the ropes, which warn him that the train is approaching the bridge, which without such warning he might strike.

"*Railroad Gazette*" . . . . * xxiv. 627.

Bridge'pot. (*Milling.*) The socket of the mill spindle carried by the lighter-screw which adjusts the vertical height of the runner to grind close or coarse.

Fig. 425.



Arch Bridgepot.

The arch bridgepot, shown in Fig. 425, is intended to be used for straddling the driving-shaft where bevel-gear is used. On bridgepots used in portable mills the fulcrum is so arranged as to allow of placing the lighter-screw to the right or left of the meal spout at will.

Bridge Sad'dle. The block which rests upon the summit of the pier of a suspension bridge, and over which the wires pass, and upon which they rest. See Fig. 4519, p. 2011, "*Mech. Dict.*"

Bridge Test'ing Car. A car with a tank capable of being loaded to the required strain *in situ.*

A car said to be owned by the State of Connecticut, and used in testing railway bridges, is thus described: —

"The car is to be used on every railroad bridge in the State at least twice a year. It consists of an iron tank resting upon three trucks, the tank being capable of holding eighty tons of water. On the center truck are four hydraulic jacks, operated by one lever, and by these the entire weight of car and contents can be thrown upon the center truck. In case a weakness is discovered, the floodgates are opened by a single lever and the water instantly let off, relieving the bridge of 80 tons weight. The car will weigh about 60 tons, and when the 80 tons of water are added, the full test will be 140 tons. This weight may be lessened, of course, if desired." — *Chicago Railway Review.*

Brim-poun'cing Ma-chine'. A machine for shaving hat brims, to remove the shaggy fibres. See POUNCING MACHINE.

Brim Stretch'er. A machine for stretching the brims of felt hats, developing them out of the edge of the crude cone. See Fig. 427.

The brim-stretching ribs which support the brim are mounted upon a vertically reciprocating spindle which is operated by the treadle, and these ribs are provided with a spreading mechanism and are operated by the hand lever on the side of the machine. An adjustable metallic block supports the crown, and by its position determines the height of it. The upper stretching devices consist of a series of automatically reciprocating brim-stretching ribs, arrayed in a horizontal plane, equidistant from each other, in a circular line; each operating from a common center in a different vertical plane. A crank-shaft which has its bearings in the framing receives motion through the belt from a counter-shaft, and should make 500 revolutions per minute.

Through the connecting rod a reciprocating motion is given to the rocking shaft and the rods which carry the ring to which the outer ends of the vibrating stretching ribs are attached.

The hat body to be stretched, having previously been drawn out on the tip by a *tip-stretcher*, is placed upon the former of this machine and the treadle depressed, bringing the two sets of stretching ribs in working position. The hand lever is now gradually raised, and the hat-body thus spread to cause the vibratory ribs to act upon it.

When the hand lever has been raised sufficiently high to bring the spreading ribs to their full extension, the former is lowered, the hat-body shifted slightly upon it and the operation repeated until the brim is perfectly flattened out.

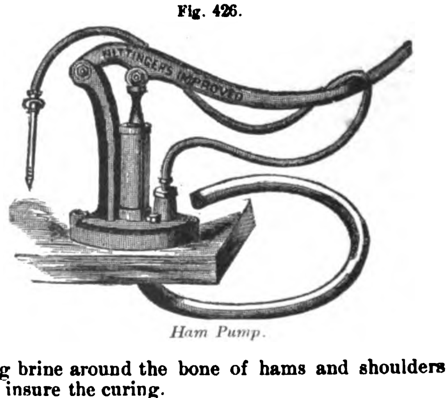
The rapid motion of the vibrating ribs enables the operator to stretch the hat while it is hot and injury by tearing is thereby prevented.

Machines made on the same principle for use in factories where all the work is done by hand are now very generally used, and but a very small percentage of all the soft wool and fur hats are now blocked in the old manner.

The finishing of fur hats is done upon a fur hat blocking machine which has an oval former, and acts upon the crown and brim simultaneously. See HAT-SHAPING MACHINE.

Brine-for'cing Pump. A pump for injecting brine around the bone of hams and shoulders to insure the curing.

Fig. 426.

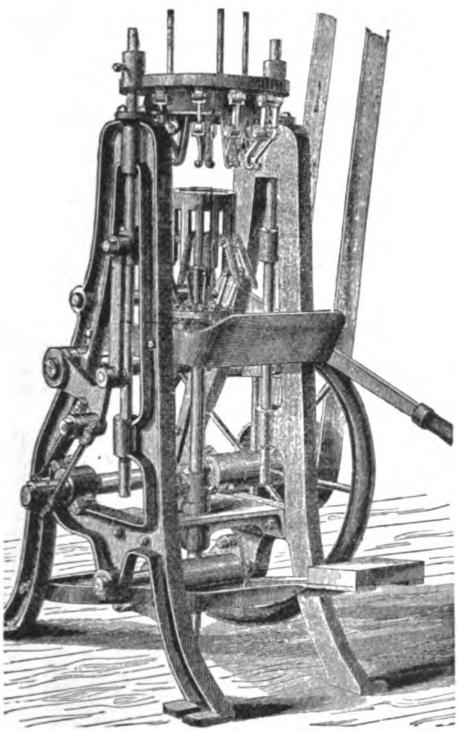


Ham Pump.

Bri-quet'. Fuel compressed into brick-like blocks. A product of increasing economic value, composed chiefly of inferior coal or coal waste, to which is added coal-tar as a cement.

France, Belgium, Germany, and even Great Britain manufacture this new fuel, France obtaining part of her supply of the raw material from Wales, and finding a market for the sale of a portion of the manufactured product in Italy, where it is used as fuel for locomotives. Machines for the manu-

Fig. 427.



Eickemeyer's Power Hat Brim Stretcher.

facture of this fuel are numerous, and several forms are shown under PEAT MACHINE, p. 1646, "*Mech. Dict.*" France annually produces about 700,000 tons of briquets and Belgium about 500,000 tons; Germany and Great Britain, respectively, manufacture large quantities. At present the use in Europe is mainly upon steamships and in locomotives. In the United States a successful attempt to manufacture compressed fuel from anthracite coal dust has been made on a large scale at Fort Ewen, near Rondout, N. Y., and to-day the enterprise is firmly established, the fuel, which is in large lumps, being supplied to steamships and locomotives. Loiseau's apparatus has attracted and deserved marked attention.

Two large manufactories of patent fuel are running in Wales, one the Crown Preserved Coal Company, of Cardiff, under the H. Walker Wood Patent, having a capacity for 500,000 tons annually. The process has been worked there since 1857.

Another, the Coal Company of Merthyr, Swansea, producing 200,000 tons annually. The composition is small coal and coal-tar pitch. The process has been carried on there for twenty years.

See FUEL, ARTIFICIAL, p. 921, "*Mech. Dict.*," *et infra*. Marseilles. *Engineering*," xxvi. 367.

Bris'tle Pro'bang. (*Surgical.*) A probang having on a section of its length a number of bristles arranged lengthwise, so as to catch over and include fungoid or other matters, and furnish a means for the withdrawal of the same. There are several forms, either a bunch of bristles tied at each end, or a frame upon which cords are strained so as to form a sort of cage.

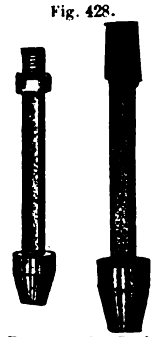
Fig. 336, p. 83, Part II., and page 5, Supplement, *Tiemann's "Armamentarium Chirurgicum."*

Brit'ish Gum. Torrefied starch; used in calico manufacture. Dextrine. See p. 691, "*Mech. Dict.*"

Broach. A reamer, for rounding or enlarging a drilled bore.

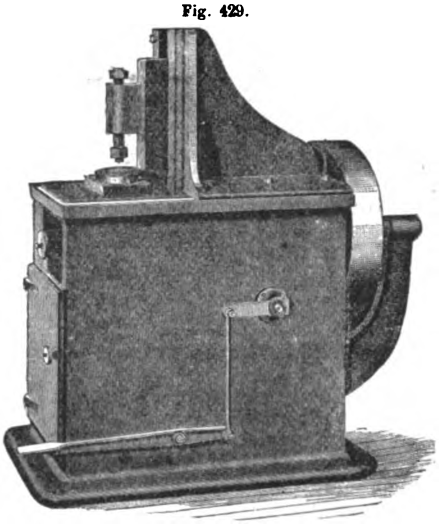
Broach'ing Press. A machine designed to make holes by the planing action of a vertically moving tool; especially useful in making holes of such diametrical form that they cannot be finished by any rotary motion, as by drilling or boring. It may be used as a slotter, and also for finishing the outside of work. The pitman which carries the slide is attached to a worm-wheel that runs in a pan of oil; a heavy balance-wheel and the Pratt friction-clutch furnish the means for a steady equable motion, and for stopping and starting instantly at any point of the stroke, which is from 1″ to 7″.

Fig. 428.



Broaches, for Rock-drilling.

Fig. 429.



Broaching Press. (Pratt & Whitney.)

Broad'cast. (*Printing.*) Matter set up to run the long way of a page, and having its top along the left-hand edge.

Broad'cast Seed'er. A machine for scattering seed upon the ground, as distinguished from one which sows it in drills.

Broadcast seeders are power and hand, and each of those kinds has as representatives two varieties: those which scatter widely, imitating the human hand in throwing, and those which sow a breadth equal to the width of the implement.

Of the power machines: The Cahoon machine acts upon a scattering principle. The seed hopper is carried in a wagon and discharges on to a wheel rotated by chain connection from a sprocket wheel on the hind-wheel axles. The rotation of the scatterer disperses the seed widely, from 16 to 36 feet in total width, according to the seed; timothy and wheat being at the opposite ends of the scale. The scattering wheel revolves in a vertical plane.

In Buist & Alden's machine the wheel is horizontal.

In the hand form of the scattering kind, the Cahoon drill consists of a bag carried in front by a neck strap, and a scattering wheel rotated by hand.

In a French form of the same implement, shown in Fig. 430, and made by Pernollet, of Paris, the scattering wheel is vertical as in the Cahoon, and the width of wheat sown is 7 to 8 meters.

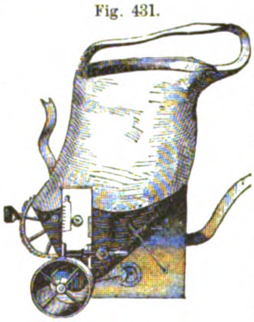
Fig. 431 shows on a larger scale the apparatus detached

Fig. 430.

Sowing with the Pornollet's Centrifugal Broadcast Sower.

from the person. An index on the side shows the condition of the opening which graduates the passage of seed according to the quantity desired to be sown.

Fig. 431.



Centrifugal Broadcast Sower.

In regard to machines for sowing widths equal to the track machines, such are both power and hand.

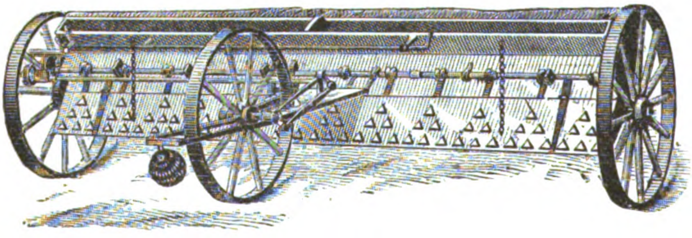
Of the power machines there are at least three varieties: —

The convertible drill, in which the shares and seed tubes are replaced by spouts which scatter the seed upon the surface of the ground, each of the eight spouts covering with seed its proportionate width of the track of the machine. Many of the American seed drills are thus convertible. In France the same practice is pursued, a broad casting spout of sheet metal being substituted for the seed-conductor. See Fig. 124, p. 113, Knight's report, "*Paris Exposition Reports*," vol. iv.

Another form of broadcaster is represented by the "Buckeye" 11-foot broad-cast sower. This has a force-feed at each of 7 openings, and has conductors which lead the seed near to the surface of the soil; but, instead of dropping it in the rear of the shares, — none of which are present, — the seed drops on a scattering plate from which it bounces on to the ground.

A third form of the machine broadcaster is that common in England and on the Continent of Europe. The seed,

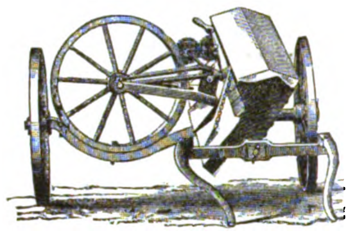
Fig. 432.



Ramussen's Broadcast Seeder.

issuing from the series of spouts, falls down an board, whose length is equal to the width of the h striking against triangular studs, arranged in quinc ion, is dispersed over the whole space of ground be wheels of the machine. The machine illustrated is Danish, made by Ramussen & Co., of Stubbekjø resembles in all material respects that made by Sons, of Peasenhall, England. The Danish mach ever, is so constructed as to be capable of bein

Fig. 433.



Ramussen's Broadcast Seeder on its Cross-a

around so as to travel upon a cross-axle, in order to pass along narrow roads and through gateways. tion of the seed-distributor is obtained from the r seen in Fig. 432, on the ground, and in Fig. 433, a on the cross-axle.

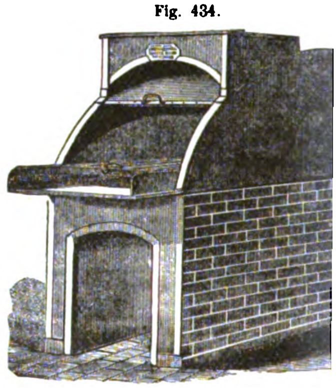
Broad'-tread Wheel. (*Railway.*) with an extra-wide tread to enable it safely, varying within a range of say 1¼" (of gage.

Also known as a *compromise* wheel.

Broil'er. 1. A gridiron.

2. A hearth for broiling steaks, etc., o scale. It is heated with charcoal, has a

Fig. 434.



Charcoal Broiler.

sliding on ways, a canopy to conduct th the chimney, a pit beneath for draft and a sliding cover, to contract at pleasur space above the gridiron.

Brok'en (*Masonry.*) A f stone work in continuity of co maintained. Se

Brok'en Ran (*Masonry.*) A which the level is not strictly See Range.

Bro'mine tus. The sou mine in the U is the mother l remains after the extraction of salt. The following description of the process is condensed from the "*Moniteur Scientifique*" : —

"The saline liquors, when first pumped up from the pit, mark 9° Baumé. They are evaporated in long iron boilers to 15° Baumé, allowed to settle, then farther evaporated to the crystallizing point in wooden tubs heated by steam. The first crystallization forms the salt of commerce. The tubs, five in number, are placed side by side, and every day the liquor is decanted from one to another, — from No. 1 to No. 2, then to No. 3, and so on to No. 5. The crystallized salt is removed from each tub after draining off the liquid. When the brine reaches tub No. 5 it has become mother liquor, and consists principally of chlorides of calcium, magnesium, sodium, and a little chloride of aluminium, with varying proportions of bromides of sodium and calcium. Tub No. 1 is filled every day with fresh brine, so that the process becomes continuous. The mother liquor, marking 30° to 38° Baumé, is evaporated to 45°, thus separating a new quantity of salt. The liquor is then decanted into stone stills; materials for the production of chlorine are added; and heat is applied in the form of steam injected directly into the still, until all the bromine has been eliminated and evaporized. It then passes into a condenser, and thence into a receiver."

See —
"*Scientific American*," xli. 240.
Dr. Jenkins' report in "*Paris Exposition Reports*," 1878, iv. 54, 55.
Bromide of Ethyl Apparatus, "*Manufacturer & Builder*," xii. 157.

U. S. BROMINE PATENTS.

No.	Inventor.	No.	Inventor.
5,658.	Alter & Gillespie.	110,662.	J. J. Jühler.
12,077.	E. Stieren.	132,296.	Leruer & Harpold.
62,464	D. Alter.	137,222.	Leyert & Winter.
62,988.	D. Alter.	137,512.	D. C. Turner.
82,309.	G. A. Hageman.	181,617.	F. W. Arvine.
93,099.	H. Leruer.	217,076.	J. N. J. Dubreuil.
103,253.	Stieren & Nesbet.	219,004.	Müller & Böckel.

Bronze. An alloy of copper and tin: the most ancient artificial alloy.

The molds for casting bronze articles are found in many European countries, as are also pieces of runners and sprues made in running the metal into the mold. In general, the proportions are 90 copper, 10 tin: but tables in *Wilson's* "*Prehistoric Man*," pp. 310, 312, and vol. i., p. 388, of the "*Mechanical Dictionary*," indicate various proportions and additions, in many cases, doubtless, unsuspected impurities.

The addition of a small quantity of iron, insisted upon of late as so valuable in the constitution of brasses and bronzes is seen by table on p. 61, "*Mech. Dict.*," to have been anticipated in the ancient bronze weapons of England and Ireland, the coins of Rome, weapons of South America, and the Chinese *packfong*.

Herrera specifies "crucibles to melt copper," as contained in the canoe met near one of the Guanaja islands, manned by a Yucatan cacique, his wives, children, and 25 rowers.

See also *Worsaal*, "*Primeval Antiquities of Denmark*," pp. 137, 138.

In addition to the compositions given on pp. 387–389, "*Mech. Dict.*," the following may be noted. Patents of —

Doubleday, No. 160,885. Copper, glass, antimony, tin, spelter, and lead.
Kirk, No. 201,536. Copper, tin, arsenic.

AUSTRIAN STATE RAILWAY BRONZES AND BRASS.

	Copper.	Tin.	Zinc.
For locomotive bearings, slide valves, valves, etc.	84	16	-
For coach and car bearings	85	15	-
For cocks	90	10	-
For boiler tubes	70	-	30

Article on casting of bronze figures in built molds; *cire perdue*; zinc molded in copper molds (imitation or French bronze); with the subsequent finishing and mounting, from the "*N. Y. Tribune*." — "*Sc. Am. Sup.*," 1601.

Various alloys known as bronzes are considered under the following heads; though many are not true bronzes (copper-tin), being destitute of tin. The word "bronze" is a favorite, and, though promiscuously applied, protest is useless.

See: —

Aluminium bronze.	Inlaying bronze.
Antique bronzing.	Japanese bronzes.
Bismuth bronze.	Malleable bronze.
Bronze blacking.	Manganese bronze.
Bronze coloring.	Manganese copper.
Bronzed glass.	Mildew bronze.
Bronze paint.	Nickel bronze.
Bronze steel.	Orugo.
Bronzing.	Patina.
Carbon bronze.	Phosphide of copper.
Cupro-manganese.	Phosphor bronze.
Deoxodized bronze.	Tungsten bronze.
Electro-bronzing.	White bronze.

See also under the following references: —

"*Iron Age*."

For machinery . xxii., Dec. 19, p. 13.
Artistic castings . xx., Nov. 22, p. 24.
Properties of . . xxiv., Nov. 27, p. 9; Dec. 4, p. 15; Dec. 11, p. 9; Dec. 18, p. 3.
Malleable . . . xxv., Feb. 25, p. 26; May 13, p. 17.
Coloring . . . . xxiv., Dec. 25, p. 1.
Casting . . . . xxiv., Dec. 11, p. 16.
Bronzes . . . . xvii., May 4, p. 23.
Antique bronze . xvii., March 23, p. 9.
Electro bronzing . xvii., May 18, p. 16.
Bronzing metals . xxiv., Dec. 18, p. 7.
Bronze stem for corvette, Br. . . xix., March 8, p 15.

"*Manufacturer and Builder*."

Colored . . . . x. 264.
Blue . . . . viii. 263.
Ornaments . . . . xi. 235.
Japanese . . . . xi. 83.
Patina . . . . xii. 263.
Bronzing iron . . . . . . xii. 204.

"*Mining and Scientific Press*."

For valves . . . . xxxv. 147.
Alloys . . . . xxxvii. 39.
French imitation . . . . . xxxvii. 358.
For machinery . . . . . . xxxviii. 19.
Malleable . . . . xl. 135.

"*Scientific American*."

Experiments . . *Thurston*. xxxvii. 65.
Japanese . . . . * xxxv. 255; xl. 249; xxiv. 385; xl. 24; xli. 217.
Malleable . . . . xlii. 178.
Cleaning . . . . xxxvi. 203.
Bronze steel & guns *Uchatius*. * xxxvii. 403.
Vienna . . . . * xl. 10.
On bronzes . . . . xl. 122.

"*Scientific American Supplement*."

Finishing . . . . 620.
Art-working in . . . *Vors*. 77.
Japanese . . . . 1831, 389, 442.
Composition . . . . . . 3341.
Casting . . . . 1601.
French . . . . 2690.
Bronze steel . . . *Uchatius*. 1299.

"*Engineer*."

Bronze steel . . . *Uchatius*. xlii. 331; xliv. 254, 310.

"*English Mechanic*."

Cleaning . . . . xxvi. 292, xxvii. 76.

"*Van Nostrand's Magazine*."

Bronze age . . . *Burnouf*. xix. 502.

Bronze Black'ing. A concentrated solution of R R B methyl violet in a boiling solution of 4 parts shellac and 1 part of borax, in 15 to 20 of soft water.

Bronze Col'or-ing.

"The *soft bronze* color of medals is obtained by rubbing with a mixture of blood-stone and graphite, applied with a brush.

"*Antique green* effects are reached by dipping the metal into a solution of 10 parts by weight of salt, 10 parts of cream of tartar, 10 parts of acetate of copper, 30 parts of carbonate of soda in 200 parts of vinegar.

"*Satin finish* is produced by green vitriol or copperas and subsequent treatment with wax.

"*Old green* is obtained by several coats of acid and a final coat of wax.

"*Grayish green* is produced by sal-ammoniac." — *M. Grinand*, in Paris "*Technologiste*."

In the Japanese practice, the coloring is done in many different ways, each manufacturer having his own particular process, which he modifies according to the composition of the alloy and the color he wishes to produce. The chemicals used for this purpose are very few in number, and limited to vinegar, copper sulphate, and verdigris as the principal substances; other materials used less frequently, consist of iron sulphate, red oxide of iron, lacquer, and an infusion of *Eryanthus tinctorius*.

See BRONZING; see also PATINA, ORUGO.

Bronzed Glass. A new kind of ornamental glass, so called from its dark metallic appearance, like old bronze. It is a dark green glass, which has been subjected to corrosive vapors in such a way as to bring out the iris hues and give the appearance of great antiquity. This effect is enhanced by the classical shapes in which the vases are blown, resembling the ancient Roman glass of the museums. Viewed by transmitted light this glass is dark green, like glass colored by oxide of copper.

See IRISATED GLASS.

Bronze Paint.

Recipe: — For iron. Ivory black, 1 oz.
Chrome yellow, 1 oz.
Chrome green, 2 lbs.

Mix with raw linseed oil, adding a little Japan to dry it. It gives a bronze green. Gold bronze may be put on the prominent parts of the object, rubbing on with a piece of plush before the paint is quite dry.

Another: —

To one pint of methylated finish add 4 oz. of shellac and ½ oz benzoin; put the bottle in a warm place, shaking it occasionally. When the gum is dissolved let it stand in a cool place two or three days to settle, then gently pour off the clear mixture into another bottle, cork it well, and keep it for finest work. The sediment left in the first bottle, by adding a sufficient quantity of spirit to make it workable, will do for the first coat or coarser work when strained through a fine cloth. Next take ½ lb. of finely ground bronze green — the shade may be varied by using a little lamp black, red ocher, or yellow ocher; let the iron be clean and smooth, then take as much varnish as may be required, and add the green color in sufficient quantity; slightly warm the article to be bronzed, and with a soft brush lay on it a thin coat. When that is dry, if necessary, lay another coat on, and repeat until well covered. Take a small quantity of the varnish and touch the prominent parts with it; before it is dry, with a dry pencil lay on a small quantity of gold powder, and then varnish the whole.

Bronze Steel. Name given by Uchatius to his gun-metal alloy. The Rosthorn gun-metal, Austrian Navy brass, Parke's British gun-metal, and Overman's bell-metal, contain notable quantities of iron in their composition.

"*Scientific American*," xxxvii. 403
"*Scientific American Supplement*," 1299.
"*Engineer*," xlii. 331; xliv. 254, 310.
See also list of "*Brasses and Bronzes with the addition of Iron*," table, p. 61, "*Mech. Dict.*"

Bron'zing. Giving the appearance of bronze to a surface by a covering of metallic dust.

The surface, if of metal, is usually covered with oil varnish, and when almost dry the bronze powder is dusted upon it.

BRONZE COLORS.

Real Gold. — Made of scraps of gold leaf, mixed with honey or gum, ground on a tablet, washed and dried. Different shades are obtained by alloying with silver and copper: red, reddish, deep yellow, pale yellow, greenish. Gold powder may also be obtained by dissolving in aqua regia, and drying.

Imitation Gold. — Obtained from the waste of Dutch leaf, triturated in gum, washed and dried. The color depends on the proportions of copper to zinc. Violet and green shades are obtained by heating with oil, paraffine, or wax.

Mosaic Gold. — Tin 64.63, sulphur 35.37; soluble in hydrochloric acid, aqua regia, or boiling caustic potash. Used for bronzing plaster casts, copper, and brass, by mixing with 6 parts bone-ash and rubbing on wet.

Mosaic gold may also be obtained by heating sulphur 6 and tin amalgam 16 with mercury 1 and sulphur 4.

Or, stannic acid 8, sulphur 4.

Or, fuse pure tin 12, mercury 6, to an amalgam, and mix with flowers of sulphur 7, and sal-ammoniac 6. Heat in a retort, and after the vapors escape the mosaic gold will be found at the bottom.

Silver Bronze. — Scraps of silver foil triturated in oil.

Imitation Silver Bronze. — Imitation silver leaf similarly treated.

Mosaic Silver. — Amalgam of tin 50, bismuth 50, and mercury 25. The metals being melted and stirred and the mercury added. When cold, grind with a muller on a stone.

Copper Bronze. — Copper foil rubbed fine and ground.

Bronze Powder or Antique Bronze. — 16 copper and 1 tin beaten into leaves and ground. Bright yellow, copper 83 parts, zinc 17: orange, copper 90 to 95, zinc 5 to 10; copper red, copper 97 to 99, zinc 1 to 3.

Greenish Copper Bronze. — Copper bronze mixed with acetate of copper (verdigris). Imitates the antique *Patina*.

Patina Powder. — Bronze treated with different salts: Vinegar, nitrate of copper, sal-ammoniac, oxalate of potash, etc.

Brownish Gold Bronze. — Iron rust mixed with any of the copper bronzes according to color.

Gold-colored Copper Bronze. — Boil together an amalgam of zinc 1, mercury 12, some hydrochloric acid, a solution of tartar crystals, and copper bronze precipitated from the nitrate by iron. The color is varied by shorter or longer boiling.

Or, boil the copper bronze with a solution of 1 part gold in aqua regia; evaporate, dissolve in water 8 parts, and add ½ part ignited magnesia, then boil. The precipitate of oxide of gold is filtered, placed in a flask, and 8 parts cyanide of potassium poured over it.

Blue Bronze. — White bronzes colored with aniline blue.

SUBSTITUTES FOR BRONZING.

Tungsten Bronze. — Tungstate of soda and tungsten forming gold-yellow crystals; magenta or violet bronze, a tungstate of tungsten and potash.

Chromium Bronze, or violet chromium chloride.

Titanium Bronze, Crystallized Iodide of Lead, etc.

Coal Tar Bronzes, such as acetate of rosaniline, murexine, and green hydrochinon.

Mica Bronze. — Mica pounded into fine flakes, assorted in fineness and dusted on to a prepared or varnished surface. Colored, —

Pink, by cochineal.
Carmoisin, by bluish fuchsia.
Violet, by Hofmann's violet.
Blue, by prussian blue.,
Violet-blue, by logwood.
Green, in shades, by turmeric and aniline blue.
Golden, by turmeric.
Silver, pure mica.
Black, by logwood and litmus.

A ground of proper color must first be laid on, and the mica powder dusted on before the ground is quite dry. Excess of mica is brushed off.

For Cast Iron, without the use of metal or alloy. — The article is cleansed, coated with a uniform film of some vegetable oil, and then is exposed in a furnace to the action of a high temperature, which, however, must not be strong enough to carbonize the oil. In this way the cast iron absorbs oxygen at the moment the oil is decomposed, and there is formed at the surface a thin coat of brown oxide, which adheres very strongly to the metal, and will admit of a high polish, giving it quite the appearance of fine bronze.

Process for producing a Green Bronze on Iron. — One part of sylvate of silver is dissolved in twenty parts of oil of lavender, forming a sort of varnish, which imparts a beautiful and permanent green bronze appearance to cast and wrought iron, sheet iron, and wire. The surface to be bronzed is cleansed and dried, but need not be polished. The varnish is thinly applied with a camel's-hair brush, and the object heated quickly to 300° Fah. The proper temperature is indicated when the article shows an even bright green color. — *Paul Weiskopf in "Dingler's Journal."*

For Cast Iron. — Coat the surface of the iron (cleaned by acid and well etched) with ferrocyanide of copper, applied with linseed oil. Before this coating is entirely dry, apply bronze powder by means of a fine brush, and then polish with a burnisher. When the surface is entirely dry, wash and etch to the color desired. The use of the alkaline sulphides for the etching produces olive-green and black colors, which closely resemble those on the Japanese bronzes.

For Rifle Barrels, to Prevent Rusting. — A modification of the Barff process. Pass the current of air slowly and at a high temperature over the articles to be covered, care being taken to secure an entirely free circulation about the articles. Articles exposed for five hours at a temperature of 536° Fah., resisted the action of emery paper and dilute sulphuric acid.

See various recipes and processes, p. 389, "*Mech. Dict.*"

See, also, BRONZE PAINT.

For giving Bronze Color to articles of Copper, Brass, or Zinc. — *Roncou's* process: Treat with a composition of —

Sulphate of potassium	6
A salt of lead	6
Ammonia	12
Acetic acid	8
Hydrochloric acid	8

Antique Imitation. — Apply alternate washes of dilute acetic acid and exposure to the fumes of ammonia.

A quicker method: Immerse the articles in a solution of

1 part perchloride of iron in 2 parts of water. The tone assumed darkens with the length of immersion.

Or the articles may be boiled in a strong solution of nitrate of copper.

Or they may be immersed in a solution of 2 ozs. nitrate of iron and 2 ozs. hyposulphite of soda in 1 pint water. Washing, drying, and burnishing complete the process.

Chinese Process of Bronzing Copper.

The following ingredients are pulverized and mixed: —

Verdigris	2
Cinnabar	2
Sal Ammoniac	5
Alum	5
Beak and liver of duck	2(!)

Make into a paste with vinegar and spread over the scraped surface of the copper. The object is exposed an instant to the fire, cooled, and the operation repeated until the required tint is attained. Addition of sulphate of copper gives a browner tint, and borax a yellower shade. The color is durable and not affected by air or rain.

Bronzing Wood, Leather, Paper, etc.: Dissolve gum lac in four parts by volume of pure alcohol, and then add bronze or any other metal powder in the proportion of one part to three parts of the solution. The surface to be covered must be very smooth. In the case of wood, one or several coats of Meudon or Spanish white are given, and the object is polished with an iron of proper shape. The mixture is painted on, and when a sufficient number of coats have been given, the object is well rubbed; the coating obtained is not dull, but can be burnished. A transparent varnish is applied to preserve the metallic appearance thus obtained.

Soluble Glass in Bronzing. — "*Bottger* varnishes objects of wood, porcelain, glass, or metal with soluble glass, and then shakes bronze powder over them." — *Dingler's Journal.*

Plaster Casts. — The casts receive first several coats of a rapidly drying linseed oil varnish. When the surface has been thickly and evenly covered, and the varnish is completely hardened, another coat is given with a varnish composed as follows: Linseed oil varnish, 1 part: copal varnish, 1 part; oil of turpentine, 1-15 part. The copal varnish must be free from alcohol. This varnish will be dry enough in from 18 to 24 hours; the coat must be quite glossy and adhere slightly to the fingers. Powdered gold, silver, or copper bronze is now applied with a soft brush. The surface is then rubbed with cotton wadding, by which a very beautiful finish is imparted to it. The most important point is that the linseed oil varnish is perfectly dry before the other varnish is applied, and the latter must be of the proper consistence before bronzing it. — *Chem. Zeitung.*

See the following references: —

"Iron Age."

Antique	xvii., Mar. 23, p. 9; xxi., June 6, p. 19.
Cast-iron	xxi. March 7, p. 1.
Electro-bronzing	xxii., Dec. 5, pp. 3, 18; xxiii., Feb. 6, p. 17.
On wood, paper, etc.	xxiii., March 13, p. 17.
On metals	xxiv., Dec. 18, p. 17.

"American Manufacturer and Iron World."

On metals	xxv., Dec. 26, p. 12.

"Van Nostrand's Engineering Magazine."

On iron	xviii. 103.

"Mining and Scientific Press."

On iron	xxxvi. 3.
On leather, paper, etc.	xxxviii. 215.
Bronze green	xxxviii. 319.
Plaster statues	xxxviii. 281.

"Manufacturer and Builder."

On leather	ix. 77.
Antique	x. 148.
On iron	xi. 96; xii. 204.
Plaster statues	xi. 24.
Bronze varnish	xi. 120, 287.

"Engineering & Mining Journal."

Soluble glass in	xxvii. 204.

"Scientific American."

Iron	xxxiv. 243: xxxv. 76.
Paint	xxxiv. 312; xxxvii. 118.
Plaster casts	xl. 122.
Compound	xxxvi. 87.
Powder	xxxiv. 243; xxxvii. 363; xxxviii. 28.
Aniline	xxxvii. 213.
Liquid	xxxix. 75.
Size for	xli. 331.

"Scientific American Supplement."

On iron	3748, 1510.	On plaster casts	2686.
On feathers	2591.	Electro	2610.

"English Mechanic."

On plaster casts	xxv. 470, 494; xxvi. 342; xxvii. 533.
Florentine	xxv. 189.
Dull black	xxvii. 659.
Powders	xxv. 341, 367; xxvi. 463, 487.
On brass	xxvi. 368, 389.
On zinc	xxv. 470, 494.
Relacquering	xxvii. 274, 425.
On copper	xxiii. 527.
Antique	xxvii. 177.
Fluid aniline bronze	xxiv. 309.

"Engineer."

Castings	xlvi. 431.

Bron'zing Ma-chine'. A machine for applying bronze-powder to paper, foil, or cloth previously printed with size. See United States Patents, Nos. 161, 734; 175,450.

In addition to what has been said and shown on pp. 389, 390, "*Mech. Dict.*," the French method may be consulted in the article "*Poudreuse ou Bronzeuse Mécanique*," * *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," iv., ed. 1877.

Brood'er. A chicken protector. In some cases a coop of remarkable neatness and extent.

Again: a protector with artificial warmth, on the principle of the incubator, but allowing ingress and egress. See, also, ARTIFICIAL MOTHER.

Broom'-corn Scra'per. A rotary toothed cylinder is operated through its multiplying gearing by either hand or power, and is used for clearing broom-corn brush of its seed.

Fig. 435.

Cylinder Broom-corn Scraper.

The *ripple* has been used for 4,000 years in Egypt in removing the seed of *dhura* from the stalk, and is yet used in hand processes with flax. See Fig. 4341, p. 1946, "*Mech. Dict.*"

Broom'-corn Siz'er. A machine for sizing or preparing the corn to regular lengths, for the various sizes of brooms as required.

Broom Ma-chin'e-ry.

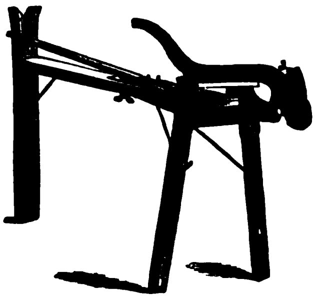
UNITED STATES PATENTS.

Broom-making machines.	
Clamp, *Day*	69,780
Day	59,977
Day, reissue	2,495
Cutting and assorting machine, *Bradley*	80,443
Sizing machine, *Truair*	33,968
Sorting machine, *Grosvenor*	7,892
Cutting and separating machine, *Walrath & Snell*	181,138
Sizing machine, *Walrath*	165,458
Blood & Topping	166,065
Handle socket, *Anderson & Houghton*	156,324
Rowe	18,770
Anderson & Houghton	150,669
Anderson & Houghton, reissue	6,275
Warner	5,444
Lyon & Hopkins	62,548
Beaman	3,219
Allen	167,051
Hinton	3,483
Spooner	718
Sherman	38,341
Split brooms, *Crum & Lanvill*	6,233
Walker	11,451
Needle, *Cowardin*	119,745
Press, *Thomas*	6,717
Boyer	162,997
Sewing machine, *Stackpole*	91,784
Tying machine, *Congdon*	118,845
Winding machine, *Walrath & Bronson*	168,814

Broom Sew'ing Ma-chine'. A species of vise, with clamping jaws operated by a screw so as to firmly hold the broom while it is being sewed.

Broom Trim'mer. A rack with a bevel-slotted aperture, on the end of the rear post that surmounts the table, and holds the broom with the assistance of the adjustable clamp on the table, while the pivoted knife trims it off.

Fig. 436.



Broom Trimmer.

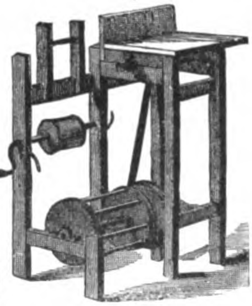
Broom Vise. A clamp in which the round bunch of corn brush is flattened and held while being sewn.

They are made to work with levers or with screws. Fig. 437 shows the former.

Fig. 437.

Broom Vise.

Fig. 438.



Broom Winder.

Broom Wind'er. A machine for winding corn brush, and tying it with cord or wire into a round bunch preparatory to flattening it in the vise and sewing. Fig. 438.

Broth'er-hood En'gine. A popular form in Britain of a THREE-CYLINDER ENGINE, which see. See, also, DYNAMO-ELECTRIC ENGINE, *infra*.

Brown'ing. To confer a brown tint on iron or steel, dissolve in —

Water	4 parts.
Crystallized chloride of iron	2 parts.
Chloride of antimony	2 parts.
Gallic Acid	1 part.

Apply the solution with a sponge or cloth to the article and dry it in the air. Repeat this any number of times, according to the depth of color which it is desired to produce. Wash with water and dry, and, finally, rub the articles over with boiled linseed oil. The metal thus receives a brown tint and resists moisture. The chloride of antimony should be as little acid as possible.

Bruis'ing. (*Leather.*) Doubling the grain side of a hide together, and rubbing it on the flesh with a graining-board.

Brush. Machines for making brushes have been adapted to manufacture certain kinds. The majority of kinds are hand-made. See pp. 392–394, "*Mech. Dict.*"

Brush binder, for clamping the bristles to the handle, *Blair*, * "*Scientific American*, xxxiv. 118.

Brush machine.

Woodbury, * "*Manufacturer & Builder*," x. 198.

Woodbury, * "*Vienna Exposition* (1872) *Report*," vol. iii, p. 309.

Woodbury, * "*Scientific American*," xxxviii. 351.

In the making of artists' brushes the following bristles and hair are employed: —

Hogs' bristles, varnishing brushes.
Bears' fur, varnishing brushes.
Badger hair, graining and gilding brushes.
Sable tail hair, finest artists' brushes.
Camels' hair, second only to the sable.
Ox hair (from the insides of the ears), striping and lettering brushes.

Ashworth's brush-comb, for the hair or the manége, has steel wires attached to an elastic caoutchouc membrane on the handle.

Brush Dike. A device for causing deposits to take place, and for deflecting the current in localities that are to be built out.

The floating brush dike is made by taking saplings from 20′ to 30′ long and from 4″ to 6 or 8″ in diameter, and nailing, or fastening to them with wire, scraggy brush of any kind obtainable in the locality. This forms what is known as the *weed*. Instead of the saplings rope may be used to hold the brush. To one end of this *weed* is attached an anchor of sufficient weight to hold it in position against the current; to the other a buoy to hold up the downstream end and prevent it from going to the bottom under the pressure of the current against it. These *weeds* are placed from 10 to 20′ apart, thus forming the floating dike.

Their action is to check the current gradually without producing that scouring effect to which the solid dike gives rise. This done, a portion of the material that is rolling along the bottom or being carried down in suspension is deposited, and causes a rise in the bed of the river, which changes its channel to the direction desired.

See DAM; DIKE; FLOATING BRUSH DIKE, etc. See list under HYDRAULIC ENGINEERING.

Brush Hold'er. (*Surgical.*) A staff for a brush for applying medicaments to the larynx, œsophagus, conjunctiva, etc.

Figs. 97, 343, 344, 349, 349 *b*, Part II., *Tiemann's* "*Armamentarium Chirurgicum.*"

Brush'ing Ma-chine'. 1. A machine used to brush up the nap on woolen under-shirts, jackets, drawers, or stockings, and put a good surface on the goods.

It consists of a framing of cast-iron, with two fluted rollers for drawing in the goods, also a pair of wooden rollers clothed with teazles or wire cards, according to the quality of the goods to be operated on. The fluted rollers revolve slowly and take in the goods whilst the covered rollers revolve at a great speed, brushing the goods as they are passed through.

2. Curtis & Marble's machine for dressing and cleaning the surfaces of piece goods, has calendering rolls and dampening box attached. It is arranged with one brush and two card rolls for each side of the goods, and is intended to finish them by once running through. It is entirely covered in, and has a fan-blower arranged underneath to carry off dust and lint.

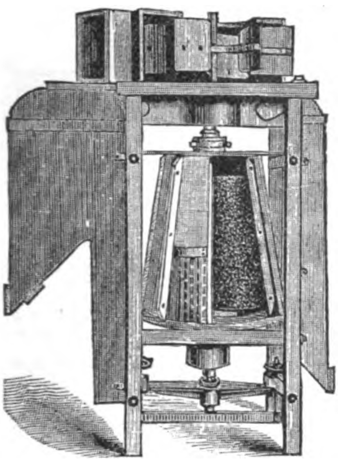
3. A wheat-cleaning machine. In some cases combined with a smutter, so as to have the scouring quality of the latter with the polishing action of the former.

In the Becker brush the concave jacket is of punched iron and steel wire, between which and the brush the wheat passes, polishing and scouring and taking the dust out of the crease, and the fuzz off the end of the berry, without disturbing the bran. The brush may be raised or lowered while in motion. A suction fan removes offal. Fig. 439.

The "Victor" brush has a series of annular inclined trays and brushes, through which the wheat passes in succession. It is known as a *double-brush*, the grain passing moving and stationary brushes, while a blast of air is drawn by an aspirating fan in the reverse direction. Fig. 440.

The brushing is done by a series of concave circular brushes attached to an upright shaft, which act against an opposed series of convex brushes, *c*, which remain fixed to the case. The surfaces of the brushes coalesce when at the closest adjustment, but when at work are separated by a sufficient distance to give passage to the wheat. The grain falls upon the upper surface of the fixed upper brush, gravitates to the center, and is caught by the upper revolving

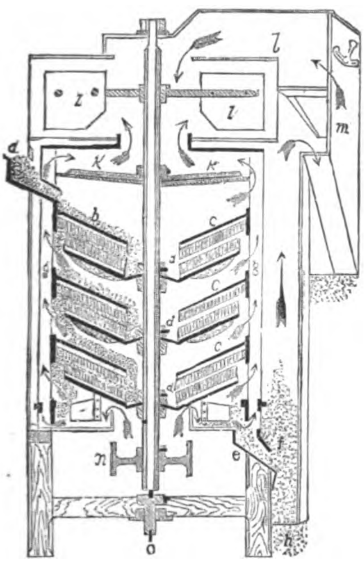
Fig. 439.



Becker Cone-brush.

brush, driven up the incline by centrifugal force, and dropped again to have the same operation twice again re-

Fig. 440.



" *Victor* " *Brush Scourer.*

peated. Each set of brushes has an independent ventilator which carries the dust upward to the suction fan, whence it is expelled from the machine.

e is the final discharge spout; *n* the driving drum; *g*, ventilator shaft; *k*, cover of brush chamber; *l*, fans and fan-case.

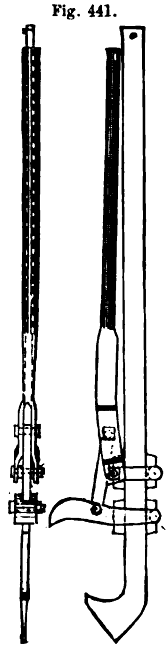
Brush Jack. (*Hydr. Engineering.*) A tool for grasping brush and confining it while being bound into fascines for dikes or dams. The saplings are pinched between two hooks.

It is also used in making mats; the saplings and brush being placed in layers, the hook is thrust through, engaging the lower pole, and the upper hook thrust down, pinching between them a mass of limbs, which are then tied to the pole by the aid of the needle. The handle has two hook-clutches which are slipped over the upper end of the rod, and the upper hook is worked down by using the handle in the manner of a pump-brake. See Brush Needle.

Brush Nee′dle. (*Hydr. Engineering.*) A needle for passing a wire around a bunch of brush in a mat. Fig. 442.

The wire is passed through the eye of the needle-bar and pushed through the mat. A man below removes it, and on the needle being pushed through on the opposite side of the pole replaces the wire in the eye to be drawn back. The wire is cut, the two ends twisted together, and the jack released by prying or hitting the lower or hook clutch on the back end.

Fig. 441.



Brush Jack.

Brush Plow. A strong plow, the land side welded to the share, which latter is of hard-rolled untempered steel. Adapted for plowing among roots and brush in new ground. Fig. 443.

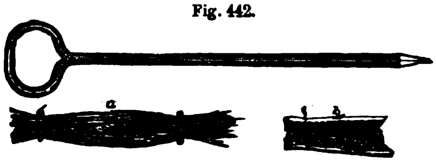
Buck′board. A spring-board wagon, Fig. 444, in which the yielding of the board gives the elasticity to the seat.

In the illustration the buck-board is combined with thorough-brace springs, *F*, *G*, which add to the ease of the rider. Side bars, *B*, connect the front bolster, *A*, with the rear axle. *C C* are side braces.

"*Sc. American*," * xxxviii. 166.

Buck′et. 1. A vessel for holding or lifting water.

Fig. 442.

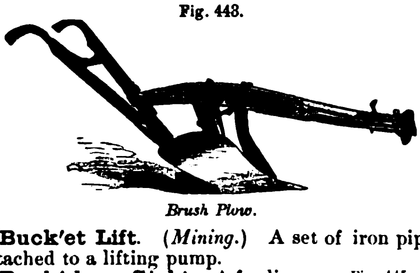


Brush Needle.

2. A valved plunger in a pump-stock.

Bucket plunger pump, *Wright* * "*Engineering*," xxi. 420.
Rubber bucket for chain pumps.
Kenyon . . . . * "*Sc. American*," xxxvi. 310.
Bucket ear, *Darkin* . . . . * "*Sc. American*," xxxv. 206.

Fig. 443.

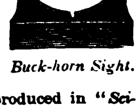


Brush Plow.

Buck′et Lift. (*Mining.*) A set of iron pipes attached to a lifting pump.

Buck′-horn Sight. A fowling-piece sight with a branching horn on each side of the sight-notch.

Fig. 445.



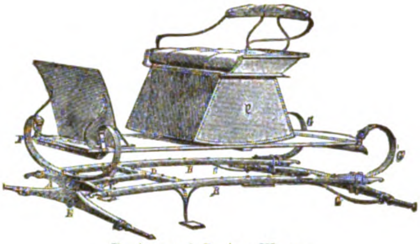
Buck-horn Sight.

Buck′skin Loom. A German pattern-chain loom, with certain peculiarities, and named from the dense and soft character of its product.

"*Zeitschrift für Textil-Industrie.*" Reproduced in "*Scientific American Supplement*," * 2705.

Buck'wheat Hul'ler. A machine for removing the hull of buckwheat before grinding, by

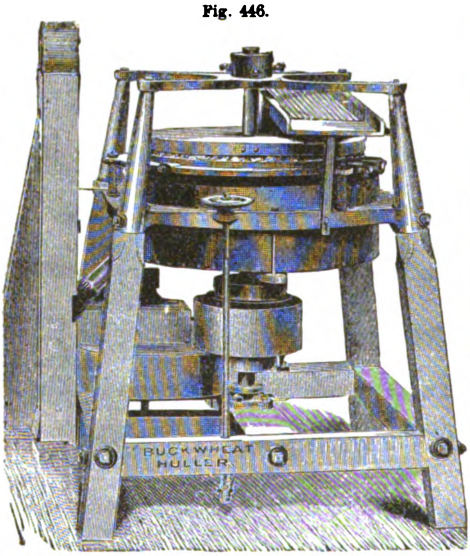
Fig. 444.



Buck-board Spring Wagon.

passing between sandstones, adjusted by tram-studs. The upper stone is stationary, and can be turned over to use either surface and utilize nearly the whole thickness of the stone. A riddle removes foreign matters from the grain before it reaches the stone.

Fig. 446.



Buckwheat Huller.

The machine has a separating trunk and fan by which the hulls are separated from the grain, and the former blown into a refuse trunk.

Cranson's * "*American Miller*" . . . . viii. 336.

Buck'wheat Shuck'er. Another name for the buckwheat huller, which see.

Bud'dle. A species of ore-separating device, using water on an inclined surface. See Fig. 962, p. 398, "*Mech. Dict.*"

Richards's buddle is on the principle of the Barker mill, the water and slime escaping at the ends of hollow arms projecting from a hollow and rotating shaft, and received on a circular table which has a slightly convex surface.

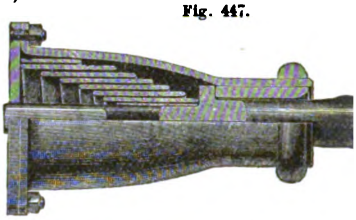
"*Mining and Scientific Press*" . . . * xxxv. 153.

Buf'fer. 1. A block of India-rubber placed on furniture to prevent the defacement of walls by contact of the furniture. A door-stop.

2. A spring block or pad to receive the impact of connected or colliding railway carriages in a train, to absorb the jar.

Fig. 447 is a British form, made by Ibbotson, of Sheffield, England. Other forms are sh 399, "*Mech. Dict.*"

Fig. 447.



Turton's Wrought Iron Spring Buffer

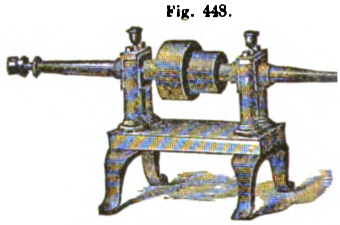
The following references may be consulted: —

Thomas, Br.	* "*Engineer*," xlix
Tijou, Br.	* "*Engineering*," :
Turton, Br.	* "*Engineering*," :
Garey	* "*Railroad Gazett*
London & S. W. Railway .	* "*Engineer*," xlvi

Buf'fing. (*Leather.*) Taking off thin from the grain side with a buffing-slicker skin is very thin; the object being to n hide imitate calfskin. The operation is fi whitening.

Buf'fing Lathe. A polishing lathe

Fig. 448.

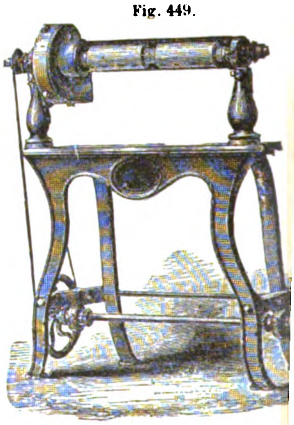


Buffing Lathe.

silver and nickel platers, etc. The buffer cotton, walrus hide, or other material, is the end of the arbor, which is shown secured by the screw-nut. The buffer is emery, crocus, rouge, rotten stone, put etc.

Buf'fing Ma-chine'. A machin wooden roller covered with sand-pape

Fig. 449.



Shoe-sole Buffer.

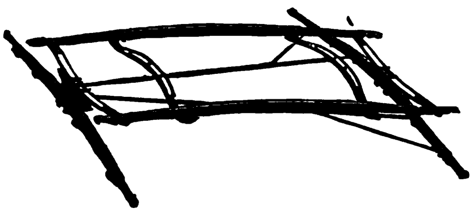
for buffing shoe-soles, etc. A suction upon the same shaft and draws the partially enveloping sheath and disch duct.

The paper is held by a clamp, dispensing with nails.

Bug'gy Spring.

The Brewster spring has half-springs interposed between the axles and the side bars, and other half-springs between

Fig. 450.

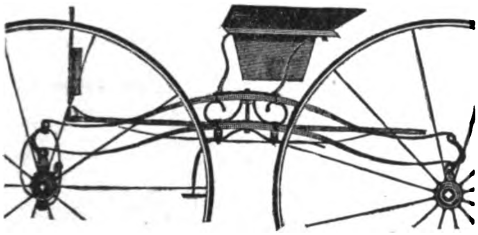


Brewster Side-bar Wagon Spring.

the body and side bars, giving the effect of a full elliptic spring, while retaining the modern and stylish appearance of the half-spring wagon. They can be made lighter, hung lower, and are as suitable for country roads as the full elliptic spring wagon.

The "Dexter" spring consists essentially of two "Concord," or side springs on each side; one spring above the

Fig. 451.



"*Dexter*" *Spring.*

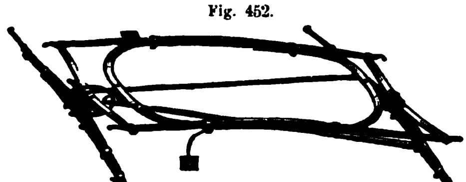
other and parallel to it. The two springs are rigidly connected at their centers, and pivoted at their ends to spring links above or on either side of the axle and spring-bar. The spring-links are rigidly attached to the head block and rear axle respectively.

The parallel motion of the springs prevents rocking of the axles. One spring being above the other prevents side motion and the settling of the body to one side. The absence of a reach allows either wheel to pass over an obstruction almost independently of the other wheels. The elasticity of the springs takes much strain off the fifth wheel, and cushions the stroke when striking an obstruction.

Patents, June 16, September 15, 1874, June 15, 1875.

The Stiver's circular combination spring has a circular

Fig. 452.



Stiver's Circular Combination Spring.

spring used in connection with end half springs, securing the effect of the full elliptic spring.

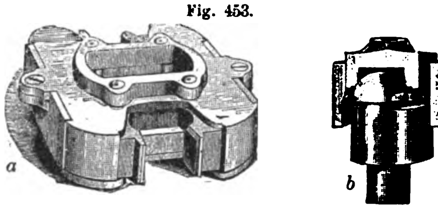
Bu'gle. (*Add.*) The simple bugle or clarion is written on the G clef like the trumpet. It possesses 8 notes. There are bugles in B♭, C, and in E♭. The keyed bugle has 7 keys which traverse chromatically a compass of more than two octaves from B♮ beneath the stave up to C above. The bugle with *pistons* or with cylinders has a lower compass than the keyed.

Buhr Dress'er. An implement for channeling and facing millstones. See MILLSTONE DRESSER; FURROWING AND FACING MACHINE.

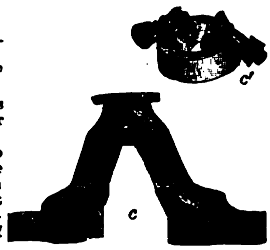
Buhr Dri'ver. The stud or projection on the millstone spindle which acts upon the bail of the millstone to drive the latter. The ordinary device is shown at G, Plate XXII., "*Mech. Dict.*," article "*Grinding Mill.*" The bail is also called a balance-rynd.

Fig. 453 shows several forms of drivers.

Fig. 453.



Buhr Drivers.



a, is the Duvall central-cross mill-buhr driver.

b, is the "Universal" buhr-driver.

c c', show Sergeant's back-lash bail mill-buhr driver.

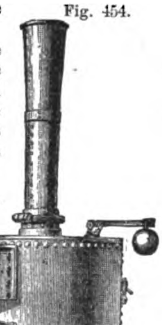
Each of them aims to have a perfect drive free from rattle and with such a degree of freedom that the runner stone shall adjust itself to the face of the bed-stone.

See "*American Miller*," * vii. 300, and elsewhere.

Buhr Rub'ber. A block composed of emery and a cement; used in cleaning, sharpening, and facing down buhrs. *Millstone levelers, Furrow dressers*, are synonyms or analogous devices.

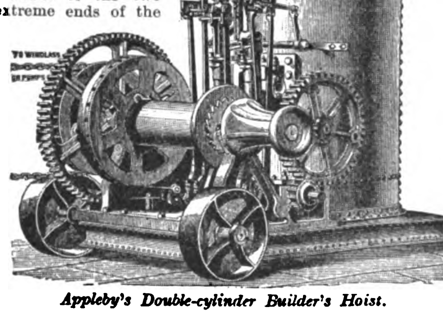
Build'er's Hoist. A form of steam-hoist used in lifting stone, brick, mortar, lumber, etc., in constructing buildings. The cage, the barrow, or the material, as the case may require, is suspended by a rope from a tackle, the fall passing to the drum.

Fig. 454.



Of a larger size, but of the same general construction, are hoists for railways, docks, and harbors, for lifting up to three tons. More powerful engines assume a substantially different form.

When employed for hoisting building materials, the engine is usually put down in a central position, and the chains or ropes are carried away in opposite directions to the two extreme ends of the



Appleby's Double-cylinder Builder's Hoist.

works, and there hoist the bricks, mortar, etc., in barrows on to the scaffolds, along which they are wheeled to serve the bricklayers.

The hoists are usually made with two speeds: one for ordinary building work, and a slow speed for hoisting columns and girders, timbers, stones, etc. The weight lifted direct from the barrel is about 1,500 pounds, and for heavier loads blocks and falls are used. The size employed for lifting barrows is 3-horse power nominal, but they are made up to 12-horse power, and with single or double cylinders. Fig. 454. The ends of the shafts are extended, so that a capstan, a pump arm or pulley may be fitted for transmitttng power for other purposes, and each engine has reversing gear and all the usual appliances.

Build'er's Knot. A form of knot shown at 27, Fig. 2777, p. 1240, "*Mech. Dict.*"

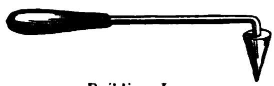
Build'ing Block. Material shaped into blocks for building. See

Clayton	* "*Scientific Amer.*," xxxv. 242.
Hollow concrete	"*Scientific Amer.*," xxxv. 406.
Stone, marble, cement, etc.	"*Scientific Amer. Sup.*," 2020.

See also BÉTON; CONCRETE; STONE, ARTIFICIAL, etc.

Build'ing Iron. (*Electrotyping.*) A heated iron applied to a strip of wax to cause it to flow down from the point on to the blank of the model in order to make corresponding depressions in the plate in the larger spaces where there is no type.

Fig. 455.

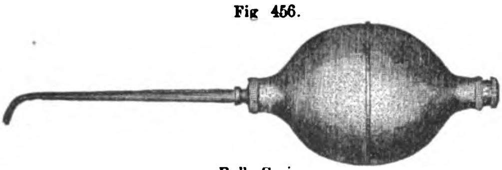


Building Iron.

Build'ing Wax. Wax used in building up the blanks in the molds for electrotype plates. It is cut in strips 8″ to 10″ long by ⅜″ wide, and must be kept dry.

Bulb Syr'inge. A dentist's syringe used for blowing debris from cavities after excavating.

Fig 456.



Bulb Syringe.

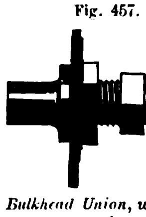
A valve in the base end of the bulb admits the air instantaneously.

Bulk'head Door. A door in the bulk-head of a ship built in compartments. It is to be capable of instant closure, and self-fastening. Some are closable from the deck in emergencies. See

Bartley, Br.	* "*Engineer*," xlviii. 144.
Simey, Br.	* "*Engineer*," xlviii. 268.
Device for closing, *Simey*, Br.	* "*Engineer*," xlvii. 453, 473.
English	* "*Sc. American Sup.*," 2398.

Bulk'head Union. A pipe coupling where the pipe passes through a bulkhead or partition.

Fig. 457.



Bulkhead Union, with Fly-nuts.

Bull'dog For'ceps. (*Surgical.*) Forceps with pointed teeth for fistula, for grasping an artery, etc.

Figs. 131, 343, Part I., *Tiemann's* "*Armamentarium Chirurgicum.*"

Bull'en Nail. An upholsterer's nail, with a round head and short shank.

Carmoy's machine (Fr.) * *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," vol. iv., ed. 1877, article "*Clous de tapissier.*"

Bul'let. 1. A missile for a fire-arm.

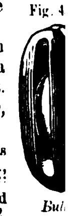
Bullets with wings, the counterpart of rifling: *boulets tournants.*

Systèmes Cavalli.	Systèmes Tamisier.
Gras.	Burnier.

* *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," iv., article "*Boulets*," Figs. 3426 *et seq.*

2. (*Nautical.*) Or jib-sheet block; the l name indicating the purpose. Made of *lignum vitæ.*

Fig. 4



Bul

Bul'let For'ceps. (*Surgical.*) An instrument to be introduced into a wound to grasp and extract a bullet. See BULLET EXTRACTOR, Fig. 970, p. 402, "*Mech. Dict.*"

The United States Army bullet forceps has scoop-shaped ends. Fig. 115, p. 40, Part I., *Tiemann's* "*Armamentarium Chirurgicum.*"

Hamilton's bullet forceps is a long-nosed pincers with toothed jaws. Fig. 124, p. 42, *Ibid.* It resembles the *sequestrum forceps*, Fig. 4884, "*Mech. Dict.*"

Thomasin's has scoop and claw. Fig. 128, *Tieman*

Gross's has loop and claw. Fig. 123 *b*, *Ibid.*

Bul'let In'stru-ments. (*Surgical.*) ments used in exploring for and extracting from the person.

They are known by names which are expressive uses and application: —

Bullet forceps.	Bullet extractor.
Bullet scoop.	Bullet screw.
Bullet seeker.	Bullet probe.

Bul'let Ma-chine'. (*Cartridges.*) l fed in bars, which are 2′ or 3′ long, and h diameter of a bullet; the compressing and dies cut off pieces, compress and shape ther

British, "*Ordnance Report*," 1877, Appendix L., Figs. 97*x*–97*z*. The process is about as follows: —

At Woolwich: The melted metal is poured into s and as soon as it solidifies, but before it is cold, it by hydraulic pressure through cylindrical holes in t long strings. This process is to prevent the forma bubbles in the bullet, which would cause it, whe swerve from its course. The leaden strings are tl ried to the bullet-molding department, where th into lengths and roughed; then shaped in one ma finished in another. They have now to be plugg plugs were formerly made of wood, but are now from a special powder, which solidifies after bei into form.

Bul'let Patch'ing Ma-chine'. A for enveloping the cylindrical portion of lets with paper, to prevent the "leading grooves of the barrel.

In Borchardt's machine, the operating arrang on a circular table, supported by a hollow standa which an upright shaft passes from the actua that runs under a false floor. The connection friction wheels, which insures the instant stop machine in case of any impediment. The bull to the machine by hand, and the patch is pres bullet and secured by a minute drop of mucilag matically, and is rolled closely around the bullet tion of flexible rolls, at the rate of 45 or 50 pe about 20,000 per day of ten hours, including sto operatives are required to run the machine pro action of the machine is easily controlled by mea lever and clutch. The machine may be adapted and styles of rifle projectiles. The bullet-pat out with dies. The patches require damping to and uniform folding.

Bul'let Scoop. (*Surgical.*) An i with a scoop-shaped end, to be used as a tractor, the scoop being passed behind tl

Tiemann's "*Armamentarium Chirurgicum*," Fig. 116.

Bul'let Screw. (*Surgical.*) An with a fine gimlet-screw point, to be s a bullet as a means of withdrawal.

Tiemann's "*Armamentarium Chirurgicum*," Fig. 119.

Bul'let Seek'er. (*Surgical.*) An of the nature of a probe with an enlar introduce into a wound to find the bull the jar of impact or by the coloration of the bulbous head of the instrument.

The references are to Part I. of *Tiemann's "Armamentarium Chirurgicum."*

Tiemann's bullet seeker has a burr head which acts as a rasp upon the bullet and shows traces of contact. Fig. 117.

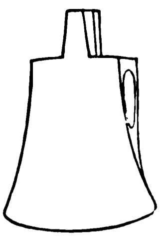
Nélaton's has a rough porcelain head which is marked by contact with the lead. Figs. 120, 126.

Tiemann's bullet seeker, Fig. 121, has a flexible stem.

Sayre's instrument has a vertebrated stem, and follows the windings of a deflected bullet. Fig. 122.

See, also, *Bullet Probes*, pp. 40, 42, as above, and p. 403 of *"Mech. Dict."*

Fig. 459.



Bull-head Axe.

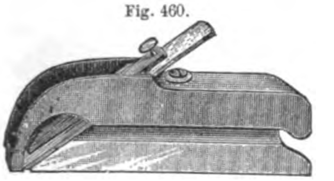
Bull′-head Axe. A poll-axe. One with a small poll for stunning a bullock, by striking it on the forehead.

Bul′lion Point. (*Glass.*) The thick portion at the center of a disk of crown glass.

Bull Net. (*Fishing.*) A large hoop-net, worked with ropes and blocks.

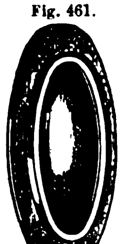
Bull′-nose Rab′bet Plane. A plane with the bit at the end, in order to enable it to work up close into corners. Named from a fancied resemblance to the muzzle of a bull. It is made open or close by a screw on top.

Fig. 460.



Bull-nose Rabbet Plane.

Fig. 461.

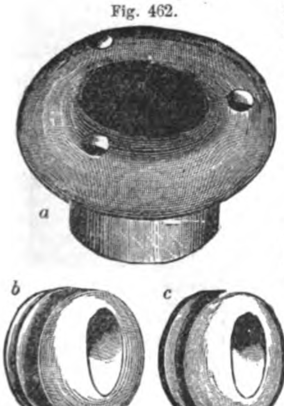


Bull's Eye.

Bull's Eye. 1. A strong round glass in a metallic frame let into a deck or side of a vessel to give light to a cabin. Fig. 461.

2. A form of rope-leader (Fig. 462) without a sheave. Known by other names also, *lizard* for instance.

Fig. 462.



Bull's Eye.

a. Floor bull's eye of lignum vitæ.
b. Lignum vitæ bull's eye for iron straps.
c. Bull's eye for wire or hempen rope.

Fig. 463.

Bull's-eye Condenser.

Bull's-eye Con-den′ser. (*Optics.*) A means for condensing the light from a lamp, or of obtaining parallel rays from diverging ones. It consists of a plano-convex lens of deep focus. Fig. 463.

Bump. (*Fire Arm.*) The corner of the stock at the top of the heelplate.

Bung. Several forms of automatic vent, the siphon, gravitating ball, and separated chamber and ball, are shown in Figs. 2554-2556, *Laboulaye's "Dictionnaire des Arts et Manufactures,"* tome iii., ed. 1877, Article *"Vin."*

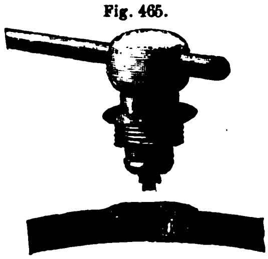
Fig. 464.

Talley's Bung and Vent.

Talley's bung has a vent in a recess, so that the bung may be driven flush with the outside of the cask. The vent has side openings and a piston valve.

Bung Buck′et. Also known as a *velinche*, *water thief*, *thief-tube*, etc. See Fig. 6925, p. 2696, *"Mech. Dict."* A *sampling* tube. A tube open at both ends is inserted at the bung-hole; the upper end being closed with the finger, the tube with its contents is withdrawn.

Fig. 465.

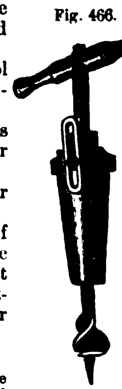


Cornell's Screw Bung Bush and Wrench.

Bung Bush. More correctly, bung-hole bush. The bush is tapering inside and outside, the outer surface having a screw thread for screwing into the bung-hole. The wrench for screwing the bush into place consists of a shank and a conical plug or core; the core has an irregular base, around which are loosely fitted a series of sections, which press equally in all directions against the interior of the bush as the core is rotated.

Bung′-hole Bor′er. An auger and annular reamer. It bores a complete round hole, regular taper, and holds its own chips. Fig. 466.

Fig. 466.



Bung-hole Borer.

Bung′-hole Brush. A tool for cleaning the insides of barrels.

The illustration, Fig. 467, shows it in position for entering, and for operating, respectively.

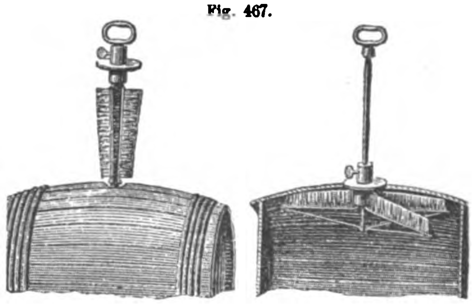
Bung Lathe. A lathe for turning taper bungs. Fig. 468.

That shown is by Arbey, of Paris. It is a small special lathe with an oblique tool on the rest which slides transversely in cutting down, and in adjusting for bungs of different diameters.

Bung Ma-chine′.

In Kirby's bung-cutting machine the square blocks are placed in a vertical pile in the hopper, and fed automatically one by one to the plunger, by which they are forced through

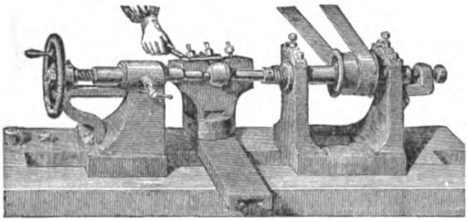
Fig. 467.



Bung-hole Brush.

the circular cavity of the cutter, and formed into cylindrical blanks. Each block as it is fed into the machine serves as a cutting-board for the next preceding block. The bungs are subjected to a great pressure so as to condense the wood.

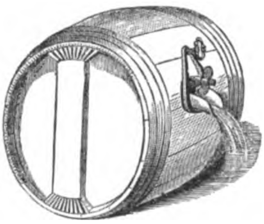
Fig. 468.



Arbey's Bung Lathe.

Bung Spout. An attachment to a cask at the bung-hole to form a lip for the latter, and enable the contents to be discharged without dribbling. Especially intended for heavy oils and molasses.

Fig. 469.

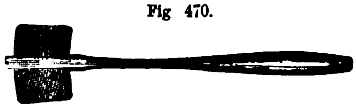


Bung Spout.

Bung Start. An instrument to start a bung by beating the bung stave of the cask. A *flogger*.

Bun'ion Ap'pa-ra'tus. (*Surgical.*) An apparatus which permits

Fig 470.



Bung Start.

freedom of motion in the vertical plane while the malposition of the toe is gradually rectified by constant lateral traction. The apparatus consists of a delicate lever of spring steel, with an oval ring in the center which is provided with hinges at its anterior and posterior margins. It is attached to the instep by a laced band, and the toe to the extremity of the spring by a piece of webbing.

Fig. 78, p. 39, Part IV., *Tiemann's "Armamentarium Chirurgicum."*

Bun'sen Bat'te-ry. (*Electricity.*) One having amalgamated zinc in sulphuric acid and carbon in nitric acid, with an intervening porous cell.

Prescott's "*Electricity*," * p. 66; Ganot, * 687, 688.
Noad, London, 1859, * 281.
Du Moncel, Paris, 1850, 69.
De la Rive, London, 1853, * 46.
Shaffner, New York, 1859, * 95.
"*Scientific American*," * xxxix. 139.
Niaudet, American translation, * 158.
"*Engineer*," xlv. 268.

Azapis' improvement consists in replacing the acidulated solution of the Bunsen by the cyanide of potassium, etc. "*Scientific American*," xxxviii. 266; xliii. 266.

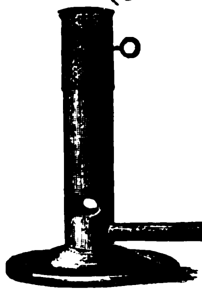
Fitzgerald, mod. of Bunsen: depolarizes by a secondary current, calcic dihydro-chromate is substituted for the nitric acid. "*Scientific American Supplement*," 764.

Bun'sen Burn'er. A form of gas burner, the invention of Bunsen, and especially adapted for heating. Its performance depends upon the proper admixture of gas and air. See 14 Figures, pp. 2411, 2412, "*Mech. Dict.*"

"It can be made of glass. A tube of glass, 4″ or 5″ long by ¼″ to ½″ wide, is taken, and by blowing out the glass, heated at two points by the pointed flame, the air holes at the bottom are produced. The gas is introduced at the center of the bottom of the tube by an upward-bent glass qu tube, with the delivery end shaped like a cross (X), a fo well adapted to mix the rising current of gas with the i This tube is fastened to the lamp by a foot, made of plas of Paris, in which it is imbedded. A short piece of glass t ing may be fastened by a rubber coupling to replace fr tures. This lamp is much better for the flame reactions th the ordinary metal lamps." — *Dingler's Journal.*

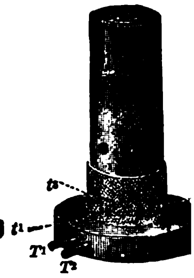
Wallace's improved Bunsen burner has an adjustable of perforated metallic plate, which enables it to burn a m more inflammable mixture of air and gas than is poss with the ordinary burner. The tendency to light withi also completely prevented, whatever may be the press quality, or quantity of gas passing. By raising the ca the necessary height a perfectly solid flame is obtaine a novel and valuable feature, since it allows any subst to be heated to be put much nearer than usual to the ce of the flame without interfering with combustion. It ca made from one inch to two inches in diameter, and is c ble of burning as much as 40 cubic feet of gas per hour.

Fig. 471.



Wallace's Solid Flame Bunsen Burner.

Fig. 472



Godefroy's Bunsen Burner.

M. Godefroy's new burner, Fig. 471, is composed c concentric sheet-iron cylinders. The first and thi pierced with lateral holes at the base. The intervals b the cylinders communicate, some with the pipes, t_1 joining the exterior gas tube, T, and others with the t_3, t_4, which unite with the tube, T_2. Wire gauze pl the base of the apparatus prevents the flame from flic while it regulates the introduction of the air. Or internal cylinders may be used if desired, in which high and regular white flame is produced.

Solid flame, *Wallace* . . "*Scientific American Su*
* "*Eng. and Min. Jour.*,"
Retort, *Kendall & Gent*, Br. * "*Engineer*," xlv. 419.

Laboulaye's "Dictionnaire des Arts et Manufactur Fig. 3462, article "*Chauffage.*"

Lecture on the theory, *Prof. Thorpe*, Chemical London. Reported in "*Scientific American Suppl* 1060.

Bun'sen Burn'er Fur'nace. Fig. 473 sents forms of the Bunsen burner furnace.

The figure on the left shows the top of a

Fig. 473.

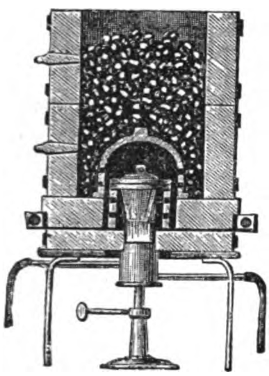
Bunsen Burner Furnace.

inside the chimney, *c*. A sole plate, *d*, r trivet, *b*, and supports an iron ring, *e*. dome covering, and *g* the chimney.

The next figure shows an evaporating and the figure on the right is a section of t minus the pan. It has a rose burner, whic erable for evaporating, as the single jet is ing metal in crucibles.

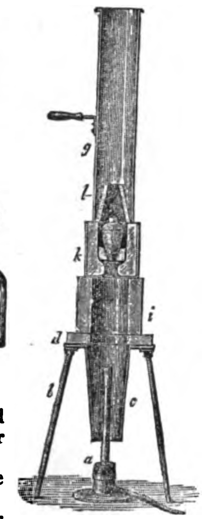
Figs. 474, 475 show other forms of the furnace

Fig. 474.



Single-jet Burner Furnace.

Fig. 475.



Bunsen Crucible Furnace.

with a single jet burner and crucibles in position on their rings.

Bun'sen Lamp. See Bunsen Burner.

Bun'ter. The bumper or buffer of a railway car. The bar on the front end of the car, which strikes against a similar bar on an adjacent car in coupling. It often forms the draw-head. See Buffer.

Fig. 476.

Buntline Leader.

Bunt'line Lead'er. An eyelet for rope, — specifically for a buntline.

Buoy. The illuminated buoy is the invention of a German, *Pintsch.* The buoy is made the recipient for a large body of compressed, rich, and heavy gas, produced by distilling shale or any fatty material. An ingenious regulator provides for the regular supply of the lamp, which will burn three months, night and day, with only one filling, the light being visible at a distance of about four miles. An electric lighting apparatus might be employed, so that the light could be extinguished at sunrise and restored at night, giving a much longer duration to the working of the buoy.

* "*Engineer*" . . . . xlvii. 289.

The illuminated buoy of Lieut. Cook, R. N., is mentioned under Buoy, "*Mech. Dict.*" Phosphide of calcium is added to the composition of the fuse, and takes fire on being wetted when the buoy is thrown overboard, and burns persistently even in rough water which dashes over it.

Bu-rette'. A graduated glass tube for transferring small quantities of fluids. See p. 408, "*Mech. Dict.*" Similar instruments are known under various names, such as Dropping Tube, Dosimeter, Pipette, etc., which see.

Dr. Bunte's gas burette for the examination of mixtures of gases. "*Journal for Gas Lighting,*" * reproduced in "*Scientific American Supplement,*" * 1603.

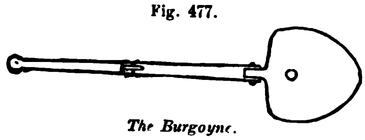
Bur'glar A-larm'. A bell, located in the sleeping room, when set for the night, rings upon the opening of any door or window in the night. The connection is by electric wires. See various forms, "*Mech. Dict.,*" pp. 408, 409.

Western Electric Manufacturing Co.; the electric connection is made with any or all rooms, can be turned off in the morning by hand or automatically, can be arranged to keep on ringing until stopped; connection can be made to doors, shutters, and windows, the latter so arranged that they may be left open for ventilation at any desired height, and yet give an alarm if disturbed. The system may be connected to a police station, and applied to safes and banks.

Powell . . . . * "*Sc. Amer.,*" xlii. 210.
Window fastening, *Saurbrey.* . * "*Sc. Amer.,*" xxxvii. 294.

Bur-goyne'. The British name for an intrenching tool; a combination of spade, axe, and

Fig. 477.



The Burgoyne.

mantlet. The handle is jointed to facilitate packing. The sharp-edged spade forms an axe; when used as a mantlet against bullets, the soldier fires through a hole in the blade.

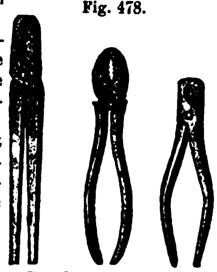
See Intrenching Tools, Fig. 2691, and Trowel Bayonet, Figs. 6673, 6674, "*Mech. Dict.*"

Burn'er. The tubular wick, with access of air to exterior and interior, is the invention of Argand. See page 142, "*Mech. Dict.,*" and list on page 1247, *Ibid.*

Lungren . . * "*Scientific American,*" xxxviii. 355.
Carcel burner . * "*American Manuf.,*" Jan. 10, 1879, p. 18.
See also Bunsen Burner; Gas Burner.

Burn'er Pli'ers. Pinchers for unscrewing or screwing burners and small connections. Fig. 478.

Fig. 478.



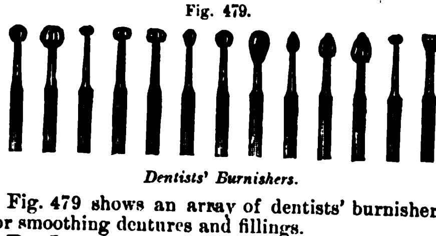
Gas-fitters' Burner and Meter Pliers.

Burned Sand. (*Molding.*) Sand in which the tenacity imparted by the clayey part has been destroyed by heat.

This happens to all that part which comes in contact with the casting, extending, in the case of large castings, to a considerable depth. It is removed as far as possible with the casting. That which remains renders the old sand weak. When fresh river or sea sand cannot be had, burned sand may be used for *partings.*

Bur'nish-er. A tool for smoothing by mechanical compression in rubbing.

Fig. 479.



Dentists' Burnishers.

Fig. 479 shows an array of dentists' burnishers, for smoothing dentures and fillings.

Bur'laps. A coarse canvas used in upholstery and elsewhere.

Bur'ring En'gine. An electric substitute for the various foot-power machines which have been devised for facilitating operations on the teeth, excavating and shaping cavities, dressing down and polishing fillings, separating teeth, etc.

The speed is about 2,500 revolutions per minute. A gear-joint allows motion at any angle. The motion is reversed at will. The engine complete weighs 12 ounces.

See Dental Drill.

Bur Thim'ble. An attachment to the finger to support the end of the bur drill when operating; designed for the protection of the hand and the easy operation of the instrument.

Fig. 480.

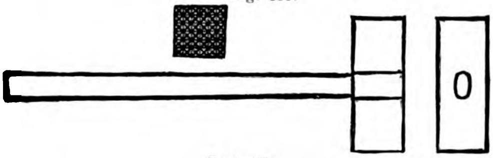
Bur Thimble.

Bush Ham'mer. (*Stone Working.*) A square prism of steel, with ends cut into pyramidal points. The cutting face is from 2″ to 4″ square. One end has sometimes the form of an axe. The tool, Fig. 481, is used in dressing and stunning.

The various forms and methods of stone working are considered under their special heads, and collections of the terms may be found under MASONS' TOOLS, etc., page 1405, "*Mech. Dict.*" and STONE WORKING, *infra*. See also lists under HAND TOOLS; MACHINES, *infra*.

Bush-ham'mered Stone Work. (*Stone Cutting.*) Work in which the roughnesses of the stone are pounded off with the bush-hammer. The sequence of operations with limestone is (1) rough-

Fig. 481.

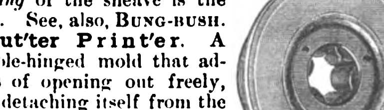


Bush Hammer.

pointing; (2) tooth-axeing; (3) bush-hammering. Sandstone is seldom bush-hammered, as the stunning makes it scale.

Bush Hook. A brier hook; bramble hook;

Fig. 482.

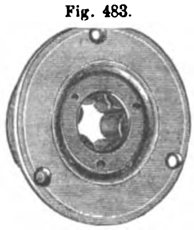


Bush Hook.

bill-hook. A hook-ended cutting tool for cutting bushes, grubs, briers, etc.

Bush'ing. (*Nautical.*) The metallic reinforce of the cheeks of a tackle-block, where the pin passes. The *bushing* of the sheave is the *coak*. See, also, BUNG-BUSH.

Fig. 483.



Block Bushing.

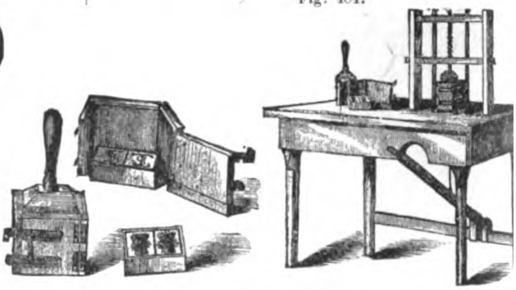
But'ter Print'er. A double-hinged mold that admits of opening out freely, and detaching itself from the butter without marring it.

The butter is weighed and placed in the mold, when it is forced by a plunger on the block at the bottom of the mold that contains the impression. The plunger is operated by a lever in connection with the main frame, and, when the pressure is removed, is retired by the action of a spiral spring. Fig. 484.

But'ter Tub. A tub in which butter is stored and shipped, especially the latter. Fig. 485.

Koehler's butter tub is oval, of white cedar, bound with galvanized iron or brass hoops. Within the tub is fitted the tin cooler, having a removable chamber for ice at each end — which is a great improvement on the old style, with stationary ice chambers — saving a great deal of inconvenienc filling the chamber with ice or removing unnecessary ice

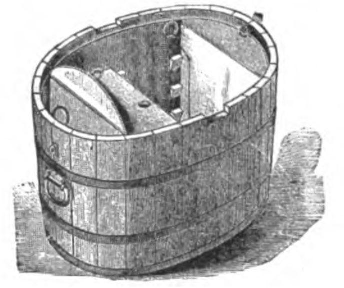
Fig. 484.



Butter Printing Apparatus.

water therefrom. On the tin are constructed a seri ledges, on which rest the shelves for supporting the butter, being used without shelves for roll butter.

Fig. 485



Butter Tub.

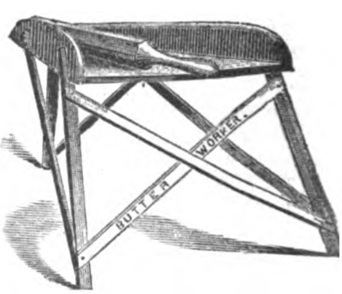
hinged cover having a fixture at one end and a hinge l the other can be locked for shipping. Hinges, has fixtures are tinned to render them rust-proof.

But'ter Work'er. A tray with roller tc the butter-milk from the butter.

The illustrations show three forms with rc

In Fig. 486 the roller is pivoted at the end and r sector.

Fig. 486.

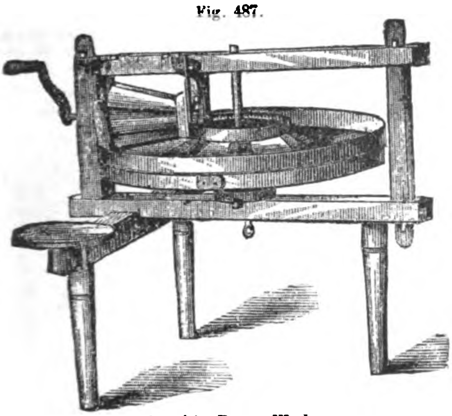


Whipple's Butter Worker.

In the rotary butter-worker, Fig. 487, the butter on a rotary circular table and is confined by a crank shaft which revolves the table also rotates t conical presser that works the butter. As the pre the paddles as they leave the butter slightly raise allows the passage of the buttermilk to a groove a periphery whence it passes by a tube to the well ter of the table.

The butter-worker, Fig. 488, consists of a tray, a with paddles which is turned by a crank, and from end to end of the tray. The roller is ren the tray by turning the long end of small butt side of the tray, which admits of the roller comin the end of the tray, and allows the clamps whic

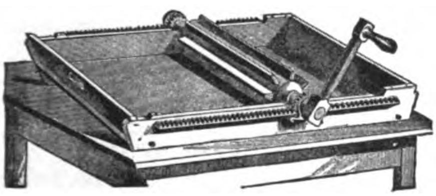
Fig. 487.



Embrie's Butter Worker.

roller down to be raised from the rack underneath, when the roller can be lifted out.

Fig. 488.



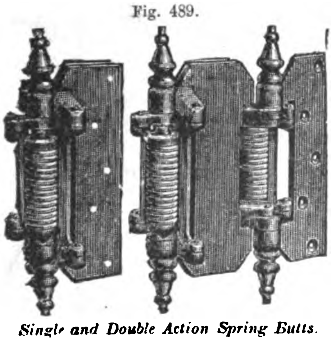
Reid's Butter Worker.

May refer to

Butter, Artificial, *Mott*.	"*Scientific Amer. Sup.*," 760, 774.
	"*Scientific American*," xxxv. 337.
Packing, *Bemis* . . .	* "*Scientific American*," xxxvii. 66.
Worker, *Sands* . . .	* "*Scientific American*," xxxvii. 5.

Butt Hinge. A door or casement hinge adapted to be fastened to the edge of the object, and hidden when the latter is closed. Differs from the hook strap, T, and other long-membered or ornamental hinges which are displayed upon the door.

Fig. 489.



Single and Double Action Spring Butts.

Geer's butts, shown in Fig. 489, exhibit several points of value. The figure on the left is for a single door of the usual action, but with a spring to close the door automatically and having its greatest power at the point of closure, the least when opened to a right angle; and also holding the door in open position. The double action hinge allows the door to swing either way. They are not rights and lefts, but adaptable to either edge of a door.

Loose-pin	* "*Iron Age*," xxi., April 11, p. 9.
Spring, *Geer*	* "*Iron Age*," xxi., Feb. 7, p. 1.

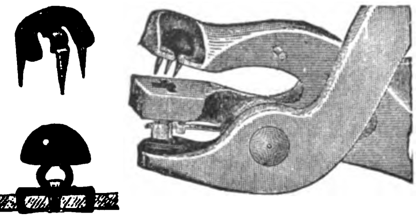
Butt Lathe. A stock-turning lathe, invented by Blanchard. A gouge 18″ in diameter, that makes from 3,400 to 3,600 revolutions per minute, is guided by an iron pattern the shape of the stock required. The stock goes through a set of these machines before it is ready for polishing.

But'ton. (*Surgical.*) A species of clamp for holding the suture, in operations for vesico-vaginal fistula. The invention of *Bozeman*.

See Figs. 268–271, Part III., *Tiemann's* "*Armamentarium Chirurgicum*."
The *button-adjuster* and *button-shaper* are accessories.

But'ton Fas'ten-er. A clasp which hooks over the eye of a shoe button and is then clinched to the shoe.

Fig. 490.



Heaton's Button-setting Instrument.

The illustration shows the article, its attachment, and the tool. It is applied without previous piercing of the leather; has sufficient freedom of motion; can be removed by unclinching the points.

Button apparatus, Covered . .	* "*Sc. Amer.*," xxxvii. 175.
Button sewing-machine, *Fries*.	* "*Sc. Amer.*," xxxv. 6.

But'ton-head Bolt. A carriage bolt with spheroidal head. Fig. 491.

Fig. 491.

Button-head Carriage Bolt.

But'tress. (*Add.*) Buttresses are *Close*, like extended pilasters.

Open, with perforations in the profile.

Flying, with half an arch suspended, bearing against the clerestory or a wall.

But'ty-gang. A word used among English contractors to signify a gang of from 10 to 13 men, who do a piece of work for a given sum divided equally among them, except a small additional sum to the head of the gang. *Helps's* "*Life of Thomas Brassey.*"

Buz'zer. 1. A small, rapidly-revolving wheel, used in grinding or polishing small objects. It is plied with emery, crocus, rouge, etc., according to requirements. Named from its whirring sound.

2. A telegraphic call in which a vibrating hammer strikes a sounding piece and gives out a buzzing sound, which, in certain cases, is preferable to a bell.

Buzz Pla'ner. A small planing machine for wood. It is named from the whirring hum of its rapidly revolving knife-cylinder, and is used to take out of wind and smooth up small stuff.

Bye'-pass. 1. A cut across furnished by an extra pipe of smaller dimensions, leading around a certain chamber, valve, or apparatus which is temporarily cut out of the circulation.

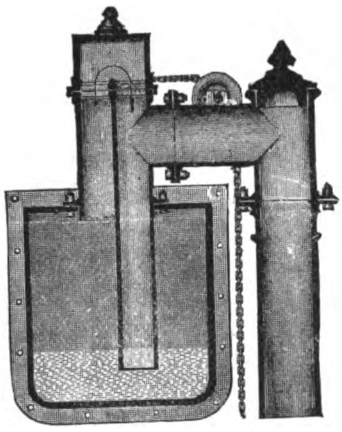
The *bye-pass* is found in: —

Mackenzie's surface condenser.
* "*American Gas-light Journal*," July 3, 1876, p. 12.
Smith & Sayre's gas exhauster.
* "*American Gas-light Journal*," *Ibid.*, pp. 10, 11.
Woodbury & Merrill's hot-air engine. *Infra.*

The illustration shows Farmer's hydraulic main, with dip-pipe and bye-pass. — "*American Gas-Light Journal*," July 3, 1876, p. 20.

See Gas Compensator; Gas Exhauster.

Fig. 492.



Farmer's Bye-pass Dip-pipe.

2. A protecting pipe around the tip of a gas-burner to prevent the light being extinguishe gust of wind. Used in lighthouses. See Elliot's Report, U. S. Engineers. The top bye-pass is pierced with holes supplied wi from a source independent of that of the flame, and will relight the former immed should it be extinguished.

See, also, paper by Wigham, Mechanical Science se British Association, 1878, reproduced in "*Scientific can Supplement*," * 2389.

Byrne Bat'te-ry. (*Electricity.*) A fo pneumatic battery.

The negative electrode consists of a coppe coated with lead on one side, and the oth faced with platinum. Two of these are u tween which is a zinc plate. The exciting is agitated by injection of air.

"*Niaudet*," American translation, 226.
"*Scientific American Supplement*" . . * p. 2526
"*Telegraphic Journal*" . . . . * vi. 222,
"*Engineer*" . . . . * xlv. 27
"*Scientific American*" . . . . * xxxviii

Dr. J. H. Thompson's Report, "*Centennial Exhib ports*," vol. vii., Group XXIV., p. 53.

C.

Cab. 1. A city passenger vehicle for hire by course or hour.

2. The shelter on a locomotive for the engineer and fireman.

See notices: —

Chariot cab, *Murch* . . * "*Scientific American*," xliii. 191.
Murch . . Patents 147,421, 152,244, 154,572, 151,240, 149,779.
Herdic . . * "*Scientific American Sup*," 3901.
Locomotive cab.
Pa. Railway . . . * "*Engineering*," xxiv. 105.

Cab'in. A saloon for officers or passengers on board ship.

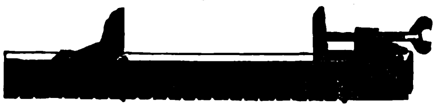
Swinging cabin, *Bessemer*, "*Van Nostrand's Mag.*," xvi. 569.

Cab'in Car. (*Railway.*) A car carried at the rear of a freight-train to accommodate the conductor and train-hands. Known also as a *caboose*.

Pennsylvania Railway . . * "*Engineering*," xxiv. 413–417.

Cab'i-net Ma'ker's Clamp. A species of vise for bringing parts of a frame together and

Fig. 493.



Cabinet Maker's Clamp.

holding them. The heads are adjustable by stirrups on the rail, which has a notched lower edge, and one of the heads has a screw for clamping the object.

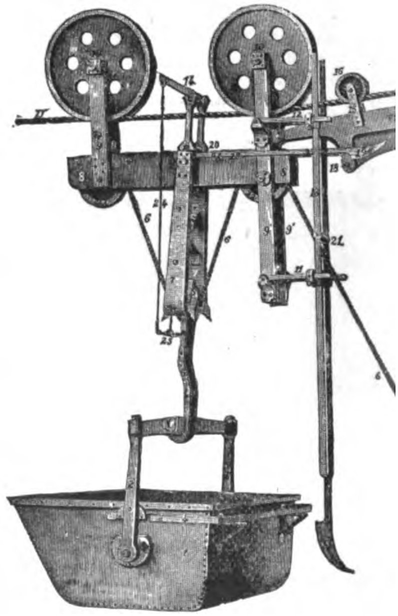
Ca'ble. A large rope, warp, or hawser.

The catenary of a suspension bridge.

East River Suspension Bridge.
* "*Scientific Amer.*," xxxvii. 63.
* "*Scientific Amer.*," xxxviii. 303–6.
Fastening . . . . * "*Scientific Amer.*," xxxvii. 79.
Making . . . . . * "*Scientific Amer. Sup.*," 755.
Gear, wire.
S. S. "*Moewe*," Br. * "*Engineer*," l. 494.
Grapnel . . . . . . * "*Scientific Amer. Sup.*," 979.
Grappling, *Capt. Stead* * "*Iron Age*," xxi., June 6, p. 8.
Hauling gear, telegraph.
Johnson & Phillips, Br. * "*Engineering*," xxix. 205
Making for suspension bridges.
Hildenbrand . . . * "*Van Nost. Mag.*," xvii.
Towing . . . . . . * "*Scientific American*," xl

Ca'ble Car'ri-er. A means of tran rough materials; stone, sand, lime, coal, e a suspended bucket traveling on a wire Fig. 494.

Fig. 494.



Brown's Cable Carrier.

While filling the tub, the carrying bail 2 is turne when filled the bale is turned upright, and there the dumping bail 4. The bail is then attached to block 5, through which the hoisting rope 6 pas over pulley 22, to the hoisting drum (not shown.) When the load is raised, the upper edge of block 5 enters between the inwardly curved ends of the hooks 7, 7′, which separate and pass over the block, falling together beneath it. The block is then lowered and rests upon them, transferring the load from the rope to the hooks.

These hooks are attached to levers 19 pivoted at A and having a limited movement, the weight depresses their inner and raises their outer ends, unhooking them from pin 18 on the holding block 15. Simultaneously with the transfer of the weight to the hooks, the hoisting rope and drum are released from the power and the carriage with its load descends the cable 17; and when it reaches the point where it is desired to deposit its load, the drum is again thrown into connection with the power, arresting the outward progress of the carriage, and starting it simultaneously upon its return. The hoisting rope, passing under roller 21, between the two parts of dumping hook 13, is by it deflected downwards as the carriage passes out, and when the drum is thrown into gear the straightening of the rope raises the hook which is pivoted upon levers 11 and 12, brings its point, 13′, in contact with the dumping bale, unlocks the tub, which capsizes, ejects its contents, attains its upright position, and relocks itself while upon its return.

When the carriage reaches the holding block it is stopped, and the tub is raised until the block, acting upon projections 26 on the inner sides of the hooks, forces them apart sufficiently to allow of its passing down between and clear of their points. A notch on lever 14 retains them apart until the block has passed their points and strikes the jointed lever 25, which, through rod 24, raises lever 14, releasing and allowing them to fall together.

The tub is then lowered and the operation repeated.

By the use of this machine (hoisting power being furnished) material can be conveyed a thousand feet, and piled to any height, with the labor of one man.

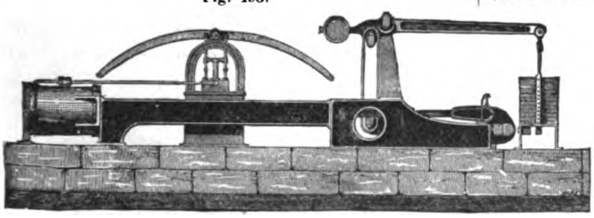
See, also, WIRE-WAY, Fig. 7006, p. 2798, "*Mech. Dict.*"

Ca′ble Screw. A fastening for boot-soles; a wire in shape of a twisted cord.

Ca′ble Screw Ma-chine′. One for putting screw pegs into boot and shoe soles. It goes round the sole in 15 seconds, putting in 80 to 85 wire pegs.

Ca′ble Test′ing Ma-chine′. The machine shown in Fig. 495 is made in accordance with the

Fig. 495.



Chain Cable and Anchor Testing Machine.

"Board of Trade" (British) regulations, operating by medium of dead levers upon an active weight. The series of levers is similar to that in compound beam scales, the strain being given by a hydraulic ram of 8′ stroke. The great length of stroke is for the purpose of taking up the stretch of the cable when testing lengths of 20 fathoms at a time. The machines are made to test up to 200 tons. A hydraulic gage indicates upon a scale the strain upon the levers.

For chain-testing establishments, in addition to the testing machines there are required steam-pumping apparatus, cable-shears for cutting out defective links, capstans for hauling the chains, a hydraulic anchor crane, and a blacking apparatus; it is usual also to add a more powerful short machine to test a few links of the largest cables to destruction.

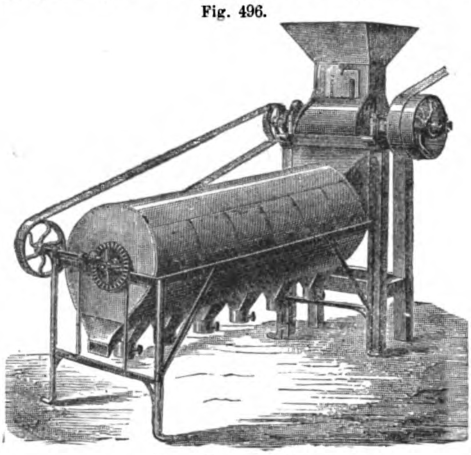
The cable-testing apparatus of Giffard's captive balloon, Paris, 1878, was a hydraulic press mounted above a frame so as to bring a strain upon a section of the cable which had two eye-splices to the holder and puller respectively, the latter depending from the piston of the press. An accumulator is arranged to prevent any shock from the rupture affecting the manometer which registers the tension.

"*Scientific American*" . . . . . . * xxxix. 194.

Ca′bres-to. A halter. A word of Spanish introduction used on our Western plains. Properly *Cabestro: Cabresto* in Portuguese.

Ca-ca′o Grind′er and Sort′er. A machine for grinding the cacao nut and sorting the result

Fig. 496.



French Cacao Machine.

into different finenesses. The distance between the cylinder and its concave is adjustable in order to determine the fineness of the result. The ground cacao is sorted into six sizes, and refuse.

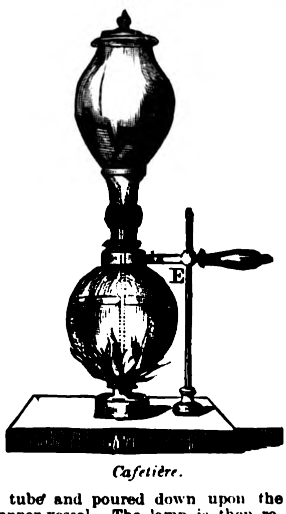
In the cacao mill of De Batiste, Paris, France, the cacao is put in a hopper having at the bottom a screw which partially grinds the nut and feeds it into the center of a pair of stones, similar to a pair of grist-mill stones. These grind it into a liquid which collects in a pan surrounding the lower stone.

Cacao manufacture . . . . . "*Sc. American Sup.*," 1014.
Chocolate machinery, *Menier* . "*Engineering*," xxv. 443.
Cocoa . . . . " *Sc. American*," xxxv. 278.

Cafe-ti-ere′. A French apparatus for making infusion of coffee.

The apparatus has two bulbs and connecting neck with ejector tube.

Fig. 497.



Cafetière.

As shown in Fig. 497 the lower bulb contains water which is in process of being heated by the alcohol lamp. When steam forms above the water, the latter is raised in the central tube and poured down upon the ground coffee in the upper vessel. The lamp is then removed, the steam soon condenses and the water is drawn down through the coffee so as to have the grounds as dry as fresh sawdust.

The *Etzenberger* steam tea and coffee filter is on larger scale but involves the same principle of action.

Cage. (*Add.*) 6. A prison of iron bars.

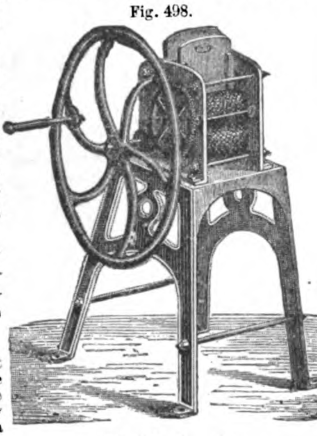
Iron cages are now frequently made for prisons in the South and West, to be used when there is no conveniently available material except wood.

Cais'son. An iron-lined shaft; or a shaft used in pneumatic subaqueous excavation. Pages 49, 420–422, "*Mech. Dict.*"

Arsenal of Nagasaki	* "*Engineer,*" xliv. 60–64.
Air-lock, Hudson River Tunnel	* "*Engineer,*" l. 327.
Subaqueous, Antwerp . . .	* "*Engineering,*" xxviii. 280.

Cake Grind'er. A machine for breaking linseed oil cake for food for stock. The cake is dropped into the hopper edgewise, is broken in pieces, and these ground by passing between toothed rollers.

Fig. 498.



Oil Cake Grinder.

Cake Ma-chine'. A machine for cutting dough into cakes.

Ruger's soft cake and jumble machine takes the dough previously prepared in a dough mixer, spreads it on an apron, and cuts it into cakes of the required size and shape; cakes, snaps, jumbles, drops, fingers, bars, etc. The cakes are taken from the apron with a peel. There is no automatic scrapper as in some forms of cracker machines. See CRACKER MACHINE.

Cake Steam'er. A machine for *washing* cakes, snaps, and crackers. It has an iron frame having an endless chain apron for carrying the pans of cakes underneath a dome where steam and water are sprayed upon the cakes, causing them to spread, and then by filling the dome with hot steam a thin skin forms over the cakes, by which, when baked, they acquire a rich, cracked top, and glossy color.

Cal-cim'e-ter. An instrument invented by Scheibler, and modified by Pellit & Salteron, for making volumetric analyses of bone-dust, meerschaum, and other compounds containing lime.

"*Scientific American Supplement*" . . * x. 4002.

Cal'ci-mine. A superior kind of wash for walls. See also KALSOMINE, "*Mech. Dict.,*" p. 1222.

Cal-cin'ing Fur'nace. A furnace for roasting ores.

In the Gestenbrofer furnace, named after the inventor, was first introduced the feature of burning the sulphur of pyritic ores to accomplish the calcination.

In practice, the sulphurous fumes are used to make sulphuric acid, which is used to make soda from common salt.

See paper by Holloway read before the "Society of Arts," London, February, 1879, "*On a New Application of a Process of Rapid Oxidation by which Sulphides are Utilized for Fuel,*" referred to in "*Engineering and Mining Journal,*" xxvii. 201; xxix. 423.

See also *Dr. Jenkins's* report, "*Paris Exposition Reports,*" 1878, vol. iv., pp. 9 *et seq.*, 74, 80 *et seq.*, etc.

Boston and Colorado Works	* "*Engineering,*" xxii. 290.
Borrie, Br.	* "*Iron Age,*" xxiii., June 12, p. 1.
Howson & Wilson, Br .	* "*Iron Age,*" xxiii., June 12, p. 1.

Cal'ci-um Light. An improved form of the calcium light has been invented by *Khotinsky*, a Russian naval officer.

A thin pyramidal crayon of lime or magnesia is suppo (adjustably) in a vertical position, with its thinner end fa the orifice of the burner below, which surmounts two tu for coal-gas and oxygen, both controlled by one stop-c The two gases only mix at the mouth of the burner. crayon, immersed in the flame, is successively heated below, without any sudden difference of temperature oc ring in its several parts. The same crayon will last fi days, with daily use. The burner consumes about 0.014 meters of oxygen per hour, and as much coal-gas, givi light equal to about 1.5 Carcel burner.

Cal'cu-la-ting Ma-chine'. An arithmom "*Mech. Dict.,*" pp. 143, 144.

Circle, *Boucher* . . .	* "*Engineering,*" xxvii. 498.
Grant	* "*Engineer,*" xliv. 12.
	* "*Scientific American,*" xxxvi

Babbage's and Scheutz's * machines, described, "*Calculer, Machine à,*" *Laboulaye's* "*Dict. des Arts et* *factures*, vol. iv., ed. 1877. See also pp. 423-24, "*Mech.* *Stamm's* "*Machine à equations,*" * *Ibid.*

Cal'en-der-ing Ma-chine'. 1. (*Laun* A machine for smoothing clothes or linen. A gle. Much used in France. Machines o character are made by Pierron & Dehaitre, See LAUNDRY.

2. Machines for smoothing piece goods in of manufacture after washing, dyeing, blea etc.

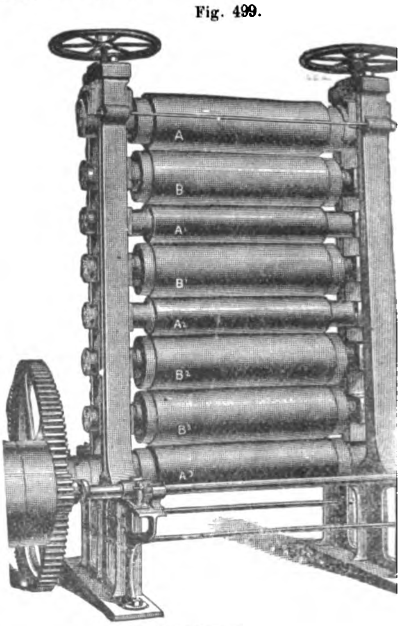
See Fig. 1026, p. 426, "*Mech. Dict.*" Also Fig. 252. "*Blanchiment,*" *Laboulaye's* "*Dictionnaire des Arts et* *factures,*" tome i., ed. 1877.

3. A machine for giving lustre to stuffs by ure, which may be accompanied by heat. French calendering machine has rollers of tree wood or paper alternating with cast iron

See *Laboulaye's* "*Dictionnaire des Arts et Manufa* *article* "*Calandre,*" Fig. 498, tome i., ed. 1877.

Fig. 500 is a French machine of two cylin which the lower one is paper covered. Tl roller is adapted to be heated by steam Machines of the same class, with three cy are made, adapted for cloths or linen, for of dressers, dyers, laundries, etc. See also LING MACHINE.

Fig. 499.



Poole's Super-calender Rolls.

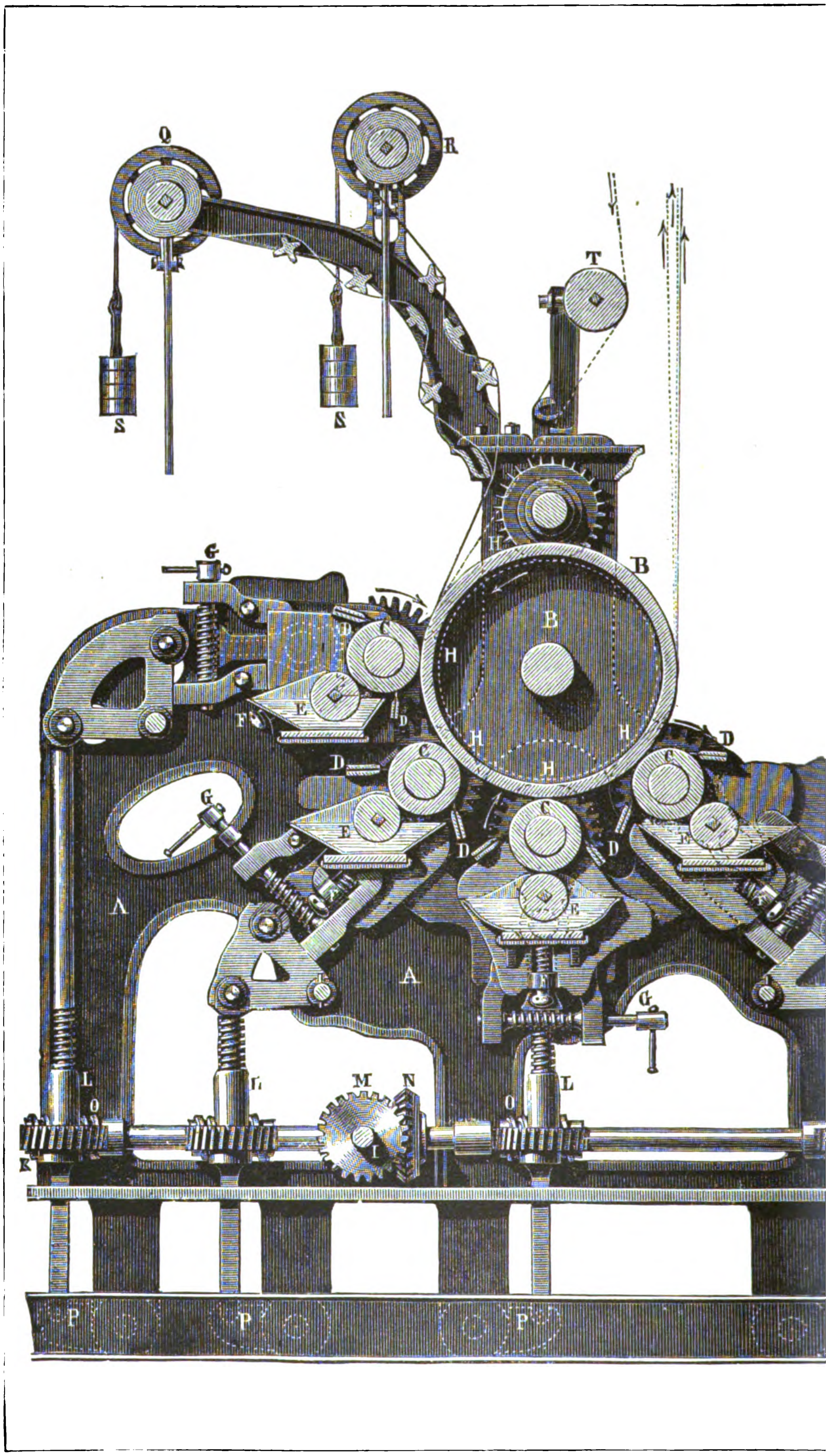
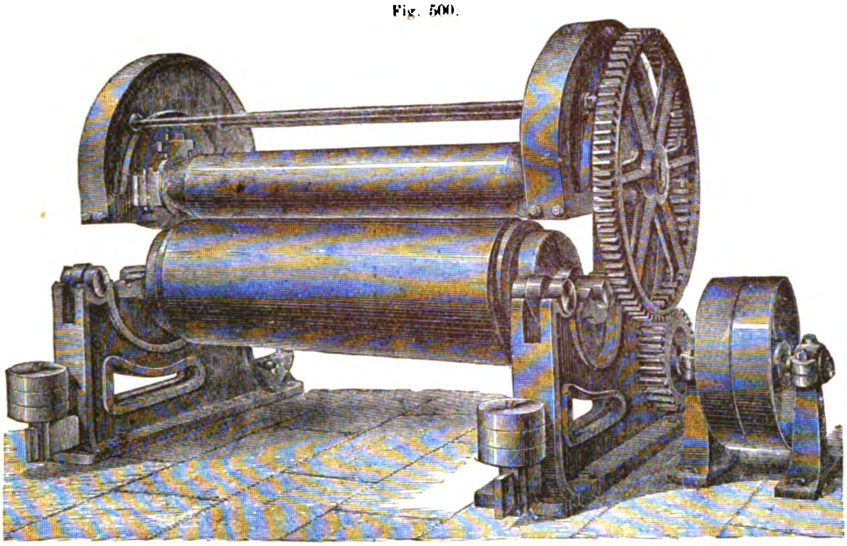


PLATE VI. CALICO PRINTING MACHINE. (In four colors.)

Fig. 500.



French Calendering Machine. (*Pierron & Dehaitre, Paris.*)

Small machines are made for watering or moiring ribbons, etc.

4. In paper-making for expressing the moisture from the felted web, and giving a surface to the incipient paper.

Poole's calender rolls are shown in Fig. 499.

The figure represents a stack of super-calenders for a paper machine, but their rolls are adapted for various uses, working in paper, rubber, gutta-percha, brass, copper, flour, etc. As shown, the rolls *A A'*, etc., are of chilled iron, *B B'*, etc., are paper. The number and dimensions are varied to suit the work required of them. They are put in motion by a friction pulley, and the strain is carried by large wrought iron rods, connecting the caps of the upper with the lower bearings of the lower roll. The gearing at the side belongs to the winding arrangement.

5. A machine for running rubber into sheets, or spreading it upon cloth.

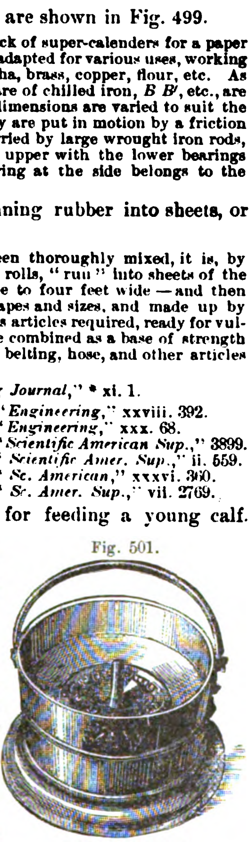
When the rubber has been thoroughly mixed, it is, by means of large iron calender rolls, "run" into sheets of the required thicknesses — three to four feet wide — and then rolled or cut into various shapes and sizes, and made up by the workmen into the various articles required, ready for vulcanizing. Cotton fabrics are combined as a base of strength with the sheets intended for belting, hose, and other articles requiring it.

"*Engineering and Mining Journal*," * xi. 1.

Machine, *Voith*, Ger.	* "*Engineering*," xxviii. 392.
	* "*Engineering*," xxx. 68.
	* "*Scientific American Sup.*," 3899.
Rolls, *Poole*	* "*Scientific Amer. Sup.*," ii. 559.
Of paper	* "*Sc. American*," xxxvi. 360.
Grinding, *Poole*	* "*Sc. Amer. Sup.*," vii. 2769.

Calf Pail. A pail for feeding a young calf. The teat in the center is hollow, and the milk is drawn through it by the natural action of sucking.

Fig. 501.



French Calf Pail

Calf muzzle, *Miller*, * "*Sc. Amer.*," xxxvi. 386.

Cal'i-co-print'ing Ma-chine'. A machine for printing tissues. It was originally designed for cotton prints or calicoes, but has more lately been applied to a very great variety of fabrics of wool, linen, silk, and other materials, and of various mixtures of these and others.

The modes of printing are various, but the greater number concern the chemical side of the question and are described on pages 426–429, "*Mech. Dict.*"

Plate VI. shows a machine for printing in four colors which will give a clearer understanding of the construction and operation than one for printing in twenty-four colors, which might have been selected. The latter has a larger central cylinder so as to make it possible to arrange around it a series of twenty-four different impression rollers, each having its own paraphernalia of color-roller, color-trough, doctor, and the necessary means for adjustment.

The plate shows a transverse vertical section of the machine. A, is the frame of the machine on which the various parts are mounted. B is the impression cylinder, and around it are four engraved cylinders, C C C C, which receive their color from felt-covered copper rollers which revolve in the color-troughs, E E E E. Each of the graven cylinders has two doctors, D D, one to remove superfluous ink in advance of the impression being delivered, and the other one to catch and remove any fluff or fibre which might adhere to the cylinder and so be carried into the color. The doctor is a steel blade held by an adjustable screw against the cylinder and having a back and forth movement in the direction of its length.

The plate shows three webs passing around between the impression cylinder and the engraved cylinders. That passing from Q is the fabric to be printed. It passes over several wing rollers and flat surfaces which spread it evenly and remove folds and wrinkles; the tension being maintained by a weighted strap, S, which acts as a brake upon the axes of the cloth roller and prevents its paying out too fast.

Next to the tissue to be printed is a cloth called a doubler (*doublier*) which unrols from R and has the same smoothing devices and brake weight S as previously mentioned.

The doubler lies at the back of the fabric to be printed, and is itself backed by an endless blanket, which is shown coming past the roller T and the spiked roller H; this lies next to the impression cylinder, the doubler and blanket together acting just as the blankets of an ordinary copper-plate printing-press, to form an elastic spongy backing to the fabric and force it into the graven lines from which it absorbs the colors.

Each graven cylinder, as has been said, has its own set of devices, color roller, and trough, and these, with it, are mounted upon a carriage which can be set towards or from the impression cylinder B. A system of gearing, M N O L K, actuates these altogether, but individual adjustments of any one set are made by a screw G, which acts upon its own set.

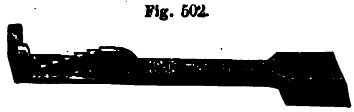
The cylinder is rotated by a gear-wheel on its shaft, and the graven cylinders by the planetary gears H H H H.

On the right are shown the tissue, with the doubler and the felt proceeding toward the drying chamber.

The Monteith (Glasgow) hydraulic press, for calico printing from flat plates, is shown in article "*Impression sur Étoffes*," Fig. 43, *Laboulaye's* "*Dictionnaire des Arts et Manufactures*, tome iii., ed. 1877.
Machine for printing in 24 colors. *Ibid*, Fig. 63.
Cf. "*Sketch of the History of Calico*." Paper read before a literary society of Melrose, Mass. "*Boston Journal*," reproduced in "*Scientific American*," xli. 401.
Copper facing calico rolls. "*Iron Age*," xix., June 14, p. 20.
Cf. O'Neill's "*Chemistry of Calico Printing*," etc.
O'Neill's "*Dictionary of Calico Printing and Dyeing*."

Cal'i-for'ni-a Sight. A hind sight for a gun; capable, by elevation of the rear portion on one or other of the steps of the fin, of adjustment for ranges of varying distance. Fig. 502.

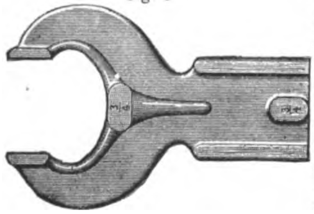
Fig. 502.



California Sight.

Cal'i-pers. Standard calipers are made for outside and for inside measurements; the prongs answering for the former, and the bar for the latter. They are preferred to plugs and rings for some purposes. See CYLINDRICAL GAGE. They are both light and strong. They are used as standards in a shop, to which all workmen's measurements must conform.

Fig. 503.



Standard Caliper Gage.

Each full set of these gages is arranged in a case, and contains sizes from ¼″ to 2¼″ diameter, varying by $\frac{1}{16}$″.
Form and use of . . . . * "*Sc. Amer.*," xxxvi. 3.
Manufacture of . . . . . * "*Sc. Amer.*," xxxviii. 85
Micrometer, *Brown & Sharpe* * "*Sc. Amer.*," xxxvi. 9.
Gages and caliper machines, "*American Manufacturer*," 1879, March 28, p. 13, and April 4, p. 13.

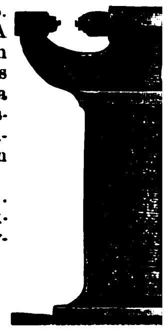
Cal'i-per-ing Ma-chine'. A machine, Fig. 504, used in a shop for testing work. A sort of stationary caliper, with capacity for fine adjustment. It is on the principle of the Whitworth measuring machine, Fig. 3104, p. 1414, "*Mech. Dict.*"

It has a fine screw, with a large graduated wheel, and a tangent screw for fine adjustment.

"*American Manufacturer*," * 1879, April 4, p. 18.
"*Iron Age*" . . . . . . xxiii., Jan. 30, p. 8.

Cal'i-per Rule. One with a sliding which protrudes at the end; the foot may be used to measure outside dimensions, in the manner of calipers. Fig. 506.

Fig. 504.

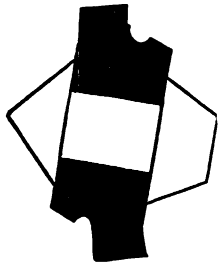


Calipering Ma

Calk'ing I'ron. A chisel by which oakum is driven into the seams between the planks of a wooden ship. The chisels vary in form according to the size or position of the seam. Fig. 507.

Calk'ing Joint. One tightened by a calking tool, as in some riveted boilers.

Fig. 505.

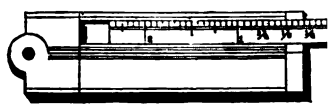


Connery's Method of Calking.

Connery's method is with a round end stead of one with an The advantage is tha cut the iron, makin cracks, but simply metal in between the wedging it tight. parts in the cut re portions disturbed b

Cal'lan Bat (*Electricity.*) A form of Grove which the platinu tric acid are replaced by platinized lead a ture of sulphuric and nitric acids, and sal lution of nitrate of potassium.

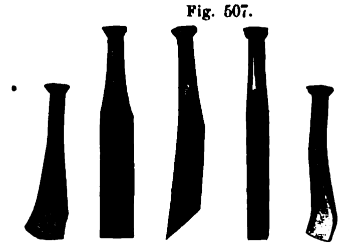
Fig. 506.



Caliper Rule.

"*De la Rive*," London, 1859, 283.

Fig. 507.



Calking Irons.

Call An-nun'ci-a'tor. An audible which has, in addition to the gong, a which are arrows (or what not) which in source whence the call proceeded. Sucl in hotels and elsewhere. See ANN "*Mech. Dict.*"

Cal'laud Bat'te-ry. (*Electricity.*) inal gravity battery, invented by Jea Callaud. See p. 430, "*Mech. Dict.*"

Prescott, "*Electricity*," 79.
Niaudet, American translation, * 118.
Plush, imp't on Callaud, * "*Sc. Am. Sup.*," 2
* "*Engineer*," xlvii.
"*Journal Franklin*

Call Bell. A bell situate to be sounded by the distant closing of an electric circuit.

Such are used constantly on telegraph and telephone circuits

The illustration, Fig. 508, shows the latter. Above is the *transmitter*, below are two call-bells; on the left hangs the *receiving* instrument; on the right is the crank of the magneto-electric instrument.

A *buzzer* is sometimes used instead of a bell to call a clerk without making a noisy alarm.

Fig. 508.

Magneto Call Bell.

Fig. 509.

Call Button.

Call But'ton. A small stud which is pressed to close an electric circuit and sound a gong at a distant station; an office, guard-room, servants' quarters, or what not.

Fig. 509 shows one which is stationary in a wall; another pendent at the end of a cord.

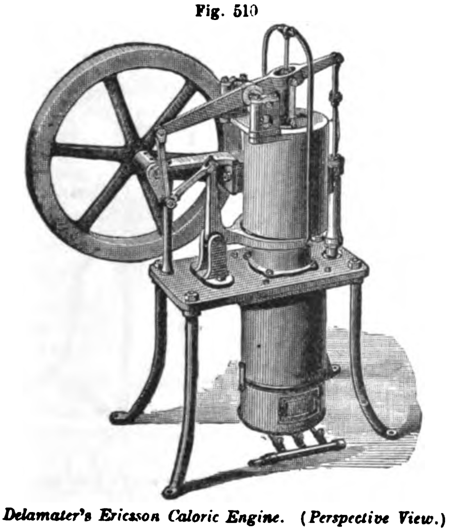
Cal'li-graph'. A writing machine.

Cal'o-ric En'gine. The name given by *Ericsson* to the heated-air engine. His earlier form of engine was given in Fig. 84, p. 40, "*Mech. Dict.,*" and accompanying description. His device was followed by a host of others. See Figs. 85–94, pp. 41–45, *Ibid.*

The illustrations below show the latest and a very compact form of the *Ericsson* engine.

Fig. 510 is a perspective, and Fig 511 a sectional view of the

Fig. 510



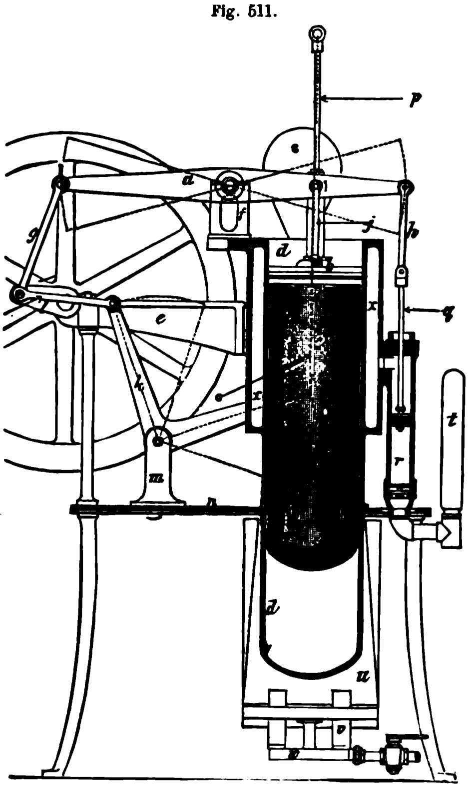
Delamater's Ericsson Caloric Engine. (*Perspective View.*)

engine pump and furnace. The engine is specially intended for domestic use in lifting and forcing water from wells and cisterns, or from city mains, to tanks on upper floors of buildings.

No steam is employed, and any kind of fuel will answer for this engine, but coal-gas is preferable, the consumption being 15 cubic feet per hour for average house use.

The action of the engine is to alternately heat and cool the air confined below the air-piston *b* in cylinder *d*, the heating of the air generating a pressure which acts on the air-piston, causing it to move through its upward stroke, actuating the pump *r* and fly-wheel by means of beam *a* and links *j h g*. The momentum of the fly-wheel and contraction of the air cause the return stroke. The office of the transfer piston *c*, by its movement derived from the crank through link *l* and bell crank *k*, is to displace the air from the lower or heated part of the cylinder *d* to the upper or cold part, and *vice versa*.

Fig. 511.



Delamater's Ericsson Caloric Engine. (*Sectional View.*)

u is the gas furnace, *t* the vacuum cylinder, *x* the water jacket, *e* fly-wheel bracket, *f* beam center bearing

The Brown caloric engine has the furnace separated from the working cylinder, has valved connections between the two, and uses the hot air expansively. The inlet and outlet valves operate independently of each other. The furnace is supplied with coal by a cut-off bottom hopper while the machine is in motion

The steam siren fog signal at the Centennial was operated by one of these engines. See Fog Trumpet.

Compound, *Beaumont*, Br.	* "*Scientific Amer.,*" xliii. 385.
Brown	* "*Manuf. & Builder,*" x. 97.
	* "*Eng. & Min. J.,*" xxvi. 349.
	* "*Iron Age,*" xx., Dec. 6, p. 1.
Ebert	* "*Scientific Amer. Sup.,*" 1412.
Roper	* "*Manuf. & Builder,*" xi. 177.
Van Renne's	* "*Sc. American,*" xxxix. 307.
"Tom Thumb"	* "*Sc. American,*" xlii. 373.
Pumping engine, *Ericsson*	* "*Manuf. & Builder,*" xii. 150.
Wilcox	* *Laboulaye's* "*Dict.,*" etc., iv., article "*Air Chamber.*"
Compression engine, *Rider*.	* "*Polytechnic Review,*" ii. 195
	* "*Am. Artisan,*" No. 12, 1874.

Cal'o-rie. The amount of heat required to raise the temperature of 1 kilogram of distilled water 1° Centigrade; about equal to 2.2 pounds raised 1.8° Fah.

Cal'o-rim'e-ter. An instrument for measuring the quantity of heat given out by bodies in passing from one temperature to another.

For *Reynault's*, see *Laboulaye's* "*Dictionnaire*," etc., article, "*Chaleur Spécifique*," tome iv., ed. 1877.
For sugar, * *Ibid.*, vol. iii., Figs. 75, 76, article, "*Sucre.*"
Hare's . . . . . . * "*Scientific Amer. Sup.*," vii. 2527.
Ericsson's . . . . . * "*Scientific Amer. Sup.*" iii. 1103.
Liquid "*Les Mondes*," . "*Scientific Amer.*," xxxviii. 185.
Violle, Fr. . . . . . * "*Scientific American*," xli. 53.
Massachusetts Inst. . . "*Scientific American*," xxxv. 164.

Cal'va-ri-an Hook. (*Surgical.*) A post-mortem hook, used, as its name indicates, in working upon the skull.

Ca-ma'cho Bat'te-ry. (*Electricity.*) A perfluent battery in which the cells are arranged in steps. The exciting liquid (solution of bichromate of potassium) is contained in a reservoir, and conducted from cell to cell by means of siphons.

Niaudet, American translation . . . . . * 231.
"*Engineer*" . . . . * xlii. 203.
"*Scientific American Supplement*" . . . * 749.

Cam'ber-ing Ma-chine'. A machine for giving a vertical curve to a railway rail. Such rails are used at the summits and feet of inclines and at the junction of grades of varying inclination.

Also used to curve a rail to such a degree that it will be straight when cooled.

See Figs. 8, 9, and pp. 372, "*Engineering*," xxix.

Cam Cut'ter. A special machine-tool made to cut and finish cams of all curves up to 5″ diameter. It is made with either single or double heads. The carriage for reception of the blank is gibbed to the bed, and has sufficient traverse toward or from the cutter-spindle to cut to any required depth. The cones of the cutter-spindles carry 2″ belts. The feed is by worm and gear, and has variable speeds. Machines are built for cutting either periphery and face or periphery alone.

Cam'el. (*Hyd. Eng.*) A float for raising a vessel.

Ships over shoals.
Clark & Standfield, Br. . . * "*Engineering*," xxiii. 370.
See, also, Depositing Dock; Dock; Floating Dock, "*Mech. Dict.*," *et infra.*

Cam'el's Hair Pen'cil. A small brush used by artists, the tuft being made of the hair of the camel. Similar brushes of differing degrees of elasticity are made of fitch, badger, squirrel, goat, and sable.

Cam'e-o Cut'ting. In the process of cameo-cutting the method in Italy is as follows: —

The shell is first cut into pieces the size of the required cameo by means of diamond dust and the slitting mill, or by a blade of steel fed with emery and water. It is then shaped into a square, oval, or other form on the grindstone, and the edge finished with oil stone. It is next cemented to a block of wood, which serves as a handle to be grasped by the artist while tracing out with a pencil the figure to be cut on the shell. The pencil-mark is followed by a sharp point, which scratches the desired outline, and this again by delicate tools of steel wire, flattened at the end and hardened, and by files and gravers for the removal of the superfluous portion of the white enamel.

The cameo cutter selects from the shells which possess the three layers: (1) those which have the layers strongly adherent to each other; (2) those in which the middle layer is thick; (3) those in which there is a good distinction of color between the layers; and (4) those in which the inner layer is of the color suited for his purpose.

The central layer forms the body of the relief, the inner layer being the ground, and the outer the third or superficial color, which is sometimes used to give a varied appearance to the surface of the figure.

See, also, article in "*Scientific American*," xlii. 69.

A fictitious cameo is made from lava or from steatite. In the case of the latter, after the cutting is finished the cameos are inclosed in an air-tight crucible, heated at a red for several hours, and allowed to cool slowly. then flint-hard. Color is given by immersion f hours in dyes, — saffron, gumboyl, campeche, blood, etc.

Cam'e-o Glass. Glass cut in imit cameos.

Cups and bowls for this purpose are formed of body or layer of dark blue glass, with an outer layer of even thickness of opaque white glass, in design is wrought by carving or grinding down to colored sub-layer, or foundation. This outer whi about ⅛″ thick, and is chiseled in high relief, in manner to that by which the Portland Vase in Museum was formed, and also the Pompeiian Vi museum at Naples. It is a difficult task to get glas that have exactly the same degree of shrinkage o The two differently colored pastes must shrink ex or cracking would result, especially when the out chiseled away in forming the design. — *Blake.*

Cam'e-o In'crus-ta'tion. (*Glass.*) ure, say a small porcelain bust, is introd a small cylinder of glass, which is then cl it.

Cam'e-o Press. A small screw-pres ing a convex roundness to photograph The bed and platen are in cameo and in spectively, and the object is pressed betw

Cam'e-ra. A chamber used in obta tures. See p. 433, "*Mech. Dict.*"

Enlarging, *Edwards* . * "*Scientific American* S
Field . . . . * "*Scientific American* S
Lucida, *Hofmann*, Fr. . * "*Scientific American*,"
* "*Scientific American* S
* "*Scientific Am. Sup.*,"
Multiplying . . . . * "*Scientific American* S
Obscura, *Kellett* . . . * "*Scientific American* S
Obscura . . . . . . * "*Scientific American* S
Obscura, sketching . . * "*Manufact. and Build*
Photographic, *Basham* * "*Scientific American*,"
Portable . . . . . . * "*Scientific American* S

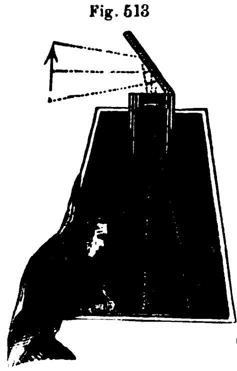
Cam'e-ra Lu'ci-da. A glass prism to the eye-piece of a microscope. Described and shown at Fig. 1043, p. 434, "*Mech. Dict.*" The instrument shown at Fig. 512 has a lens to magnify the pencil point; a very important adjunct in making drawings of microscopic objects.

Fig. 5

Beck's Cam

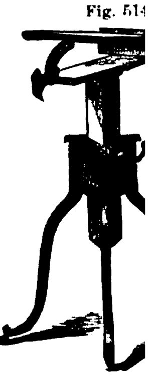
Cam'e-ra Ob-scu'ra. The camer shown at Fig. 1044, p. 434, "*Mech. Dict.* a long time but little more than a toy. its development into the photographic ca

Fig. 513



The Camera Obscura.

Fig. 51



Bowditch's Ca

removes it far from this criticism, yet i lately been adapted in a worthy way to use: the throwing of an image on a piec to facilitate making sketches, drawings, The camera obscura, shown in Fig. 513, has a reflector and a lens, by which the magnified image is thrown upon the paper in the camera, the only light entering at that point. A curtain at the back of the draftsman occludes other light. The lens is in a sliding tube, which may be raised or lowered to adjust the focus. The height of the box must not be less than the focal length of the lens. The mirror is hinged to adjust its direction.

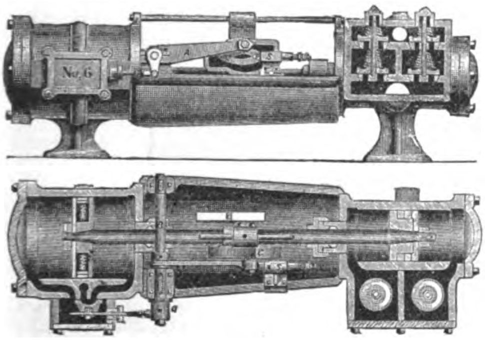
Cam'e-ra Stand. A table to support the photographic camera, having adjustments for height and inclination.

Cam Loom. One in which the harness is operated by cams instead of by pattern chain, jacquard, or other device.

Cam Press. One in which the action of the punch or shear is due to the rotation of a cam: as distinct from a screw, lever, or pendulum press.

Cam Pump. A steam pump, the motions of which are obtained by the media of cams; as distinct from other mechanical means.

Fig. 515.



Dayton Cam Pump.

In the case illustrated in Fig. 515, the steam valve is a plain slide valve, worked by means of a cam bolted on the piston-rod, and moving with it, and by the shape of the cam the stroke is slowed down at each end, giving ample time for the water cylinder to fill, and water valves to close before the return stroke. This insures a full stream every stroke, and prevents the pump piston from striking against the water when the cylinder is but partly filled, it being impossible for the steam valve to be thrown into such a position as to shut off steam and stop the pump.

Cam'py-lom'e-ter. An invention of M. Gaumet. A pocket instrument capable of giving at one reading the metric length of any line, straight or curved, on a map or plan; and the natural length corresponding to the graphic length on maps, with a scale of one 80,000th or one 100,000th, or multiples or submultiples of these scales.

"*Manufacturer and Builder*," xii. 157.

Ca-nal'. See following notices:—

Bude in Cornwall	"*Sc. Amer.*," xxxv. 340.
Darien, *d'Aoust*	"*Technologiste*," xl. 389.
Du Midi. Fr.	"*Sc. Amer.*," xxxv. 55.
Florida ship	"*Sc. Amer.*," xxxix. 296.
Inter-oceanic	"*Sc. Am. Sup.*," 2752.
Obi & Jenissei, *Sidoroff* . . .	"*Technologiste*," xl. 291.
Suez, history of	"*Sc. Amer. Sup.*," 93.
U. S. Consul Farman's Rept. on	"*Sc. Amer.*," xl. 240.
Bridge, Blackburn, Engl. . . .	* "*Sc. Am. Sup.*," 1729.
St. Petersburg, *Momma* . . .	"*Technologiste*," xli. 606.
Tug, steam, *St. Clare Byrne* . .	* "*Sc. Amer. Sup.*," 44.
Works, Soonkêsala Canal, India .	* "*Van Nostrand's Mag.*," xv. 885, 481.
Boat elevator, *Clark & Duer*, Eng.	* "*Sc. Amer.*," xlii. 402.
Boat propulsion, *Legouge* . . .	* "*Sc. Amer.*," xxxiv. 278.
Boat propeller (jet), *Bugbee* . .	* "*Sc. Amer. Sup.*," 89.
Boat propulsion, *Hetzler* . . .	* "*Manuf. & B.*," xii. 128.
Lift, hydraulic, Br.	"*Engineering*," xxi. 227.
Lock working, *Marq. Caligny*, Fr.	* "*Watson's Vienna Expos. Rept.*," iii. 64.
Lock, Aubois, Loire, *Watson* . .	"*Van Nostrand's Mag.*," xix. 85.
Locks, Barrage of the Nile . .	* "*Engineering*," xxi. 41.

Hydraulic canal lift at Anderton on the river Weaver: Paper read before the "Institute of Civil Engineers" (London), by Mr. Duer. Reproduced in "*Sc. Am. Sup.*," 295.

Canal-boat lift by caisson and inclined plane, from Potomac River to Chesapeake and Ohio Canal, by William R. Hutton. "*Proceedings of Am. Soc. of Civil Engineers.*"

The invention of M. Girard for avoiding a part of the waste of water in the descent of a boat from a superior to a lower level, is described in *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," Paris, 1877, cap. "*Écluse.*"

Can'al-ic'u-lar In'stru-ments. (*Surgical.*) For operating upon the lachrymal duct.

Jaeger bistoury caché.
Beaumont's concealed canalicular knife.
Greenslade's concealed canalicular knife.
Agnew's canalicular knife.
Petit's Fistula lachrymalis knife.
Lachrymal canula, etc.

Page 10, Part II., *Tiemann's* "*Armamentarium Chirurgicum.*" See, also, CANALICULAR SCISSORS, *a* Fig. 4672, p. 2054, "*Mech. Dict.*"

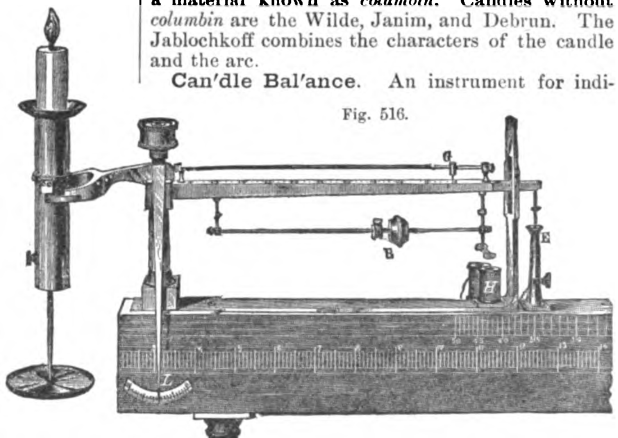
Can Bod'y Form'er. (*Sheet Metal Working.*) A machine for forming the bodies of cans. The locks for the seams being first formed on the blanks, and they placed in position, a single movement of the lever presses the former into the mold and two hinged side-pieces spring forward and clasp the ends of the blank around the back of the former.

Can'dle. (*Electricity.*) An arrangement of carbons in an electric light. The carbons are placed parallel, and as the waste of the two must be equal, they are fed by alternating currents. See ELECTRIC CANDLE.

The Jablochkoff electric light is the most noted of the class; in this the carbons are separated by a material known as *columbin*. Candles without *columbin* are the Wilde, Janim, and Debrun. The Jablochkoff combines the characters of the candle and the arc.

Can'dle Bal'ance. An instrument for indicating when a candle has consumed a set amount of the material of which it is composed.

Fig. 516.



Goodwin's Candle Balance.

The instrument is shown in Fig. 516, *G* being at zero, the weight, *B*, is made to counterpoise the candle. The weight, *G*, being then shifted to the mark indicating the amount to be consumed, the candle is lighted. When the amount is consumed, the balance-lever falls, an electric circuit is completed at *E*, and the armature is drawn to the magnet *H*.

"*American Gas-light Journal*" . . * July 3, 1876, p. 6.

Can'dle Lamp. A lamp, the stem of which holds a candle forced upward by a coiled spring. Used in railway cars and traveling carriages.

Fig. 517.

Candle Lamp.

Can'dle-mold'ing Ma-chine'. A candle-molding machine, made by Wunchmann of Leipzig, was shown at the Centennial Exhibition, 1876.

It is constructed of iron, and designed for molding either paraffine, stearine, or tallow candles.

The molds, 100 in number, stand in two double rows in a close cast-iron box, where they are made steady in the upper and lower walls, but so that they can be taken out, one by one, with ease.

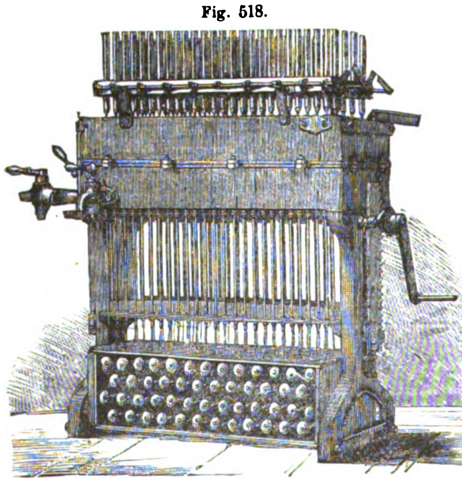
Each of the molds is a tubular structure open at both sides. In it moves a piston that constitutes the mold for the apex of the candle, and is itself attached to a slender iron tube. At the lowest stage the piston shuts the somewhat conically shaped mold close and tight.

All the pistons are secured to a frame by means of long slender tubes, and are raised and lowered simultaneously, by a crank, pinion, and notched bar.

In the lower part of the machine is the wick-box, which can be closed. It contains a hundred wick spools, the wicks passing through the box-cover into a piston tube traversing the piston itself, but by means of a simple contrivance shutting it up so closely that the liquid mass cannot permeate.

Above the two troughs that inclose the double row of molds at the top, is an apparatus called the *clasper*, that serves the purpose of holding the candles on their being raised from the molds. It can be turned on hinges back over

Fig. 518.



Wunchmann's Candle-molding Machine.

to the side of the machine till it rests against tw
It is opened and shut by means of small levers and
There is a simple attachment to centralize and hol
wicks immediately over the molds.

The procedure in operating is as follows: Wher
have been introduced, they are in the first inst
fast to a little piece of wood laid crosswise over t
The centralizing apparatus is then applied, and st
mitted into the compartment containing the mo
are thus quickly heated by its playing around t
liquid is then admitted into both troughs, and the
filled.

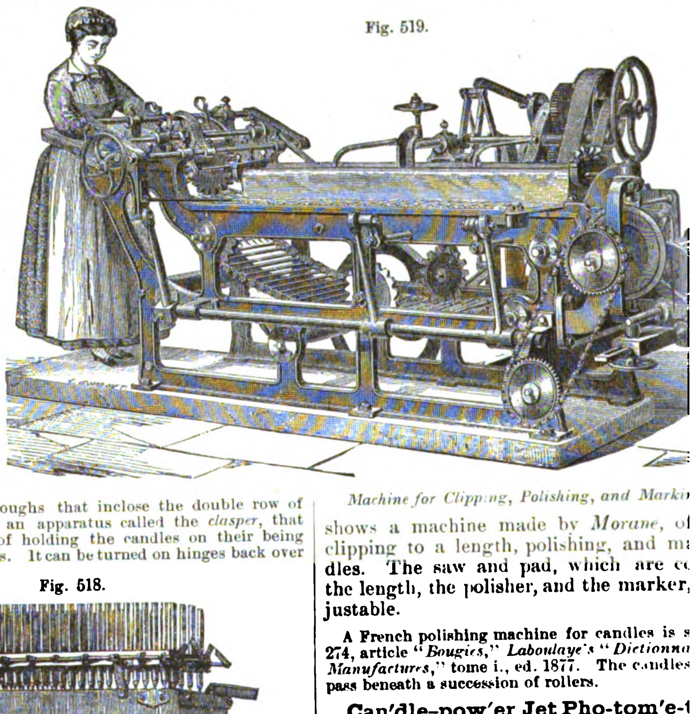
The centralizing apparatus is then withdrawn
water introduced into the compartment.

As soon as the liquid surface over the molds
sufficiently firm, it is cut off by a shovel adap
purpose. When the candles have cooled they ar
of the molds by turning the crank, and draw the
the spools along with them. The candles pass t
open claspers, and, on reaching the highest stag
made fast. The crank is then turned backward
tons shut up the lower ends of the molds. In d
wicks are cut and the candles removed.

The cut, Fig. 518, shows the candles in raised
held by the claspers.

Can'dle Pol'ish-ing Ma-chine'.

Fig. 519.



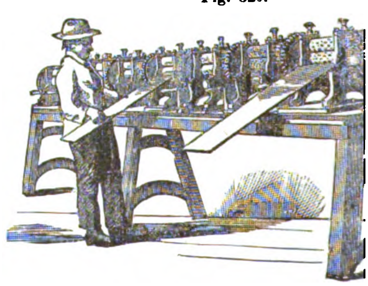
Machine for Clipping, Polishing, and Marki

shows a machine made by *Morane*, of
clipping to a length, polishing, and ma
dles. The saw and pad, which are c
the length, the polisher, and the marker,
justable.

A French polishing machine for candles is s
274, article "*Bougies*," *Laboulaye's* "*Dictionna
Manufactures*," tome i., ed. 1877. The candles
pass beneath a succession of rollers.

Can'dle-pow'er Jet Pho-tom'e-t strument for measuring the light of a b
jet.

Fig. 520.



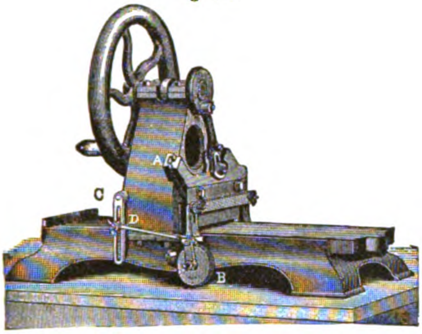
English Candy-rolling Machine.

Goodwin's, "*American Gaslight Journal*," * July 3, 1876, p. 6.
See JET PHOTOMETER.

Can'dy-roll'ing Ma-chine'. A machine with various patterns of rollers for stamping candy in sheets. The pan is $8\frac{1}{4}''$ wide, and each roller is provided with lever and clutch wheel, so that any one can be thrown in or out of gear instantly, without affecting the work of the others.

Can'dy Sli'cer. A guillotine machine for cutting candy into strips or blocks.

Fig. 521.



Candy-slicer.

The cutting-knife is raised and lowered by means of a crank-wheel, and a shearing motion is imparted by the inclined guides *A*. The carrying bed has a rack, and is moved forward by the action of a pinion-wheel on a shaft which carries at its outer end the ratchet-wheel, *B*, operated by a pawl attached to an arm, *D*. The outer end of this fits in a slot in a vibrating arm, *C*, up and down which it is adjusted to regulate the width of the candy slices.

Cane Cul'ti-va'tor. An implement made for the Cuba and West India market, with three broad, round-nosed flat shares, and an expansible frame.

Cane Cut'ter. See CANE MILL.

Cane Knife. An implement for cutting sugar-cane. It varies in different countries and provinces, from the shape of a butcher's cleaver to that of a broad-sword. See MACHETE.

Fig. 522.

Cane Knives. Louisiana Pattern.

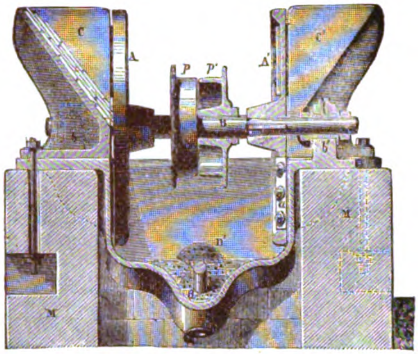
Cane Mill. The French process of *Philippe* is a departure from the ordinary, consisting in cutting the cane into thin slices with a machine, submitting them to levigation in water in a trunk in which a lifting screw rotates, and pressing them in a rotary eccentric press. See also Mignon & Rourt, "*Technologiste*," xxxviii. 81.

The Figs. 523, 524, 525 show the three stages of the operation, the two latter being, in fact, consecutive, but detached for convenience of illustration in limited space.

The cane cutter of Philippe is shown in Fig. 523, and consists of two root-cutters, composed of cast-iron disks, *A A'*, keyed upon the same axis, *B*, furnished with a fixed pulley, *p*, which communicates the movement, and a loose pulley, *p'*, which receives the belt when the motion of the cutters is to be stopped.

The axis *B*, turns in brass boxes in the pillow-blocks *b b'*, cast with a cistern, *D'*, which receives the sliced cane from the cutting-mill, and which serves at the same time by its

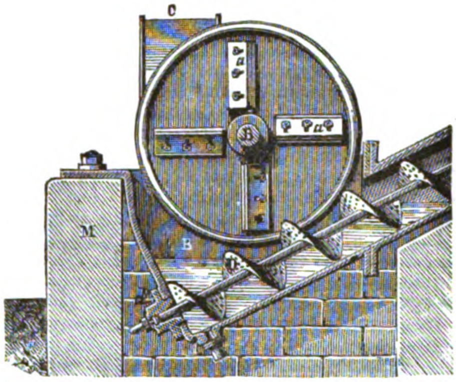
Fig. 523.



Cane-cutting Mill.

large extent to afford a seat for the elevating screw. The whole is bolted to the stone columns in masonry *M*, in

Fig. 524.



Cane-cutting Levigator.

common with the two hoppers *C C'*, into which the cane is thrown by armfuls.

Four slicing-knives *a*, are fixed on the face of each disk, inclined in their seats like the bits of planes.

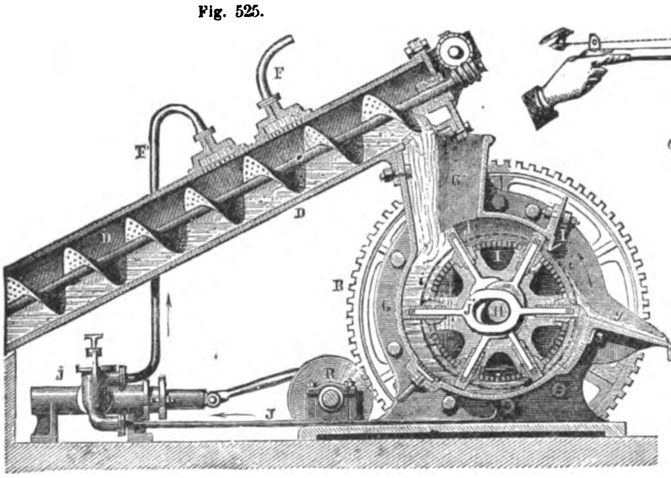
The slices of cane obtained by the action of the cutters, and arriving at the bottom of the cistern, are subjected to levigation. The bottom of the cistern corresponds in shape with the Archimedean screw *D*, the lower end of which revolves in a step, *d*, with an adjusting screw, while the upper end rotates in a bronze collar in the cap which closes the upper end of the inclined cylinder of translation. The endless screw receives rotation from a helicoidal gear whose axis carries the pulley *E*. On the top of the inclined trunk are two boxes which cover the orifices by which the liquid arriving by the pipes *F F* is distributed in the interior over the blades of the screw.

The endless converger is, so to speak, the instrument of levigation of the slices which readily traverse the trunk inclosing the screw, imbibing the liquid and undergoing osmosis more or less complete. When the slices arrive at the summit, they fall into the hopper *G* of the rotary press, which consists of a cylindrical shell *G*, cast with a bed-plate, and with ends in which are bearings of the arbor, *H*, on which is keyed the hollow drum *I*, which is eccentric with the shell *G*.

The pressing is done by six palettes of bronze, *j*, carried by the drum, which catch the mass of slices from the hopper and carry them into a more and more confined space between the drum and the concave shell, finally arriving at the discharge spout *g*, placed at that part of the envelope where the slices escape from the point of greatest pressure.

The drum *I* is cast iron, and its periphery is pierced with a multitude of small openings leading to parallel circular channels covered with perforated steel plates, so that the juice expressed from the slices escapes into the interior of the drum from whence it is discharged laterally at an opening in the central vertical line. Thence is taken by a pipe, *J*, and pump, *j*, and elevated, to be poured again by the pipe *F'* into the trunk where the elevating screw operates.

Fig. 525.



Eccentric Cane Press.

The six bronze palettes are cast hollow, and are connected in pairs diametrically across the wheel. Each pair has a yoke in the mid-length, and they slip radially, the ends of the palettes keeping their places against the interior periphery of the concave shell.

The drum *I* turns slowly, the power being applied by a pinion on the axis of the wheel *R* to the spur-wheel *B*.

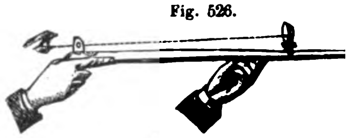
The concentration of the juice is performed by means of a hot-air apparatus, also the invention of M. Philippe, and shown in Fig. 66, article " *Sucre*," in *Laboulaye's* " *Dictionnaire des Arts et Sciences*," tome iii., ed. 1877, to which the author is indebted for the basis of the foregoing account.

The process bears some relation to the Roberts diffusion process, which also employs water to dissolve the sugar of the cane, a substitute for the ordinary cane mill.

Cane-juice bleacher, *Lescale* . * "*Sc. Amer.*," xxxiv. 86.
See also DIFFUSION PROCESS, page 702, "*Mech. Dict.*," *et infra*.

Cane Tel'es-cope. An instrument with seats for the eye and object glasses upon a walking stick. The object-glass is adjustable for focus and may serve as a microscope on occasion. See Fig. 526.

Fig. 526.



Cane Telescope.

Can Fill'er. A
for filling cans with
In Bucklin's can-
m a t o e s, — for ins
which have been p
peeled, are separated
juice with a sieve,
go forward into th
and roll thence to tl
ally tapered end of
der. The can is
the rests and is pres
which brings the ca
directly opposite the
The treadle is now
down and the plun
the tomatoes into the can.

Canning fruits, etc., Cutting Co., Cal. "*Sc. Am.*.
Can opener, *Wilson* . . . . "*Sc. Am.*,

Can La'bel-ing Ma-chine'. In Big
beling machine, the can is placed at the h
incline; rolling down which it passes ove
roller rotating in a reservoir of paste, a
over the label, taking it up as the pasted
the can adheres to it, rolling itself in it.

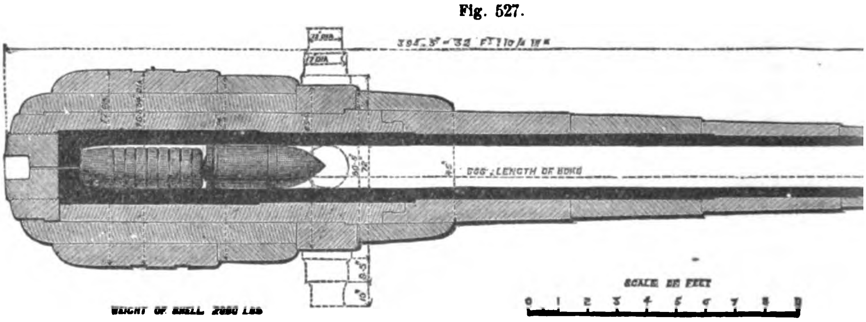
In passing down, the can strikes a leve
its connection with a second reservoir
end of the next label, at the same time
the feed screw and raising the labels the
of one.

Can'nel. 1. (*Weaving.*) A style of
making a corded or rep tissue.

2. A variety of coal: *candle-coal*, hi
minous.

Can'non. The cannon shown in Fi

Fig. 527.



Armstrong 100-*ton Gun.*

one of eight made by Sir W. G. Armstrong & Co., of Elswick ordnance works, Newcastle-upon-Tyne, for the Italian government, to be placed on board the turret-ships "Duilio" and "Dandolo." One of these ships was built at Spezzia and the other at Castellamare, and each is of 7,000 tons burden. The gun is made on the well-known Armstrong principle, having 27 grooves and as many bands of about equal width. The rifling is an increasing spiral on the parabolic development, winding up with a twist of 1 in 45 calibers. The depth of the grooves is $\frac{1}{8}''$ throughout. See p. 158, "*Mech. Dict.*"

The weight of the gun is 227,360 pounds.
Extreme length, 32′ 10½″.

Length of bore, 30′ 6″.
Diameter of bore, 17″.
Outside diameter of gun: muzzle, 29″.
Outside diameter at breech, 77″.
The barrel is in two pieces made into one in
up. There are three layers of coils over the t
the gun.

The weight of the projectile is 2,000 pounds.
Work developed at the muzzle, 39,000 foot pc
Velocity 1,400′ per second.
The loading gear is hydraulic.

Albini . . . . * "*Sc. American*
America's contribution to
modern artillery . . . "*Sc. American*,"
Armstrong . . . . . . "*Sc. American*
100-ton, Br. . . . . . * "*Engineer*," xlii
"*Iron Age*," xvii

Armstrong . . . . . * "*Engineer*," xlviii. 255.
Laboulaye's "*Dict.*," iv., article "*Boulets*."
"*Engineer*," xliii. 355.
"*Engineer*," xlix. 187.
* "*Engineer*," xliii. 355.
Woolwich . . . . . * "*Engineer*," l. 225.
"*Sc. Am. Sup.*," * 759; * 614; * 1814: 4073.
81-ton . . . . . . "*Iron Age*," xvii., Jan. 6, 11.
"*Engineer*," xlii. 183.
"*Engineering*," xxi. 536.
"*Sc. Am. Sup.*," lv. 760.
Trials, 80-ton . . . . * "*Sc. Am. Sup.*," 1046.
* "*Engineer*," xlii. 235.
"*Iron Age*," xix., May 24, 16.
Trials . . . . * "*Sc. Am. Sup.*," 1237.
Tests . . . . . . * "*Engineer*," xliii. 73, 91, 317.
Woolwich . . . . . * "*Engineer*," xlix. 187.
9.2″-gun. Woolwich . * "*Engineer*," xlix. 453.
40-ton, *Armstrong* . . "*Van Nostrand's Mag.*," xvi. 478.
38-ton carriage, Br. . . * "*Engineer*," xlii. 411.
38-ton, Engl. . . . . "*Sc. American*," xxxv. 324.
"*Sc. Am. Sup.*," 501.
12-pounder, field, Br. . * "*Engineer*," xlii. 251.
Mountain, *Armstrong* . * "*Sc. Am. Sup.*," 254.
13-dr field-piece, Br. . * "*Sc. Am. Sup.*," 4087.
"Duilio," bursting of . "*Sc. American*," xlii. 272.
Blakeley . . . . . . * "*Engineer*," l.
Elephant . . . . * "*Sc. Am. Sup.*," 2534.
Elswick, 39-ton br.-loader * "*Engineer*," xliii. 200.
38-ton. Target, etc. . * "*Engineer*," xliii. 200.
Essen, making at . . . . "*Iron Age*," xxiv., Aug. 21, 3.
Eastman . . . . * Laboulaye's "*Dictionnaire*," etc., iv., art. "*Boulets*."
Gautier, Cast Steel . . . "*Sc. Am. Sup.*," 1543.
Heavy . . . . "*Sc. Am. Sup.*," 2698, 2735.
Hotchkiss revolver . . . * "*Sc. Am. Sup.*," 735.
Illuminating Shell . . . * "*Sc. American*," xxxvii. 79.
Italian, 100-ton . . . . "*Iron Age*," xxii., July 4, 18.
Working, SS. "Italia" * "*Engineer*," xlvii. 153.
Albini, Ital. . . . . * "*Engineer*," xlvii. 156.
Tests 100-ton, Spezzia . * "*Engineer*," xlii. 445, 448.
And targets . . . . * "*Engineering*," xxii. 426, 431.
* "*Sc. Am. Sup.*," 982.
* "*Engineer*," xliii. 1.
Johnson, Br. loading attach. * "*Sc. American*," xl. 230.
Breech-loading field gun * "*Sc. Am. Sup.*," 1968.
* "*Engineering*," xxiv. 443.
Krupp and Woolwich . . "*Van Nostrand's Mag.*," xxii. 172.
Krupp, Works . . . . . "*Sc. Am. Sup.*," 633.
Field . . . . * "*Engineer*," xlviii. 121.
Making . . . . . . "*Iron Age*," xx., Nov. 29, p. 5.
Construction . . . . "*Sc. American*," xl. 250.
126-ton . . . . . . "*Iron Age*," xvii., Apr. 6, p. 7.
72-ton . . . . . . "*Van Nostr. Mag.*," xx. 522.
"*Iron Age*," xxiii., M'ch 27, 7.
71-ton } Meppen . . . * "*Engineer*," xlviii. 119, 128.
52-ton } and others (20 figs.)
16″ gun . . . . . . "*Sc. Am. Sup.*," 2580.
14″ gun, mounted . . * "*Engineering*," xxiii. 44.
14.5-ton . . . . . . * "*Engineer*," l.
Heavy . . . . . . * "*Sc. American Sup.*," 2656.
Masked . . . . . . * "*Sc. American Sup.*," 931.
Protected non-recoil . * "*Engineer*," xliv. 295.
Br. . . . . * "*Sc. American*," xxxvii. 371.
Mode of working heavy * "*Engineer*," xlvii. 24.
Line throwing, *Eggers & Pierre* . . . . . * "*Sc. American*," xl. 150.
Maquay breastwork . . . * "*Sc. American*," xxxvii. 200.
Moncrieff carriage . . . . "*Sc. American Sup.*," 76.
Mott, submarine . . . . "*Sc. American Sup.*," 2015.
Mule-back. Jointed for . . "*Sc. American*," xxxix. 40.
Palliser, Br. Breech-loader, . * "*Engineer*," l. 361.
* "*Engineer*," xlix. 169.
Powerful . . . . "*Sc. American*," xli. 265.
Prussian field-gun . . . . Laboulaye's "*Dict.*," etc., i., article "*Bouche à feu*."
Russian, heavy . . . . . * "*Engineering*," xxiii. 179.
Carriages, cyclads . . * "*Engineer*," xivii. 336.
Foundry . . . . . "*Iron Age*," xix., May 24, 19.
Span. navy breech-loading . * "*Engineer*," l. 79.
Steam gear for, Br. . . . "*Van Nostrand's Magazine*," xviii. 286.
"Thunderer," Br. Exploded * "*Engineer*," xlvii. 244.
* "*Engineer*," xlviii. 45.
Sister of expl. gun, Br. * "*Engineer*," xlix. 97, 117, 153, 261.
* "*Sc. American*," xli. 130.
Uchatius, Aust. Bronze steel * "*Sc. American*," xxxvii. 403.
"*Sc. American Sup.*," 1299.
* "*Engineer*," xliv. 255.
Vavasseur, 13.5-ton . . * "*Engineer*," l.

Whitworth . . . . . . Laboulaye's "*Dictionnaire*," etc., iv., article "*Boulets*."
Woodbridge, Apparatus for measuring pressure . . * "*Engineer*," xlvii. 134, 170.

Dean's field-piece made by a peculiar process for condensing and hardening the metal of the bore; "*Ordnance Report*," * 1877, Appendix S.
See also FIELD-PIECE.
Thompson's 12″ breech-loading rifle gun, "*Ordnance Report*," 1876, Plate I., p. 96.
Sutcliffe 9″ breech-loading rifle, *Ibid.*, 1876, p. 108.
10″ *Rodman* converted to 9″ rifle *Ibid.*, 1876, p. 134.
10″ *Rodman* converted to 8″ rifle. *Ibid.*, App. K, p. 142.
Woodbridge 10″ rifle, breech-loader. *Ibid.*, 1876, Appendix N, Plates I. to XI.
Illustrated Papers on construction of rifled cannon.
11″ m. l rifle, converted from 15″ Rodman. "*Report of Chief of Ordnance*," 1879, * p. 61.
3″ b. l. rifle. *Ibid.*, 1879, * p. 67.
3.16″ m. l. rifle. *Ibid.*, 1879, * p. 71.
3.17″ m. l. rifle. *Ibid.*, 1879, * p. 73.
4.5″ b. l. rifle. *Ibid.*, 1879, * p. 77.
"*Report on the Manufacture of Life Saving Guns.*" *Ibid.*, 1879, * p. 270, with 7 plates.
Frazer System (British), Cols. Barnard and Wright's report, U. S. Engineer Dept., 1871, pp. 84–90.
Krupp, system compared. *Ibid.*, p. 90 *et seq.* Plates XIX.–XXI., and p. 102.
Krupp, breech loading field-piece. *Ibid.*, Plate XXXI., p. 104.
Krupp, breech loading heavy guns. *Ibid.*, Plates XXII.–XXV.
Muzzle-pointing-gun carriages. *Ibid.*, page 182 *et seq.*
Frazer, 35-ton gun. *Ibid.*, * Plate XXXVI.
Moncrieff carriages. *Ibid.*, * Plate XXXVII., p. 200. App. XI.
Moncrieff, hydro-pneumatic carriage. *Ibid*, * p. 215. App. XII.
Cf. Butler's "*Projectiles and Rifled Cannon.*"
Benton's "*Ordnance and Gunnery.*"
Holley's "*Ordnance and Armor.*"

Can'non Car. (*Railway.*) *a.* A car especially constructed for transporting heavy pieces.

b. A car with carriage for mounting a gun, and usually provided with a screen for the gunners.

Can'non Re-vol'ver. See MACHINE GUN; GATLING GUN; GUNWALE GUN.

Ca-noe'. The canoe "Maria Theresa," designed by Rev. Baden Powell of England, built by E. Waters & Sons, of Troy, N. Y., and rowed by N. H. Bishop of Lake George, N. Y., from the Gulf of St. Lawrence to Gulf of Mexico, has the following dimensions: —

Length, 14′.	Weight of Canoeist, 130 lbs.
Beam, 18″.	Weight of outfit, 90 lbs.
Depth amidship, 9″.	Total weight, 278 lbs.
Weight, 58 lbs.	

Cruising . . . . * "*Sc. Am. Sup.*," 2607.
Fijeau . . . . * "*Sc. Am Sup.*," 1778.
Folding, *Berthon*, Br. . . . . * "*Engineer*," xlvii. 333.
Folding, *Berthon* . . . . . . * "*Sc. Am. Sup.*," 2873.
Life boat, "Evangelist," Australia. * "*Sc. Am. Sup.*," 1778.
Racine . . . . * "*Sc. Am.*," xlii. 231.
Steam, "Nina" . . . . . . * "*Sc. Am.*," xl. 142.
See, also, BOAT.

Cant. (*Saw-milling.*) A log slabbed on two sides and ready to turn down to be sawed the other way.

Cant'ing Ta'ble. In a band sawing machine a table capable of inclination so as to present the stuff to the saw in such position as to saw beveling. Such a table is shown in Fig. 553, p. 226, "*Mech. Dict.*"

Cant Splice. (*Nautical.*) A loop splice; also known as *cut* splice. See *k n*, Fig. 5435, p. 2279, "*Mech. Dict.*"

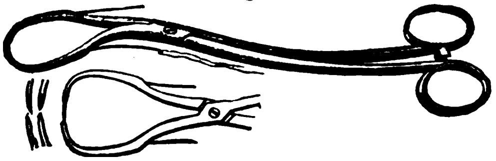
Ca-nu'la. (*Surgical.*) A tube. Its uses are various, and construction adapted to special purpose.

The references are to *Tiemann's* "*Armamentarium Chirurgicum.*"
The epistaxis canula of *Belocq*, Fig. 246, Part II.
Gooche's canula for ligating hemorrhoidal tumors; a

double canula for conducting the ligature to a deep-seated part, the loop projecting at the end. Fig. 592, Part III.
Lachrymal canula, Fig. 57, Part II.
Nasal polypus canula, double like the hemorrhoidal just cited, Fig. 245, Part II.
Double canula and obturator, Fig. 389, Part II.
Trachea canula for preserving an opening in a divided trachea, Fig. 381, *b*, Part II.

Can'u-la-ted Nee'dle. (*Surgical.*) A hol-

Fig. 528.



Currie's Canulated Needle.

low needle which affords a passage for the ligating wire or thread throughout its length. Such is *Tiemann's* hollow needle for wire sutures, in which the silver wire passes through the length of the handle and issues near the needle-point.

Currie's double canulated needle is a means of introducing a wire or silk. The views show it closed and open. Being closed upon the opposite edges of a wound, for instance, the wire is passed through the canal, issuing at the opposite member of the instrument. The upper figure shows a mode of drawing through a silk by means of a fine flexible hook.

Caout'chouc. An elastic gum obtained from the siphonia, ficus, urceola, etc., of South America and tropical Asia.

See the following references: —

Cf. Articles, manufacture of, *Longden*.
* "*Scientific American*," xxxvi. 150.
Factory and machinery * "*Scientific American*," xliii. 15.
* "*Eng. & Mining Journal*," xi. 1.
Gathering and manufacture.
Bolas . . . . . . * "*Scientific American Sup.*," 3958.
* "*Scientific American Sup.*," 3991.
* "*Scientific American Sup.*," 4006.
Gathering and preparation.
"*Scientific American Sup.*," 2288.
Uses and manufacture.
Pavoux . . . . . * "*Van Nostrand's Mag.*," xiv. 369.
Manufacture . . . . * "*Scientific American*," xxxv. 262.
* "*Scientific American*," xxxix. 105.

Caout'chouc Ar'ti-fi'cial. To a thick solution of glue add tungstate of soda and hydrochloric acid. A compound of tungstic acid and glue is precipitated which, on cooling, may be drawn into sheets.

Caout'chouc Ce-ment'. Pulverize shellac; soften in 10 times the quantity of ammonia. This will become liquid in time, and will dissolve the surface of caoutchouc, rendering it easy to unite it with glass.

Caout'chouc Sol'vents.

Of the solvents of caoutchouc, its distillate caoutchoucine may be placed at the head of the list: the others best known are pure chloroform, carbon disulphide, rosin, oil, and coal naphthas, rectified oils of turpentine, gutta-percha, tar, lavender, sassafras, ocoten, rosemary, amber, ambereupion, terebene, benzine — C_{12} H_6 — hydrochlorate of terebene, benzole — C_{14} H_6. Anhydrous oil of turpentine dissolves 49 per cent. of caoutchouc. A mixture of 6 to 8 per cent. of absolute alcohol and 100 of carbon disulphide is an excellent solvent. Sulphuric ether, which alone is but a poor solvent, dissolves rather more, if about 5 per cent. of anhydrous alcohol be added thereto. Hot alcohol dissolves out about 4.712 per cent. of a soft resin. It is sparingly soluble in hot fused oil — hydrate of amyl C_{10} H_{11} HO; readily at a gentle heat in melted hog's lard, or in very hot whale oil. After swelling up in oil of turpentine or in naphtha it is soluble in hot linseed oil.

Cap. (*Add.*) 14. (*Fire-arm.*) The metallic covering placed on the end of a pistol-shaped handle.

15. A short terminal section of a pipe, with a removable stopper called a *plug*.

16. (*Mining.*) *a.* A vein is "*in the cap*" it is much contracted.

b. A flat piece of wood placed between the the punch and the roof of the mine.

17. (*Manége.*) A small crescent-shaped pi leather placed on top of a collar. Not the *pad* is sometimes of metal and goes below it on th of the horse.

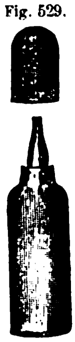
Ca'pel. (*Mining.*) A rock composed of schorl and hornblende, occurring in connecti tin and less frequently with copper ores.

Cap'il-la-ry Bot'tle. A dropping bott taining a liquid used in mounting microsco jects.

Capillary electrometer. . . . * "*Engineering*,"
Capillarity Instrument, *Romilly* * "*Sc. Amer.*," xx

Cap'per. A tool used in placing the priming cap on its seat in the rear end of the metallic shell.

Fig. 529.



Capillary Bottle.

Fi

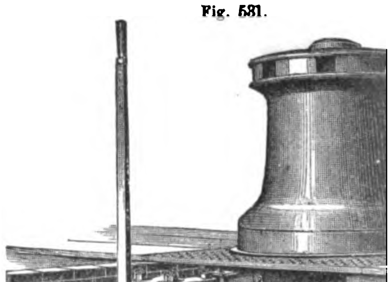
C

Cap Screw. A machine screw with a cubical head, used for screwing on the cylinder head.

Cap Shore. (*Nautical.*) A supporting spar between the cap and the trestle-tree.

Cap'stan. The Brotherhood engine, which has three cylinders, and pistons at 120° working to a common three-throw cran pecially adapted to direct circular moveme shown in Fig. 531. It is more direct and

Fig. 531.



Dock Capstan with Brotherhood Engi

pensive than the multiple geared hyd stans. In the size shown, the capstan h ty for a three-ton pull upon the **hawser,** head being 26″ diameter. The **engine** i The capstan has sockets for **hand-spikes,** with pawls for hand work. The lubrication is all from above.

Portable Steam Capstan . * "*Scientific American*," xxxvi. 4.

Cap'stan Knot. (*Nautical.*) A form of knot, shown at 11, Fig. 2777, p. 1240, "*Mech. Dict.*"

Cap'sule. A cover, cap, or sac. The word has many uses; all allied. See page 457, "*Mech. Dict.*"

Filling of Wafer Capsules . .	* "*Sc. Amer. Sup.*," 1484.
Capsuling medicines, *Limousin*	* "*Sc. American*," xxxiv. 259.

Car. A wheeled vehicle. Specially: a railway carriage.

Bullet proof	"*R. R. Gazette*," xxi. 181.
Coal, Pennsylvania Railway .	* "*R. R. Gazette*," viii. 149.
Rhenish Railway, Ger. . .	* "*Engineering*," xxx. 430.
4-wheeled, N. Y. Central .	* "*R. R. Gazette*," viii. 391.
Composite Bogie, *Festiniog*, Br.	* "*Engineer*," xlix. 338.
Director's, Penn. Railway . .	* "*Engineering*," xxiv. 460.
Dump, *Davis*	* "*R. R. Gaz.*," xxii. 489.
Elevated, Metropolitan, N. Y.	* "*Sc. Amer.*," xxxix. 310.
Freight, on construction of, Br.	"*Van Nostrand's Mag.*," xvi. 135.
W. Railway of France . .	* "*Engineering*," xxix. 30.
Austrian State Railway . .	* "*Paris Exp.*," 1878, iv. 448.
Gravel, Penn. Railway . . .	* "*Engineering*," xxiv. 469.
Iron, *Kellogg & Scarer* . . .	* "*R. R. Gaz.*," xxiii. 43.
Painting, paper by *Robertson* .	"*Sc. Amer.*," xxxix. 357.
Passenger, E. Railway of Fr. .	* "*Engineering*," xxvi. 69.
1st class, E. Railway of Fr. .	* "*Engineer*," xlvi. 278.
3d class, E. Railway of Fr. .	* "*Engineer*," xlvi. 314.
1st class, Austrian State Ry.	* "*Paris Exp.*," 1878, iv. 447.
2d class, Austrian State Ry.	* "*Paris Exp.*," 1878, iv. 448
3d class, Austrian State Ry.	* "*Paris Exp.*," 1878, iv. 448.
Eastern Railway of France .	* "*Engineering*," xxvi. 192.
1st class, W. Railway of Fr. .	* "*Engineer*," xlix. 160, 248.
	* "*Paris Exp.*," 1878, iv. 446.
3d class, W. Railway of Fr. .	* "*Engineering*," xxxvi. 406.
Western Railway of France .	* "*Engineering*," xxx. 22.
Bogie, Buenos Ayres R. R. .	* "*Engineer*," xliv. 220, 224, 238, 246.
Western Railway of France .	* "*Engineering*," xxvii. 341.
Composite, W. Railway of Fr.	* "*Engineering*," xxvii. 433.
2d class, W. Railway of Fr.	* "*Engineering*," xxviii. 170.
Southern Railway of France	* "*Engineering*," xxvii. 230.
Pennsylvania Railway . .	* "*Engineering*," xxiv. 404, 458.
Cost of	* "*Sc. American*," xli. 209.
Saloon, S. W. Railway, Br. . .	* "*Engineer*," xlv. 111.
6-wheeled truck, Midland R. R. Br.	* "*Railroad Gaz.*," viii. 368.
Sleeping, Austrian State Ry. .	* "*Paris Exp.*," 1878, iv. 448.
Door fastener, *Buser & Shaw* .	* "*Sc. Amer.*," xlii. 179.
Grain door, *Susemihl & Miller*	* "*R. R. Gaz.*," xxiii. 481.
Van Lieuw.	* "*R. R. Gaz.*," xxiii. 411.
	* "*R. R. Gaz.*," xxi. 527.
Hibbert	* "*Sc. Amer.*," xliii. 226.
Lock, *Jelly & Jones*, Br. . . .	* "*Engineer*," xlviii. 206.
Maxwell, Br.	* "*Engineer*," xliii. 293.
Lamp, *Westinghouse*, N. Br. Ry.	* "*Engineer*," xlvii. 388.
Lamp step	"*R. R. Gaz.*," xxiv. 264.
Lighting, *Westinghouse* . . .	* "*Engineering*," xxvii. 264.
Spring tester, *Riehlé's* . . .	* "*R. R. Gazette*," xxii. 64.
Seat spring, *Delessert*, Fr. . .	* "*Engineering*," xxx. 196.
Seat, *Heywood*	* "*R. R. Gazette*," xxi. 200.
Starter, *Pritchard's*	* "*Min. & Sc. Pr.*," xxxvi. 1.
Hansell's	* "*Sc. American*," xliii. 99.
Step, *Skerritt*	* "*Sc. American*," xli. 414.
Window, *Deblois*	* "*Sc. Amer.*," xxxix. 168.
Markall	* "*Sc. American*," xlii. 195.
Flexible blind, *Wilson* . . .	* "*R. R. Gazette*," xxii. 184.

For varieties of car-lamps, see *Forney's* "*Car Builder's Dictionary*, p. 94.

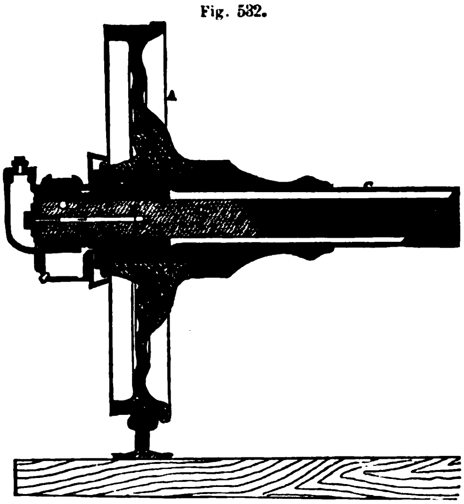
Car Ax'le. At the Centennial Exhibition (1876) were shown several axles which had for their object to allow the wheels of each pair to revolve independently of each other.

In the *S. L. Harrison* axle, each wheel is fixed to a sheath which extends to the center of the axle, and which revolves with the wheel to which it is attached, upon the axle.

The *Auchinloss* axle is divided in the middle, and there held in place by a sleeve about two feet long, in which the parts can revolve separately. In this case each wheel revolves with its own half of the axle.

"The axle of the *Miltimore Car Axle Company* was applied to one of the trains running in the Centennial grounds, and with a notable diminution of the friction in passing round the very sharp curves on this railway. In the construction of the Miltimore axle, the wheel *A* is mounted on, but not fixed to, a sleeve, *C D*, which revolves round the fixed axle *B*, upon which the car rests; the sleeve being kept in place by the axle boxes *H*, which are fixed to the main axle; the

Fig. 532.



Miltimore Car Axle.

wheel *A* can, moreover, revolve round the sleeve *D*, when, by reason of a curve or inequality in the road, one wheel is required to move with more rapidity than the other." — *Capt. Galton*. See, also: —

Standard	* "*R. R. Gazette*," xxiii. 555.
Frame	* "*R. R. Gazette*," xxii. 133.
Tests, *Chamberlain*	* "*Scientific Am. Sup.*," 1798.
Boxes, European, on, *Browne*	* "*R. R. Gaz.*," xxii. 389, 399.
Tomlinson	* "*Scientific Am. Sup.*," 1875.
Trunnion, *Hill*	* "*Scientific Am.*," xxxix. 358.
Journal bearing, *Pullman* .	* "*R. R. Gazette*," xxi. 443.
Journal box cover, *Hewitt* .	* "*R. R. Gazette*," xxiii. 448.

Car'bo-az'o-tine. An explosive: —

Nitrate of potassium	61.04
Sulphate of iron	0.73
Lampblack	24.65
Sulphur	13.58
	100.00

Car-bol'ic Ac'id Pa'per. Used for packing fresh meats, in order to preserve them.

Prepared by melting 5 parts stearin at a gentle heat, and then stirring in 2 parts carbolic acid, and afterwards 5 parts melted paraffin. The mass is well stirred until cool, and is then applied with a brush to the paper.

Paper saturated with other tar or petroleum products is also used for defending clothes, furs, etc., from moths or ants. U. S. Patents 88,519; 105,160; 94,357.

Car'bon-a-ta'tion Pan. (*Sugar.*) *Carbonatation* is the saturation of the defecated beet-juice with carbonic acid gas.

"The carbonatation pans in which the defecated and the scum juices are treated, are furnished at the bottom with a pipe, pierced with three parallel rows of small holes, ⅛" in diameter, through which the carbonic acid is forced into the liquid. There are also coil pipes or double bottoms, for heating by steam while the process is going on. When foaming has ceased, the carbonated juice is drawn off into large receivers or settling tanks, where it is allowed to settle, after which the juice is ready for the filters, unless, as is often done, it is subjected to a second carbonatation. In many works, the carbonic acid gas is produced from the calcination of limestone, instead of the combustion of charcoal.

"In the *Perier & Possoz* process of defecation and carbonation, the milk of lime which is used must be finely divided through a close metallic sieve, and must contain two per cent. of lime, indicated by 10° on Beaumé's areometer. One measure of this solution is gradually added in eight or ten successive additions, to every forty measures of the juice which is to be operated on. During this the temperature of the juice is raised from 188° to 158° Fah. Carb.-acid gas is now turned into the juice, while it is being stirred, and at the same time a small stream of milk of lime is continuously fed into it. This lime is quickly dissolved and precipitated, carrying down with it most of the coloring matters and the impurities contained in the liquid. The proper moment for arresting the carbonatation is indicated by a chemical test of the juice. When this point is reached, the juice is drawn into settling tanks and allowed to settle for about twenty minutes. From these tanks it is run into a second set of defecating pans, where more lime is added. The carbonic acid is at once turned on, and continues to flow into the juice until complete saturation is effected, which is known by a chemical test, nearly the same as before. The juice is now brought to the boiling point, to drive out the free carbonic acid, and is then run into a second set of settling tanks. In these tanks it remains until it has cleared itself sufficiently, when it is ready to be conveyed to the charcoal filters for further treatment.

"In *Jelinek's* process, defecation and carbonatation are simultaneous, and terminate in a single operation, instead of two successive ones, as in the previous method.

"The pans which are used are furnished with a carbonic acid coil-pipe, and are deeper than the ordinary defecating pans. The juice, as it is admitted to them, is comparatively cold, and must never exceed a temperature of 140° Fah.

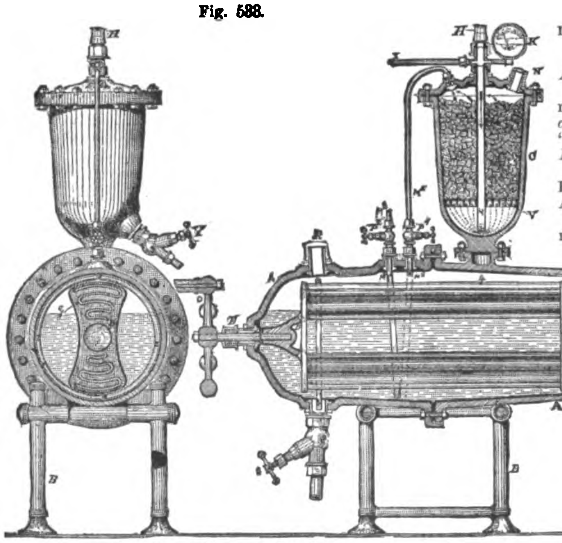
"At least two per cent. in weight of lime is added to the juice, in the shape of milk of lime; and carbonic acid gas being admitted, the heat is gradually increased until the precipitates form rapidly and fall to the bottom.

"This process is based on the theory of acting on cold juice at first so as to produce a solution of saccharate of lime, out of which the carbonic acid gas precipitates the lime as carbonate of lime, which carries with it a certain amount of organic matter, freeing at the same time, the sugar, which recombines with a portion of the lime, to be again freed by a second decomposition of the saccharates and a consequent precipitation of carbonate of lime, and so on for an indefinite number of times during the period of a single operation."

Car'bon-a'ted Bev'er-age Ap'pa-ra'tus. Apparatus for impregnating liquids with carbonic acid gas.

In the apparatus, Fig. 533, a corrugated agitator is employed in a stationary fountain. The beaters *G* are of tinned copper attached to a tinned bronze frame, and the bearings

Fig. 533.



Matthews' Corrugated Agitator.

E F and the agitator itself are covered with tin to avoid contamination of the beverage. The agitator is revolved by the handle *O*, which passes through the stuffing box *E*. The corrugated beaters carry up the liquid into the gas space and also submerge the gas in the liquid, bringing the two into intimate contact and causing the rapid absorption of the gas by the water. See also pp. 2235-2237, "*Mech. Dict.*"

Aërated water machinery, *Hayward, Tyler & Co.*, Br. * "*Engineering*," xxvi. 287, 349.

Car'bon-a'ted Stone. An artificial stone in which carbonic acid and steam are used artificially as re-agents in the composition. The object is to hasten the carbonation beyond that incident t exposure to the air, by exposing the com sand and cement to an atmosphere of carboni and vapor of water.

Car'bon-ates. (*Mining.*) *Soft carbonates*, containing carbonic acid, with a base of lead. *carbonates:* the same, with iron for a base.

Car'bon Bat'te-ry. (*Electricity.*) O which carbon replaces the copper element. The original and most important of this cl that of BUNSEN, which see. See also FAURE TERY, see also *Jablochkoff*, "*Technologiste*," LECLANCHÉ BATTERY.

Car'bon Bronze. An anti-friction all vented by Baldwin & Weisman. Its basis is c and it is made in Pittsburg. See —

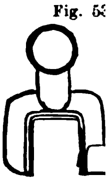
"*Iron Age*" . . . xvii., May 4, p. 24; xxii., Sept. 1
"*Mining and Sc. Press*," xxxviii. 227.

Car'bon But'ton. A variety of lam compressed by a screw press in steel dies to disk about $\frac{1}{16}''$ long and $\frac{1}{4}''$ diameter. It i as a portion of an electric circuit, as an el resistance. In practice it is placed in a sma into which is dropped a little disk faced wi tinum. Contact is made at the top and with wire. It may be adjusted to any res within the range of its own limit which chosen. The limits may be varied also pressure employed in making the carbon If the pressure be increased the sensitiveness button is very materially augmented. — *Ed*
See CARBON TELEPHONE.

Car'bon Clamp. (*Electricity.*) The connector for the carbon element in the It is screwed to the carbon, and a bindin affords attachment for the wire. See Fig.

Car-bon'ic Ac'id. See the fo notices: —

Fig. 5



Carbon C

Industrial uses of. * "*Sc. American*," xxxiv. 386.

Production of, for sucreries. Fig. 40, article "*Sucre*," tome iii., *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," ed. 1877.

See also CARBONATATION PAN: CARBONATED WATER APPARATUS.

See also Dr. McMurtrie's report, special, No. 28, U. S. Department of Agriculture.

Car'bon In'di-ca'to CARBON TESTING INSTR CARBUROMETER; FIRE DETECTOR; GRISOUMET

Car'bon-i-za'tion. bonization of wool and cloth, as is commonly c a misnomer; it is the refuse which is found in of Australia and South which is carbonized as of removal from the anim

See article from "*Textile turer*," reproduced in "*Scient can Supplement*," vi. 2335.

See also SEPARATOR, 5, p. 2094, "*Mech. Dict.*"

Carbonization of coal for the production of ill gas is considered under GAS, COKE, etc. See also on p. 2292, * "*Scientific American Supplement.*"

See also CHARCOAL FURNACE, . . * p. 527, "M

Hugon's furnace for conservation of wood by c the surface. * *Laboulaye's* "*Dictionnaire des Arts factures*," vol. iv., ed. 1877, article "*Conservation*

Carbonization pits for charcoal, * *Ibid.*, tome "*Carbonization*," Figs. 367-370.

See also COKE FURNACE, GAS AND COKE FURNACE COKE OVEN, Fig. 1384, p. 593, "*Mech. Dict.*"

Car'bon Pro'cess. (*Photography.*)

graphic process in which prints are obtained in carbon, either in lamp-black or in ink. See CARBON PROCESS, p. 461, *"Mech. Dict."*

Braun's Carbon Process (Dornach, Alsace-Lorraine). The method is as follows: A negative is obtained by the ordinary collodion process. Paper covered with a mixture of gelatine, coloring-matter, and bichromate of potassium is exposed to light behind the negative. On removal from the copying-press, a layer of caoutchouc is placed on the gelatine. This is then washed in lukewarm water, and the paper and part of the gelatine thus removed. When the remaining gelatine is dry, it is attached to the paper backing by means of a thin layer of gelatine spread on the latter, and the caoutchouc is dissolved off by benzine. Most beautiful carbon prints are thus obtained. The process requires nice manipulation and great care, but does not necessitate an outlay for presses and their appurtenances.

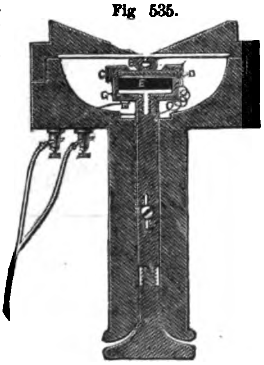
Obernetter's process (Munich). This is very similar to that of Albert (p. 57, *"Mech. Dict."*). The first part, viz: the preparation of the two coatings, is almost identical. After the exposure behind the negative, however, Obernetter covers the gelatine with impalpable zinc-powder, and then heats it in an oven to 200° C. The plate is then subjected to the action of dilute hydrochloric acid and washed, and it is thus rendered capable of receiving an ink on those parts where no zinc is attached. Obernetter thus obtains a plate from which more impressions can be taken than from even that of Albert. The grain produced in the picture is also of great advantage.

See, also: —
Farguier . . . . . . *"Sc. American,"* xxxiv. 242.
"Manufacturer & Builder," x. 240.
Brit. Jour. of Photography, *"Sc., American Sup.,"* 1642.

Car'bon Tel'e-phone. That form of telephone invented by Edison, in which a piece of compressed carbon is placed in a galvanic circuit, the vibrations of the diaphragm causing by pressure variations in the electrical resistance of the carbon, resulting in the production of an undulatory current capable of producing in the receiving instrument sonorous vibrations similar to those which were made at the transmitting end of the wire.

"English Mechanic" . . . . * xxvii. 381.

Fig 535.



Edison's Carbon Telephone.

In Fig. 535, the ferrotype diaphragm of the mouth-piece lies upon *B*, which is a piece of rubber resting on an ivory disk, *C*, beneath which is a piece of platinum, *D*. The block of compressed or gas-carbon is represented by *E*, and beneath that is a plate of platinum, *G*, with a screw to attach it to the stem. The latter can be advanced or withdrawn by means of the screwed end-piece, so as to bring the ivory disk, and consequently the carbon, with more or less force against the diaphragm.

Car'bon Test'ing In'stru-ment. An instrument for the determination of the relative quantity of carbon in steel. See, also, CARBON INDICATOR, *supra;* and CARBUROMETER, *infra.*

For fire-damp detectors see GRISOUMETER, and references *passim.*

McCreath's analysis app. . . * *"Eng. & Min. J.,"* xxiii. 169.
Ryder's magnetic testing instr. * *"Eng. & Min. J.,"* xxiii. 27.

Car'bon-zinc Con-nect'or. A binding post used in making the necessary connections between the elements of the galvanic battery.

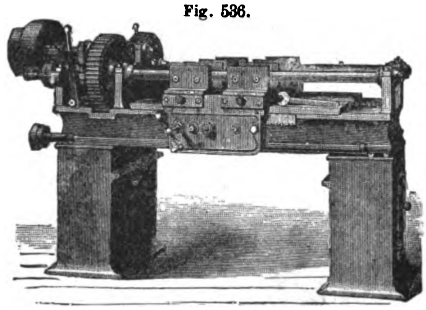
Car-bor'ing Ma-chine'. A boring machine of large size for boring the sills and other timbers of cars.

Such are horizontal, angle, etc. See ANGLE CAR-BORING MACHINE.

Also Fig. 818, p. 341, *"Mech. Dict."*

Car'-box Bor'ing Ma-chine'. A machine to bore the brass boxes for car axles; it is furnished with two boring bars of steel 2⅝" diameter, and so arranged that either bar may be used independently of the other. A slide-rest is provided for each bar, and is so arranged that four boxes may be operated upon at the same time, on each rest.

Fig. 536.



Car-box Boring Machine.

The rests are operated by means of a rod feed; can be used in either direction, or instantly detached and operated with a quick hand movement. The boring-bar is of sufficient length to admit cutters for rounding both ends of the boxes without removing them from their places after being bored.

"Railroad Gazette" . . . . * xxi. 415.

Car'-box Drill. A tool for removing broken cap-bolts from car-truck boxes. The horns projecting below the base are made to include the box, and the pointed set screws take hold of it. — *Thorne & De Haven.*

Fig. 537.

Car-box Drill.

To remove the broken bolt, a hole is drilled in it for a short distance, the drill then removed, and a square drift with tapering edges substituted in the spindle and forced into the hole by the feed-screw, until its edges are slightly imbedded in the bolt. By turning the crank and feed-screw in the reverse direction, the broken bolt will be readily backed out.

See also *"Railroad Gazette"* . . . . . * xx. 75.

Car'-box Grind'ing Ma-chine'. A machine for fitting car brasses by means of an emery wheel turned to the correct circular shape by means of a diamond tool. See Fig. 538.

The brass to be ground is put in a clamp, which is set in planed ways and passed beneath the emery wheel. The detached portions below (*B C D E*) represent parts and boxes in various conditions.

Car'boy. A large globular bottle for acids.

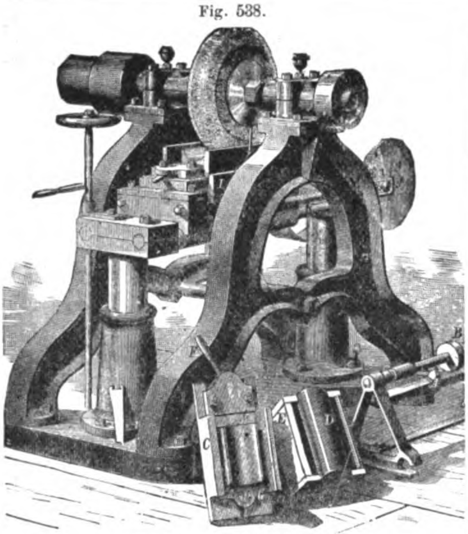
Carboy barrow, Fr. . . . . * *"Sc. American,"* xxxix. 322.
Carboy holder, *Laquas*, Fr. . * *"Sc. American,"* xxxix. 324.
Carboy pump, *Nichols* . . . * *"Iron Age,"* xxii., Sept. 5, p. 9.

Car Brake. See RAILWAY CAR BRAKE.

Car'bu-ret'or. A machine for impregnating with the vapor of a hydro-carbon. Page 464, * *"Mech. Dict."*

"Alpha" . . . . . . * *"Engineer,"* xxiii. 69.
Pew & Weart . . . . * *"Scientific American,"* xl. 262.

Fig. 538.



Car-box Grinding Machine.

Car′bu-rom′e-ter. An instrument invented by M. Coquillon for determining the composition of gases contained in fuel, as regards their contents in carbonic oxide, hydrogen, and hydro-carburets.

The general principle of the apparatus is the same as the inventor's GRISOUMETER (which see), (fire-damp detector), the hydrogen and hydro-carbon being determined by means of combustion in contact with palladium wire, while the other constituents are absorbed by special solvents.

"*Engineering*" . . . . * xxiv. 317.
"*Scientific American Supplement*" . . . . * 1615.

Car′cel-bec. The French unit of illumination. Given the preference over *candle-power* and the equivalent German and other words, at the Electrical Congress, in Paris, 1881.

Car Coup′ler. A link, hook, or bolt connection between adjacent railway cars.

Miller's arrangement is automatic, and used with his platform. It consists of two heavy iron hooks which act as draw-bars, and are made to engage with each other by springs when the cars come together. See *C C*, Fig. 1607, p. 466, "*Mech. Dict.*"

Janney's. The outer end of the draw-bar is made of a forked or U-shape, and to one arm an L-shaped knuckle or clutch is pivoted, so that when the two draw-bars come together the two knuckles engage into each other. A buffing or compressing device, consisting of two buffers, one on each side of the draw-bar, is also used in connection with the self-coupling apparatus described.

Forney's "*Car Builder's Dictionary*" . . . * 364.
"*Railroad Gazette*" . . . . * xxiii. 13.
"*Scientific American Supplement*" . . . . * 2619.

English railway-car couplings are considered in a paper by T. Atwood Brockelbank, read before the "Society of Arts," London, 1876; and reproduced in "*Scientific American Supplement*," * i. 333.

It considers the history of car couplings; cites early methods and patents, and illustrates *Spooner's*, *Sterne's*, *Brockelbank's*, etc. See also Fig. 1107, p. 456, "*Mech. Dict.*"

	"*Scientific American Sup.*," 513.
Bailey	* "*Scientific American Sup.*," 690.
Becker, Austria . . .	* "*Engineering*," xxiv. 424.
	* "*Engineer*," xlii. 444.
Chandler, Br.	* "*Engineer*," xlviii. 268.
	* "*Engineering*," xxviii. 413.
Douglas, Br. / *Harrison*, Br. / *Walker*, Br.	* "*Engineering*," xxv. 182.
Fenwick, Br.	* "*Engineer*," xlvii. 117.
Harrison, Br.	* "*Engineering*," xxiv. 493.
Haswell, Vienna . . .	* "*Engineer*," xlii. 220.
Heavener	* "*Sc. American*," xxxvii. 198.
King, Br	* "*Engineer*," xlii. 145.
Lahaye	"*Am. Railroad Jour.*," x
Mawlam, Br.	* "*Engineering*," xxx. 8.
	* "*Scientific American*," x
Patterson	* "*Scientific American*," x
Peck	* "*Scientific American*," x
Buffer, *Turton*, Br. . .	* "*Engineering*," xxx. 568
Walker, Br. / *Harrison*, Br.	* "*Engineer*," xlv. 188.

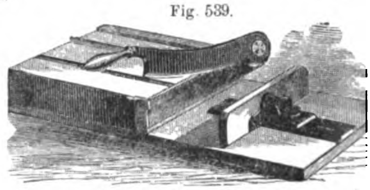
Card′-board Cut′ter. Packer's car cutter is designed for cutting card and mil for paper-box manufacturers, etc., who requ terial cut in oval and circular forms. Th board is placed upon a stand in certain posit cording to the shape required, and is passed b two disks with knife edges operated by a cr

See also diagrams of blanks, page 1616, *Dict.*"

Dickinson's gang card-cutter is composed series of circular shears, upper and lower, n on iron axes, on which they are adjusted by of wooden flanges. The shear axes are dri belt.

Fig. 539 is a wooden frame card-cutter with a pivot cutting against a straight edge. In front is an ac gage.

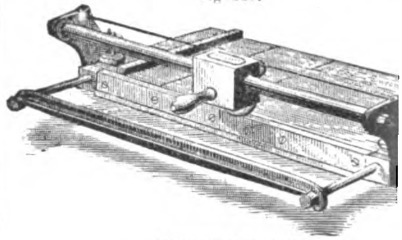
Fig. 539.



Wooden Frame Card-cutter.

Fig. 540 is a rotary card-cutter which has a circ ting disk traversing against a straight edge. The a gage has a pair of sliding extension rods and set scr

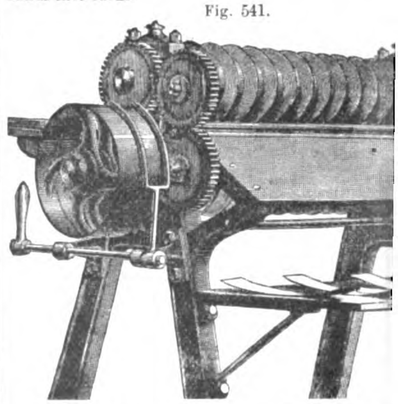
Fig. 540.



Circular Card-cutter.

The machine of Pierron & Dehaitre, of Paris, has circular knives for cutting card-boards in bands bands into cards.

Fig. 541.



Circular Card-cutter. (Pierron & Dehaitre, Pa

It is made to work by hand, foot, or power; is made of capacities to suit the merchant sizes of card-board, and the blades are adjustable in width for the specific sizes of cards required.

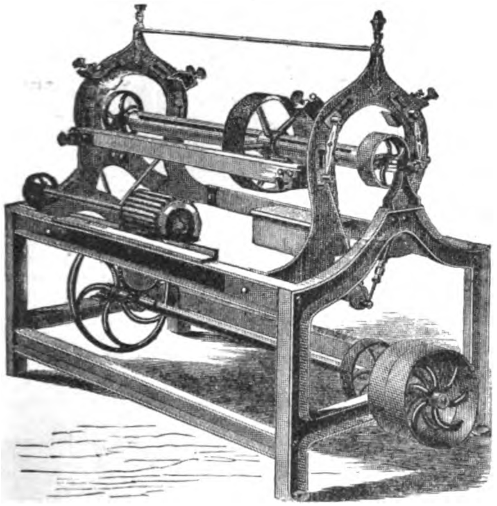
See also Fig. 392, article "*Cartes à jouer*," *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," tome i., ed. 1877.

Card'-grind-ing Ma-chine'. A machine for grinding the card clothing of carding machines, to give the shape and sharpness to the ends of the wires.

The card roller or flat is placed in bearings or clamps in the machine, and the grinding wheel traversed back and forth in front of it. The wheel runs clear past the end of the roller or flat, as the case may be, before it stops and commences the backward motion. The traversing grinding roller is held to be an improvement upon a full-length roller, the inequalities of which are repeated upon the card-roller or flat.

Fig. 542 represents the *Hardy* traverse-wheel grinder, for grinding from 1 to 4 top-flats at a time, with a cylinder

Fig. 542.

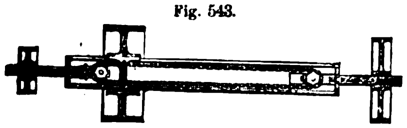


Traverse-wheel Card-grinder.

brush for cleaning out the teeth before the grinding is done perfectly. The motion of the grinding wheel is caused by a screw inside of the slotted and hollow shaft on which the wheels slip and with which it rotates.

Fig. 543 shows Roy's mode of traversing the grinding-wheel; the motion is rapid, the wheel traversing from 10 to

Fig. 543.



Roy's Traverse-wheel Card-grinder.

20 times per minute, according to the length of the card. The motion of translation is by an endless chain and bevel gears inside of the sleeve, which is at the same time the axis of the wheel.

Edwards's mode of clothing the grinding cylinders with emery cloth is described in

"*Scientific American Supplement*" . . . . * vi. 2179.

The grinding machine of *Platt Bros.*, of Oldham, Britain, shown at the Centennial Exhibition, in 1876, was arranged for grinding either two rollers or two clearers at the same time, and for carding-engines both 40″ and 48″ on the wire.

In the most modern construction the machine carries a ventilating fan, and has setting-on apparatus to move the parts to be ground parallel with the emery cylinder; this machine, however, is not adapted for two widths of carding engines.

The machine of *Dobson & Barlow*, of Bolton, Britain, is for grinding rollers and flats, one of each at the same time. It has a cylinder 12″ in diameter, and can have a fan applied. It occupies but a small space. The flat passes slowly over the cylinder while grinding, and returns quickly, thus saving time in grinding. This is a small-sized machine, but they are made to grind two or more rollers or flats, as required.

In the machine of *M. A. Forbush*, of Philadelphia, the grinding cylinder has an angular thread cut from one end to the other, and the card cylinder rests in bearings on the frame and is revolved by a belt from a pulley on the grinder-shaft. Flour of emery and oil are used, and the shape of the end of each wire on the card agrees with that of the angular tooth.

In the carding machine of *Platt Bros.*, of Oldham, Britain, the card clothing on the flats is ground when the machine is in full work, thus avoiding any loss of time and any necessity for a separate grinding machine.

Car'di-a-graph'. An instrument for recording the beats of the heart. It is usually applied to the chest.

The *sphygmograph*, as its name indicates, is applied to the pulse.

The *pneumograph* and *myograph* are also instruments of research of allied character.

The *sphygmograph* of Dr. Keyt (see SPHYGMOGRAPH) is also capable of being used as a *cardiagraph*, for tracing the action of the heart's apex against the chest wall. The base of the instrument is pressed down upon an intercostal space, at the point of greatest impulse, which is usually between the fourth and fifth ribs.

The cardiac apparatus of *Marey* is referred to in

"*Scientific American*," * xxxvi. 51.

"*Scientific American Supplement*," * i. 117.

Laboulaye's "*Dictionnaire des Arts et Manufactures*," tome iv., article "*Graphiques*," ed. 1877.

The telephone is used in auscultation, for cardiac murmurs and different varieties of respiration ("*Boston Medical and Surgical Journal*") and, it may be added, though not apropos of the chest, that the *microphone* has been used by Sir Henry Thompson in lithotrity to detect by sound the contact of the lithotrite (or sound) with fragments of stone.

See, also, PLETHYSMOGRAPH; CHEILOANGIOSCOPE.

Car-di-am'e-ter. An instrument for measuring the rate or force (or both) of the heart action. See CARDIAGRAPH.

Cammann's cardiameter is an instrument for measuring the distance of the apex beat from the median line. It is of the nature of a compass, with sliding bar and graduated index.

Fig. 273, p. 84, Part I., *Tiemann's* "*Armamentarium Chirurgicum.*"

Car'di-gan-jack'et Ma-chine'. A knitting machine adapted to making knit jackets. It is a circular rib machine, making the polka or one-and-one stitch; and the one shown by Gimson & Coltman, of Leicester, England, at the Centennial, had an action by which it could form a welt at any time, according to the length of jacket required. It is fitted with a dial for indicating the length and number of courses made. It will produce in a day 6 dozens of bodies.

See also SLEEVE MACHINE.

Lamb's Cardigan-jacket machine is also adapted for the polka, or one-and-one rib stitch.

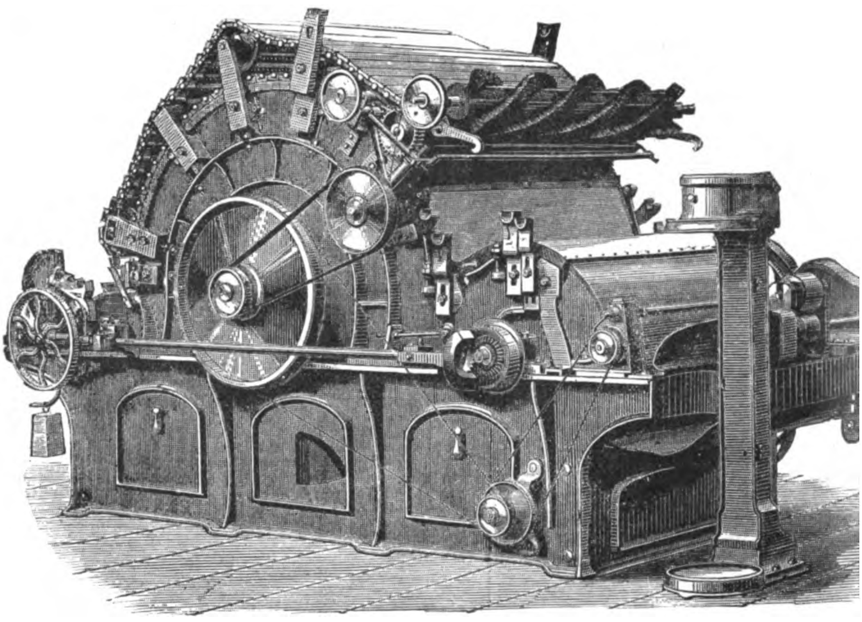
It is described in G. W. Gregory's report on knitting machines. — "*Centennial Reports.*"

Card'ing Ma-chine'. The *revolving*, or *traveling-flat* carding machine, exhibited by Dobson & Barlow, of Bolton, Britain, at the Centennial, has a *cylinder* 50″ in diameter, 40″ wide on the wire; *doffer* 24″ diameter, *takers in* 9″ diameter, also 70 iron *flats* 2″ broad, which have been tested by an apparatus which insures perfect accuracy.

The flats travel over the cylinder supported on a flexible iron bend which has 5 adjusting screws, and by this means the flats can always be accurately set at the proper working distance from the cylinder. The machine has fixings for grinding the flats while the card is at work: also for grinding the cylinder and doffer separately. No less than 27 flats are always at work on the cylinder at any time.

The machine has a taker-in with inserted wire, and containing eight separate coils in every inch. This make of

Fig. 544



Dobson & Barlow's Carding Machine.

taker-in is preferred on account of its not being so liable to choke as the ordinary wire, but is always clean, and requires no grinding. This card is also arranged for stripping out the cylinder by power, and has an angular bar casing under the cylinder only, with adjustable plate to and from the doffer, adjustable knife under taker-in, and sheet-iron division between the cylinder and the taker-in, to keep the waste from each separated.

The advantages of this card are, that the flats can be ground on the machine. The fixings for supporting the flats, knives, etc., are fitted on planed surfaces cast with the bends, so that they are not liable to be moved from their proper positions. All the flats are well borne up when not working on the cylinder, so that the person setting them may be able to test their accuracy without difficulty.

The cylinder and doffer can be ground separately at one time, if required.

The composite carding machine of *Dobson & Barlow*, of Bolton, England, has a cylinder 45″ in diameter, 40″ wide on the wire; doffer 22″ diameter, taker-in 9″ diameter, two rollers 6″ diameter, two clearers 4″ diameter, and 16 flats 2¼″ wide, stripped in three different ways. The six flats at back nearest the feed roller are stripped three times, the five center ones twice, and the five at front once, thus stripping those flats most charged with waste more frequently than the flats nearest the doffer which are least charged.

This stripper is so arranged that a quick motion is given during the time the flat is being stripped, in order to prevent any collection of fly in its absence from the cylinder. The flat stripper is also cleaned by a top stripper, thus allowing the flat stripper to pass underneath the flat perfectly clean, and without the necessity of touching the wire, except in one direction, and that when stripping the flat.

See also, French carding machine; Figs. 1324–1326, article "*Laines*," *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," tome ii., ed. 1877.

In *Platt Bros.* (Oldham, Britain) carding machine, the oiling apparatus for wool is applied under the first burring (steam) cylinder, the oil being supplied to a trough in which a smooth roller works; above this roller, and in contact with it, is another roller covered with cloth, which is also in contact with the burr roller. The oil is taken from the smooth roller by the covered roller, and from the covered roller to the teeth of the burr roller, by which it is imparted to the wool as it passes over the same. The oil is fed regularly to the trough from a cistern by means of a siphon.

In the triple burr roller arrangement the wire on the first roller is of the coarsest pitch, that on the second of an intermediate pitch, and that on the third roller of a finer pitch; the large burrs, etc., are thrown out by the first guard roller, the intermediate burrs are thrown out by the second guard roller, and the finest burrs by the third guard roller.

Car Gain'ing Ma-chine'. A ma cutting slots transversely in car timbers c across the face of a beam.

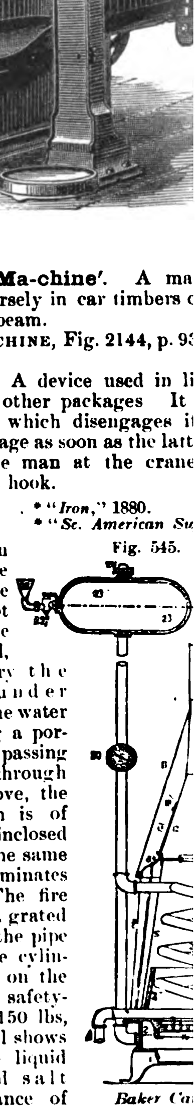
See Gaining Machine, Fig. 2144, p. 9 *Dict.*"

Car'go Block. A device used in li depositing bales or other packages It self-detaching hook which disengages i the sling of the package as soon as the latt bottom, enabling the man at the crane away and detach his hook.

Lawrence's cargo block . * "*Iron*," 1880.
* "*Sc. American Su*

Car Heat'er. In the Baker heater the heat is applied to the car by means of hot water led round the car on the floor level, with bends to carry the pipes horizontally under each row of seats; the water is heated by coiling a portion of the pipe, and passing this coiled portion through a circular iron stove, the fire-box of which is of wrought iron, and inclosed in an envelope of the same material, which terminates at the chimney. The fire is fed by opening a grated lid. Both ends of the pipe terminate in a close cylindrical cistern placed on the roof of the car. A safety-valve is loaded to 150 lbs, and an indicator dial shows the pressure. The liquid used is a saturated salt water. The allowance of

Fig. 545.



Baker Ca

heating surface is 4½' of pipe per passenger. See also page 484, "*Mech. Dict.*"

The French system of heating cars is by portable hot-water heaters placed on the floors of the cars. The apparatus by which they are expeditiously heated in sufficient numbers at large depots is described in a French report, and reproduced in "*Scientific American Supplement*" * vii. 2815.

Acetate of soda in solution is now used on the Paris, Lyons, & Mediterranean Railway. The substance has great latent heat: being heated, the salt dissolves; in cooling, crystallizes; is again heated to redissolve the crystals.

See, also, FOOT-WARMER.

Simple steam-pipes from the locomotive conducted through the train by pipes. "*Scientific American*," xxxviii. 223.

Heating apparatus	"*Scientific Amer.*," xxxix. 406.
E. Railway of France	* "*Engineering*," xxvi. 427.
	* "*Engineering*," xxvi. 193.
Stove, *Rice*	* "*Scientific American*," xl. 86.
Stove, steel-cased	* "*Railroad Gazette*," xxiii. 607.
Spear.	*Forney's* "*Car Builder's Dictionary*," * p. 411.
Baker.	*Ibid.* * p. 416.

Ca-ril'lon. 1. A chiming or bell-ringing apparatus; or the chime itself. Page 472, "*Mech. Dict.*"

2. A stand of bells mounted on a frame, and used with brass bands.

In Gillest & Bland's (British) carillon machine described in "*Iron*," and reproduced in "*Scientific American*," the difficulty of keeping correct time, owing to the different power required to drive the barrel in different passages of the music, is thus avoided: —

The hammers are always kept raised, and are only allowed to drop by the agency of the musical barrel. The instant they fall they are lifted again, and, so long as the lifting is accomplished quickly enough, the time of lifting has nothing to do with the production of the air. That is determined solely by the musical barrel, which, being relieved of the work of lifting, has little or no strain on it, can be made small and light, and will always revolve at the same rate, and so insure that the tune shall be played in perfect time. It also follows that rapid passages can be played with great ease and precision.

The carillon of the Champ-de-Mars at the Paris Exposition of 1878 was the manufacture of M. Bollee, at Mans, and the statement was made in the presence of the author that the carillon of Buffalo was made by the same founder.

Carillons	"*Manuf. & Build.*," x. 252.
French Exposition	* "*Sc. American Sup.*," 2093.
Chimes, Centennial	"*Iron Age*," xvii., June 29, p. 3.
Chiming clock, Bombay Univ.	* "*Sc. American Sup.*," 946.

See also BELL, CHIME, and list under MUSICAL INSTRUMENTS, "*Mech. Dict.*," page 1501, *et infra.*

Car Jour'nal Bear'ing Bor'ing Ma-chine'. See CAR-BOX BORING MACHINE.

Car Load. Nominally, a car load is 20,000 pounds. It is also —

70 barrels of salt.	17,000 feet of siding.
70 barrels of lime.	13,000 feet of flooring.
90 barrels of flour.	40,000 shingles.
60 barrels of whiskey.	340 bushels of wheat.
6 cords of soft wood.	200 sacks of flour.
18 to 20 head of cattle.	300 bushels of corn.
50 to 60 head of hogs.	680 bushels of oats.
80 to 100 head of sheep.	400 bushels of barley.
9,000 feet of boards	360 bushels of flaxseed.
(One half less of hard lumber, one fourth less of green lumber, one tenth less of joists, scantling, and all other large timber.)	360 bushels of apples. 430 bushels of Irish potatoes. 360 bushels of sweet potatoes. 1,000 bushels of bran.

— "*Butter, Cheese, and Egg Reporter.*"

Car Ma-chin'e-ry. Machines and tools for metal and wood work on cars are assembled in lists on pages 1425, 1426, 2814, 2815. "*Mech. Dict.*" For machinery in general see list under MACHINES, infra.

Boring machine, horizontal.	* "*R.R. Gaz.*," xxiii. 220;
Fay	* xxiv. 109.
Wheel borer, *Bement*	* "*Engineering*," xxi. 505.
Putnam Machine Co.	* "*Sc. American*," xli. 210.
Bement	* "*Sc. American Sup.*," 518.
Box grinder	* "*Sc. American*," xxxv. 54.
Mortiser and borer, *Fay*	* "*Railroad Gaz.*," xxiii. 67.
Truck drill, *Bement*	* "*Engineering*," xxii. 69.
Wheel lathe, *Pfaff*, Saxony	* "*Engineering*," xxii. 174.
Double, *Fetu & Deliege*, Fr.	* "*Engineering*," xxviii 148.
Collier, Br.	* "*Engineering*," xxvii. 351.
Wheel tire lathe, *Collier*, Br.	* "*Engineer*," xlvii. 187

Car Mor'tis-ing Ma-chine'. A class of large mortising machines, for working on sills and other parts of car frames

See Fig. 3237, p. 1482, "*Mech. Dict.*"

The bed of Fay's machine will receive timber up to 17″ square, and the chisel will cut a mortise to the center 16″ long and 8″ deep; or by changing the face of the stick it can be made to work clear through. It has two boring attachments, one on a line with the chisel to bore for the mortises, which will bore to 10″, from the center of column; also, an adjustable auxiliary boring attachment, for boring bolt holes, which will bore 17″ stuff.

See also CAR-SILL MACHINE.

Car'pet. A cloth or rug to cover a floor.

Loom, *Gates*	* "*Sc. Amer.*," xxxvii. 102.	
	* "*Sc. Amer. Sup.*," 1254.	
Manufacture of, Philadelphia	"*Sc. Amer. Sup.*," 947.	
Brussels, manufacture of	"*Sc. Amer. Sup.*," 613.	
Rag looper, *Wyckoff*	* "*Sc. Amer.*," xxxiv. 118.	
Sewing machine, *Hesse* (Singer)	* "*Sc. Amer. Sup.*," 3802.	
Smyrna and Persia, manuf. of	"*Sc. Amer.*," xxxix. 264.	
Thread dressing Machine	*Short*	Patent, 139,521.
Carpet printing machine	*Crossley*	95,777.
Printed piled carpet	*Crossley*	139,706.
Loom	*Murkland*	123,037.
Matching machine		149,956.

History of the rise and development of carpet-weaving in America: *Hayes* in "*Centennial Report*," v. 70-75. See also page 475 *et seq.*, "*Mech. Dict.*"

Car'pet loom. The Dornan ingrain carpet weaving needle loom is arranged for 16 colored wefts, the vertical lifters being arranged in two ranks and the threads being passed through holes in them so that the thread appropriate to the pattern is lifted into the path of the carrier needle and carried into the middle of the shed where it is met by a hook which catches the weft thread and retires with it to the other selvage where it is knit in by a latch-needle.

The Jacquard mechanism determines the selection of the colored weft thread by raising the weft-lifter. The spools of yarn are placed on skewers on a frame upon the floor. A part of the pattern is given by the warps of solid color, being due to the concurrence of the same colors in the warp and weft. The warp is laid double in the shed.

A forked temple is combined with the jaw temple and a finger extending over the lay holds the several weft-threads in position. The lay operates the let-off and take-up, and the connection with the lay is controlled by a pivoted piece. The Jacquard has a counterpoise motion, having one top-board and two trap-boards. The journals are operated by hooked bars placed in and out of gear with the slides which support the trap-boards.

See, also, NEEDLE-LOOM.

The Murkland power carpet loom is also for weaving ingrain carpets and operates by Jacquard and by shuttles. It carries 20 shuttles and weaves 16 colors. The shuttles are carried in boxes on each side and the selection of color is controlled by the Jacquard, which also governs the warp so as to float the required weft colors in accordance with the pattern. The loom is perfectly automatic.

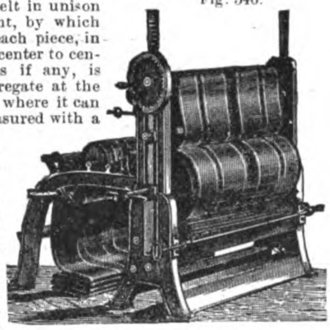
Car'pet Match'ing and Meas'ur-ing Machine'. Carpets which are woven in patterns for matching often vary in the distance from center to center of the figure from various causes, although the greatest care be taken to have them alike. The variations being sufficient to prevent some of them from matching properly, it is customary to measure each piece with a measure corresponding to the length of the figure, and note the difference, whether over or under the standard, on the tag, so that the pieces which agree in length of the figures may be put together.

Short's machine for matching and measuring carpets has an endless belt with divisions of its length corresponding

with the distance from center to center of the figure of the carpet to be matched: also mechanism in connection therewith for drawing the goods over a table alongside of the belt in unison with its movement, by which the variation of each piece, in the distance from center to center of the figures if any, is shown in the aggregate at the end of each piece, where it can be accurately measured with a rule, to be noted on the tag attached to the piece when rolled.

Combined with the mechanism employed for drawing the goods along the matching device, and operating the latter, is mechanism for measuring, singeing, brushing, and rolling the goods at the same time they are matched, by which one movement of the goods answers for all these several operations.

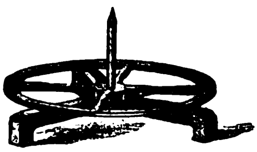
Fig. 546.



Carpet Winder.

Car'pet Wind'er. A machine on which carpet is smoothly wound in rolls from the pile or from the floor. In Fig. 546 the axis is horizontal, and in Fig. 557, the roll is vertical, being a wheel with a vertical spike revolving on a stand placed on the floor of the carpet room.

Fig. 547.



Carpet Winder.

Car Push'er. A lever for moving a car by making a fulcrum on the rail and lifting against the wheel.

See Pinch-bar, Fig. 3725, p. 1706, "*Mech. Dict.*"
Blakeslee. * "*Scientific American,*" xliii. 38.
Fessenden. U. S. Patent, December 31, 1878.

Car-re' Bat'te-ry. (*Electricity.*) A Daniel battery using parchment paper for the porous partition.

"*Niaudet,*" American translation, 108.

Car Re-pla'cer. A device for replacing derailed cars.

Newcomb . . . . . . * "*Railroad Gaz.,*" viii. 191.
Northern Railway of Fr. . . * "*Engineering,*" xxvii. 459.

Car'riage. Specifically: a four-wheeled vehicle for passengers and capable of being closed. See list of various vehicles on pages 2695, 2696. "*Mech. Dict.,*" and parts of, appliances and tools for, *Ibid.*, page 2696.

Axle, *Hendry* . . . . * "*Iron Age,*" xviii., Dec. 14, p. 1.
Building, history of the art, *Thrupp*, Engl. . . * "*Sc. Amer. Sup.,*" 901, 920.
"*Sc. American Sup.,*" 1178.
Factory, *Brewster* . . . * "*Scientific Amer.,*" xl. 79.
Springs . . . . . . * "*Am. Manuf.,*" Feb. 7, 1879, p. 13.
Dexter . . . . * "*Iron Age,*" xviii., Aug. 10, p. 1.

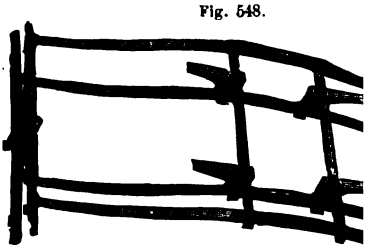
Car'riage and Wag'on Hard'ware. See under the following heads: —

Anti-rattler.
Anti-rattler fifth wheel.
Apron fastener.
Axle block.
Axle clip.
Axle lubricator.
Axle saddle.
Axle yoke.
Back-stay end.
Band.
Billet.
Body coop.
Bolster plate.
Bolt.
Bow iron.
Bow joint.
Carriage bolt.
Carriage spring lock.
Clip king-bolt.
Clip plate.
Clip yoke.
Coach clip.
Coach door handle.
Coach lock.
Corner iron.
Dash.
Dash foot.
Dash frame.
Dash lamp.
Door handle.
Drive knob.
Eye.
Eye ferrule.
Feed-box hasp.
Felloe holder.
Felloe plate.
Fifth wheel.
Foot rail.
Front stay end.
Full circle.
Gridiron step.
Hammer strap.
Hand plate.
Head-block plate.
Joint end.
Joint eye.
King bolt.
King bolt tie.
King bolt yoke.
Loop head.
Loop yoke.
Neck yoke socket.
Offset.
Perch loop.
Perch iron.
Perch plate.
Perch stay.
Platform-spring shackle.
Pole coupling.
Pole crab.
Pole eye.
Pole socket.
Pole tip.
Pole yoke.
Prop.
Prop-block washer.
Prop nut.
Reach.
Reach plate.
Reach socket.
Rockaway band.
Rub iron.
Saddle clip.
Safety loop.
Seat fastener.
Seat lock.
Shaft coupling.
Shaft eye.
Shaft loop.
Shaft rubber.
Shaft tip
Shifting carriage r
Shifting rail.
Side bar.
Side bar spring sh
Slat iron.
Sleigh shaft coupl
Spring bar clip.
Spring block.
Spring buffer.
Spring clip.
Spring coupling.
Spring shackle.
Standard brace.
Stay-chain hook.
Stay-end.
Stay-end clip
Stay-end tie.
Step.
Step pad.
Step shank.
Stump joint.
T brace.
Thimble skein.
Top brace.
Top joint
Top prop
Top prop nut.
Tufting button.
Wagon-box rod p
Wagon coupling.
Wear iron.
Whiffletree brace
Whiffletree circl
Whiffletree coup
Whiffletree hook
Whiffletree plate
Whiffletree tip.
Whiffletree tong
Whip socket.
Yoke.

Car'riage Cut'ting-off' Saw. A ting saw, mounted on a table which ha carriage on which the work is placed sented to the saw. See Cutting-off

Car'riage Spring. The spring sh 548 consists essentially of two semi-e springs upon each side. The two spring ly attached to each other at their cent pivoted at their ends to spring-links a either side of the axle or head-block. shackles are rigidly attached to the hea rear axle respectively. The parallel m springs prevents rocking of the axles. being above the other, prevents side the settling of the body to one side. of a reach allows either wheel to pass

Fig. 548.



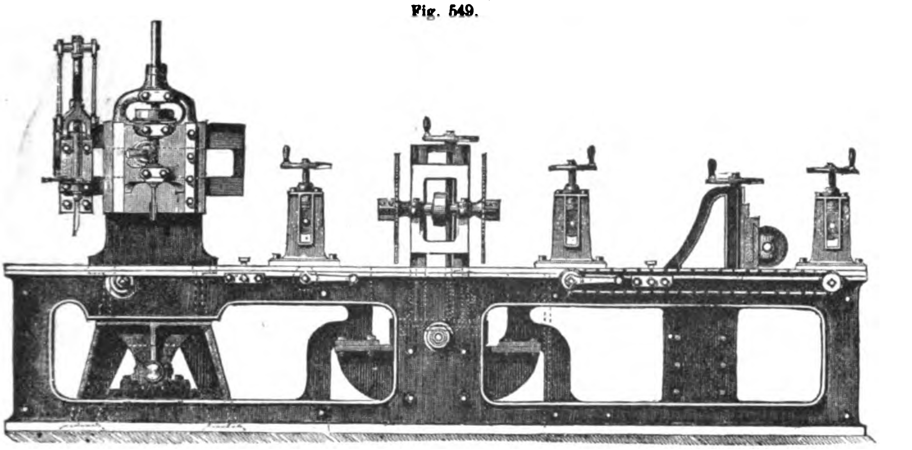
Carriage Spring.

struction almost independently of the The elasticity of the springs takes m the fifth wheel, and cushions the strok ing an obstruction.

See, also, Buggy Spring.

Car Seal. A disk of lead or pew the ends of a piece of wire which has a hasp or ring in a car-door fastening. stamped so as to prevent the opening

Fig. 549.



Ransome's Car-sill Machine.

without the cutting of the wire or defacing the device.

Car'-sill Dress'ing Ma-chine'. A traverse planer especially adapted for trueing and bringing out of wind the timbers for car-sills. These are planed to absolute shape by being dogged to stiff bed, and not merely dressed to thickness.

The Daniells or traverse planer is used, Fig. 3796, p. 1728, "*Mech. Dict.*"

Car'-sill Ma-chine'. A machine having arranged upon it all the various tools for preparing the sills or sole plates of railway cars. The bed has rollers on which the sills move longitudinally to present them to the various tools for mortising, boring, gaining, recessing, etc. See Fig. 549.

Car'-ten'on-ing Ma-chine'. A large sized tenoning machine, adapted for working on sills and parts of framing of cars.

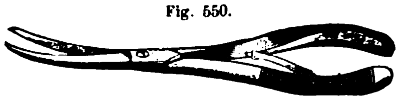
Such a one is the *Gap-bed Tenoning Machine*, Fig. 6305, p. 2532, "*Mech. Dict.*"
See, also, CAR-SILL MACHINE.

Car'ti-lage Knife. (*Surgical.*) A stout, scalpel-shaped knife for severing cartilage. Used in dismembering, post-mortem, dissection.

Figs. 146, 314, 350, Part I., *Tiemann's* "*Armamentarium Chirurgicum.*"

Car'ti-lage Scis-sors. A heavy pair of scissors for dividing cartilages.

Fig. 550.



Cartilage Scissors.

Car Trans'fer Truck. See CAR-TRUCK SHIFTER.

Car'tridge. (*Fire-arm.*) A loaded capsule or case. The case is made of paper or metal; the former, until of late years; now almost universally of metal, — copper or brass.

Cases are *cylindrical* or *bottle-nosed:* in the latter, the portion containing the powder is one or two bores larger than the actual bore of the piece, the chamber being reamed out for that purpose. By this means a shorter case may be used and the proper charge of powder retained.

In cartridge-making 18 different machines are used: 8 to form the case, 3 for the bullet, 5 to make the anvil or cap, and 2 for loading the cartridge.

The first process is called *cupping*, which is done with a die working inside a cutter. A sheet of copper 3'' wide is fed under the cutter by the attendant and a circular blank 1$\frac{3}{8}$'' in diameter is cut, and then pushed through a flaring-mouthed die by the punch, thus making it into a cup-shape about 1'' in diameter and $\frac{3}{8}$'' deep.

In the next machine, called the *first draw*, the cup is fed over the die by the revolving plate and an automatic movement, which takes one at a time off the plate and places it over the die, which is somewhat smaller than the one in the cupping machine. It is then pushed through by the punch. It passes subsequently through four more *drawing machines*, each one making it longer and narrower, until it becomes 2'' long and $\frac{3}{8}$'' in diameter. After the third *draw* it is annealed, having become hard by working.

After passing through the fifth draw it is put in the *trimming machine*, and the edge made even by a revolving cutter which reduces it to a certain size.

The capsule is next put into a machine called the *header*, which spreads the closed end into a head by pressing it into a mold.

The ninth process, *anvil-cupping*, is the same as the first, except that it produces a cup about $\frac{3}{8}$'' diameter and $\frac{1}{8}$'' deep for the cup to hold the fulminate. The anvil is then trimmed in another machine; in the next, called a *venting machine*, two small holes are punched in the head to afford passage for the fire of the fulminate to reach the charge. It next has an impression made in the outside of the head for the wafer of fulminate, and is next put in the *priming machine*, where it receives the fulminate. The practice with *central* fire and *rim*-fire cartridges diverges at this point; in the latter case the fulminate is secured by crimping the case from the outside, the same machine tapering the open end of the case to receive the bullet.

The bullets are made by a machine which cuts about 1'' from a rod of rolled lead $\frac{1}{2}$'' in diameter, and presses the leaden blank in a mold, which gives the shape and makes the three circumferential grooves. The next machine trims the bullets, which then pass through the *lubricator* which fills the grooves with Japanese wax, the object of which is to keep the barrel of the gun lubricated.

The last machine is the *cartridge loader*: the cases come successively under a powder reservoir where a charge of 72 grains is dropped into each, after which the bullet is put in, and the shell pressed around it to hold it firmly.

The following is a list of the machines included in the exhibit of the War Department at the Centennial Exhibition, 1876, under the orders of Lieutenant Metcalfe, in the Government Building; several machines are practically duplicated, as the successive drawing machines for instance: —

Cupping machine.	Priming machine.
Anvil cupper.	Loading machine.
Lubricator.	Drawing machine.
Case trimmer.	Clamp milling machine.
Impression machine.	Bullet machine.
Butt lathe.	Heading machine.
Barrel-boring machine.	Milling machine.
Barrel-turning lathe.	Rifling machine.
Straightening machine.	Bedding machine.
Tapering machine.	

See account in "*Scientific American Sup.*," * 369.

Norton's report on "*American Breech-loading Fire Arms,*" N.Y., containing a description of the following cartridges: —

Boxer, British, central fire.
Daw, British, central fire.
Chassepot, French.

Zundnadelgewehr, German.
Meigs.
U. S. Cartridge Co.
See report on "Performance of Metallic Cartridges," at Frankfort Arsenal, Penn., by Major Treadwell, U. S. Army, 1873. Notices and illustrations are given of the following (* illustrated): —

Burnside . . . * 1860.
Maynard . . . * 1860.
Spencer . . . . * 1864, rim primed.
Primitive . . . * 1864.
Laidley . . . . * 1865.
Novelty . . . * 1866, center primed.
Bar-anvil . . . * 1866.
Gatling . . . . * 1865.
Canister . . . . *
Benton . . . . * 1867, cup reinforce.
Tibbal . . . . * 1869.
Benet . . . . * 1868, cup anvil.
Service . . . . * 1868, blank cartridge.
Benet . . . . * 1866, center-primed.
Crispin . . . . * 1867, combination: paper and metal.
Colt . . . . . * 1868.
Martin . . . . * 1869.
Corliss . . . . * Front ignition.
Prince . . . . * Front ignition.
Milbank . . . * 1870, reloading.
Milbank, et al. . . * Primer.
Reïnforced . . . *
Frankford . . . * Gas check.
* Attached head.
Rodman-Crispin * 1863, wrapped metal.
Boxer-Henry . . * 1872, wrapped metal.
Frankford . . . * 1872, cast base.
Hotchkiss . . . * 1868, solid head.
Benet . . . . * 1868, solid head.
U. S. Cartridge Co. * 1868, solid head.
Dutch musket . * Reloading shells.
Dutch carbine . * Reloading shells.
Farrington . . . * Solid head.
Navy . . . . * Front lubrication.
Frankford . . . * 1865.

See report of Major Bell to Colonel Craig, Chief of Ordnance, May 16, 1856, on the firing of Dr. Maynard's breech-loading rifle charged with a metallic cylindrical water-proof cartridge.

Cartridge, *Tyler* . . . . * "*Scientific American*," xli. 246.
Making . . . . * "*Sc. American Sup.*," 2670.
Center fire, *Saget* . . . * "*Scientific American*," xliii. 86.
Cartridge shot, *Schleber* . * "*Scientific American*," xl. 212.

The Russian small arm cartridge factory near St. Petersburg is described in "*Ordnance Report*," 1877, pp. 519 *et seq.*

Car'tridge Block. A wooden block, bored to receive 8 cartridges, and having attachments by which it is secured to the gun in convenient position for loading. It is shown in Fig. 552 as attached to a *Peabody-Martini* military rifle.

Car'tridge Cap'per. An instrument for securing caps on central fire cartridge-cases. The pivoted lever has a stud beneath, which presses the cap firmly upon its seat. Fig. 551.

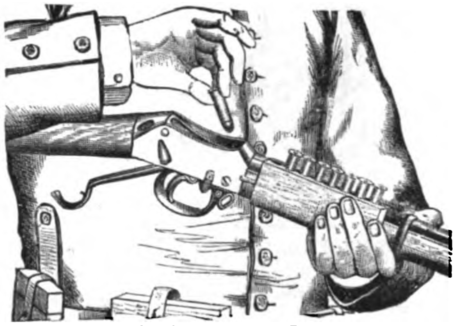
Fig. 551

Parker Bro.'s Cartridge Capper.

Car'tridge-head'ing Ma-chine'. A machine for forming the head or rim of a cartridge case. It consists of a horizontal die, countersunk at one end for shaping the head; a feed punch, to insert the tubes into the die; and a heading punch, to flatten the closed ends of the tubes into the countersink.

The tubes, which are a little longer than the completed cases, are fed into the inclined trough of the machine, whence they are taken up on the feed-punch. A shoulder on this punch, at a distance from its extremity equal to the inner depth of the headed case, prevents it from penetrating to the full depth of the tube, and a surplus of metal is thereby left at the closed end of the tube for the formation of the head.

Fig. 552.



Metcalfe's Cartridge Block.

The feed-punch inserts the tube into the die and holds it while the heading punch advances, presses and folds the surplus end of the tube against the countersink die, thus shaping the head or rim. The headed case is left in the die as the feed-punch retreats, and is expelled by the next case.
The rate is 65 per minute.

Car'tridge-head Test'er. A hydrostatic press invented by Col. Treadwell, U. S. Army, for testing strength of cartridge heads.

Plate XXIII., Ordnance Report, U. S. Army, "*Metallic Cartridges,*" 1873.
Plate XXIV. *et seq.* of the same, show the powder test by eprouvette.

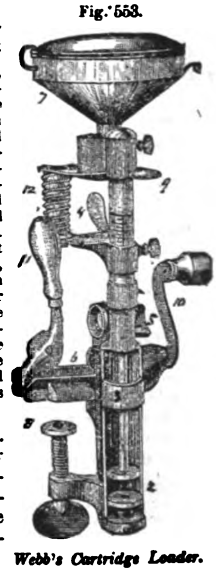
Car'tridge Load'ing Ma-chine'. 1. A machine for loading powder and bullet into a cartridge case.

It consists of a revolving circular plate with holes, and a hopper and powder measure.
The powder is placed in a brass hopper above the machine, and is fed to the cases through a paper tube; the whole inside of a conical shield of boiler iron.
The cases and bullets are fed on revolving plates: the former lifted into the receivers, passed under the hopper and measure for a charge of powder, and then under the bullet-feeder to receive a lubricated bullet. The edge of the case is crimped on the bullet by lifting the former into a contracted space of the receiver around the neck of the bullet.
A bell indicates any failure in the supply of a full charge of powder, and the rate is 35 per minute.

2. On a smaller scale, a machine for reloading cartridge shells.

The machine is clamped to a table, leaving the crimper crank 10 free to turn. The reservoir 7 being furnished with powder, the charger 9 is set to the number of drams required. Hold the shell under the aperture of 12 in the lower shelf of charger, and dump the powder therein. Having loaded the shells with powder, remove the funnel and release the rammer; put the shell in the receiver 2, place the wad on the powder and ram home. Fill the reservoir with shot, set the charger at the gage desired, drop the charge, place a wad on the shot and ram as before; or crimp the shell, placing it in the cradle 6, and rotating the revolving hub by the crank 10. The shell may be shortened before crimping by placing it on 5 and rotating it while the knife 4 is pressed upon it.

Fig. 553.



Webb's Cartridge Loader.

Car'tridge Scales. A machine for automatically verifying the weight of cartridges; invented by *Gootkoffsky*, of the ordnance works, St. Petersburg, Russia.

"The scales are composed of eight balances, slung to the tyre of a small fly-wheel which is brought into action by the main shafting. The cartridges placed by the workmen in the box are caught up by the scales themselves and are placed in the balances. The cartridges are equipoised by a reacting weight placed on the opposite ends of the balances; on the farther rotation of the fly-wheel, the balance gradually comes to an equilibrium, upon which the cartridges of a normal weight, and heavier than the normal weight are declined along with the outer end of balance downward, and are thus pushed off by the scales themselves into the receiver, from whence they fall into a box placed on the floor. The cartridges which are of less than the normal weight, are raised upward and are thrown off by the scales themselves into another receiver, from whence they fall into a locked-up box. The fly-wheel with the balances makes 7½ revolutions per minute, that is, performs 3,600 weighings per hour, or 30,000 per day, allowing for subsidiary work and chance stoppages."

Car'tridge Var'nish-ing Ma-chine'. A machine to coat the interior of metallic rifle shells with an impermeable elastic varnish, to prevent chemical action between the salts of the gunpowder and the material of the shells.

The shells are placed in a hopper, several hundreds at a time, and fed singly into a wheel, with which they revolve, while they are also rotated in the chucks which hold them; this in order to spread the varnish. Forty of them are in different stages of the process at the same time, and the work is done at the rate of 2,000 per hour. The machine is perfectly automatic. The shells are subsequently dried in a sheet-iron furnace.

Cart Rol'ler. A roller which has a cart body mounted upon it. Used in some parts of France for transporting manure on soft prairie ground.

Car Truck. The wheeled frame beneath the body of a railway car.

Iron, *Challender* . . .	* "*Railroad Gazette*," xxi. 198.
English	* "*Sc. American*," xxxviii. 226.
Passenger, *Ramapo Co.*	* "*Railroad Gazette*," xxi. 257.
42-inch, *Ramapo Co.* .	* "*Scientific American Sup.*," 1298.
Pennsylvania Railway .	* "*Engineering*," xxiv. 366, 375–378.
Safety device, *Root* . .	* "*Scientific American Sup.*," 142.

The principal forms are shown in *Forney's* "*Car-builder's Dictionary*."

Car'-truck Frame Drill'ing Ma-chine'. A multiple drill machine, for drilling at one operation the different holes required in car truck frames.

The frame to be drilled is laid upon the table, which is then fed up to the drills, either automatically or by hand through the gearing. The drills are mounted on an upper frame, at the standard distance apart, and are driven by gearing from the coned pulleys. The drill spindles slide in the vertical holders, which are tubular, and they can be locked in any desired position by set screws at the ends of the holders. The drill spindles can be adjusted on the cross frame to different distances apart so as to suit different patterns of car frames.

Car'-truck Shift'er. An invention, for changing the trucks of cars on roads having different gages, as well as for changing trucks when repairs or new trucks become necessary.

AA represent level outside tracks along the depressed main tracks; *EE* represent trucks on the outside tracks, and *F* the cross-bars or beams for carrying the car body.

To separate trucks from a car body, the car is run to the incline of the pit B, and the small truck *E* placed on each side. The supporting beams or cross-bars *F* are then placed under the frame of the car between the bolsters, the ends of the cross-bars resting on the side trucks at opposite sides of the car. Then, by moving the car over the pit *B*, the car-trucks *D* run down the incline rails, leaving the car body supported by the side trucks *E* and supporting beams *F*. To connect trucks, after the above described process is accomplished, they are run up the incline until the bolt-hole of the truck connects with the king-bolt of the car, and then, by moving the car forward, the king-bolt draws the trucks up to their proper place.

"*American Railroad Journal*" . . .	xlix. 1080.
* "*Polytechnic Review*"	Sept. 9, 1876
* "*Iron Age*,"	xviii., Sept. 7, p. 1.
* "*Railroad Gazette*"	xxiv. 267.
* "*Scientific American Supplement*" . .	706.

Car Un-load'ing Plow. Dowling's plow for unloading platform gravel-cars, is a V-shaped implement which has two flaring wings. The cars being made stationary, the locomotive is detached, and, being connected to the plow draws it the whole length of the train from car to car, depositing on each side of the track the gravel with which the cars are loaded. See also Patents 63,139, 91,440; grain-scoops for unloading.

"*Railroad Gazette*" . . . . * xxiii. 249.

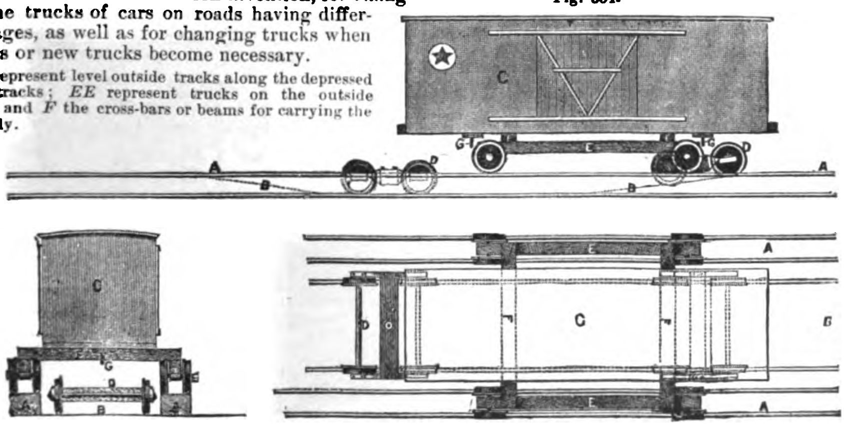
Car Ven'ti-la'tor. A device for renewing the air of a railway-car. See CAR VENTILATOR, * pp. 490, 491, "*Mech. Dict.*," and AIR FILTER, * pp. 46, 47, *Ibid.*

Winchell's Car Ventilator consists of an air-chamber attached to the roof of the car and extending its entire length. Each end is furnished with a hood, protected by very fine wire gauze screens, through which air alone is admitted to the chamber. Each drum is furnished with a cut-off, operated by a lever within the car, by means of which the supply of air may be regulated. A number of registers in the bottom of the chamber admit the air to the car. When the train is in motion the cut-off in the forward end of the car is opened, and the air enters, passes down through the registers, enters into the car, and, having served its purpose, makes its exit through the rear hood or through the windows, if they are open. In connection with the air-chamber, and for summer use only, are deflectors on the outside of each window, whose purpose is to act as an exhaust, and not only draw out the impure air from the car, but prevent the admission of smoke, dust, cinders, and rain through the open window. These deflectors, which are made of glass, so as not to impede the view from the windows, are operated simultaneously by an iron rod running along the side of the car.

Winchell	"*Van Nostrand's Magazine*," xiv. 187.
	"*American Railroad Journal*," xlix. 318.
	"*Scientific American*," xxxvii. 262.

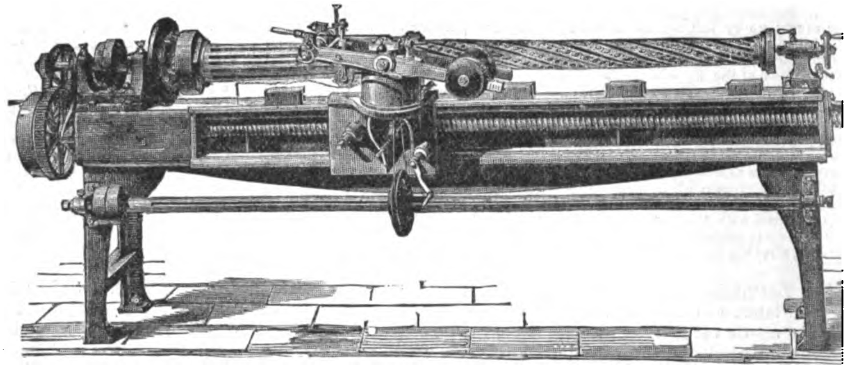
Carv'ing. The ancient, mediæval, and modern, the Orient and the Occident, vie in wood carving.

Fig. 554.



Ramsey's Car-truck Shifter.

Fig. 555.



Arbey's Carving Attachment for Lathes.

It may be said that the art has a renaissance, and the exhibitions show in great numbers imitations of the antique, the grotesque and ornate works of the laborious Orient, and the labors of the graceful modern school.

The Japanese carvings in ivory are familiar, and it may almost be said are beyond praise.

The Chinese carvings in wood are usually in teak, box, and rosewood. Much of the carving in light wood comes from Ningpo; the dark from Canton. Gilding and painting of conventional designs in bright colors are more common than in the Japanese.

The carving of India is all hand work. Sandalwood carving is carried on largely in the Bombay Residency, at Surat, Bombay, Ahmedabad, and Canara. The two former are low relief and foliated ornament. The Ahmedabad is in flat relief, floral and mythological. The Canara, high relief and mythological.

Ebony is carved at Bijnur and Monghyr in geometrical designs.

Ivory is carved all over India: gondolas, elephants, cows, peacocks, statuettes, mythological figures, etc., at Amritsar in the Punjab; Benares, Behrampore, and Murshedabad in Bengal; Travancore and Vizianagram in Madras.

The agate vases of Boroach and Cambay have been celebrated as *murrhine* vases from the time of Pliny.

Black marble is carved at Gya, white marble and reddish sandstone at Ajmere and other parts of Rajpootna. The latter province is celebrated for its white marble idols colored in red, green, and gold. Jade is carved in Cashmere.

The most conspicuous work in Paris, in the Champ de Mars, was the Italian. Usually in low relief, the designs were copies from plants and natural objects, and the beauty of the execution left little to be desired.

Plate VII. shows four panels carved in walnut by Prof. Luigi Frullini, of Florence, and purchased for the Museum of Buda-Pesth.

In regard to the choice of wood for carving, it is said that the magnificent carvings of Grinling Gibbons, at Chatsworth, Petworth, Burghley, Gatton, and other mansions in England are almost exclusively in lime-tree wood (*tilia*). The wood is soft and pliable, and is little liable to split and splinter. It takes a stain well, and, when merely varnished, resembles box.

American walnut is more open in its grain than lime, and more fragile. The color is a great point in its favor — at present.

Sycamore is used for large and coarse work, — bread-plates and bowls, for instance. Chestnut is used also. Holly is a very superior light-colored, even-grained wood.

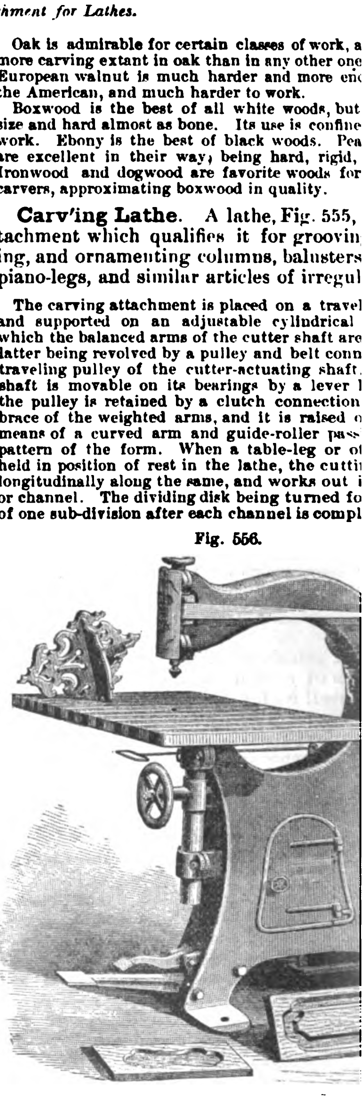
Oak is admirable for certain classes of work, a more carving extant in oak than in any other one European walnut is much harder and more en the American, and much harder to work.

Boxwood is the best of all white woods, but size and hard almost as bone. Its use is confine work. Ebony is the best of black woods. Pea are excellent in their way, being hard, rigid, Ironwood and dogwood are favorite woods for carvers, approximating boxwood in quality.

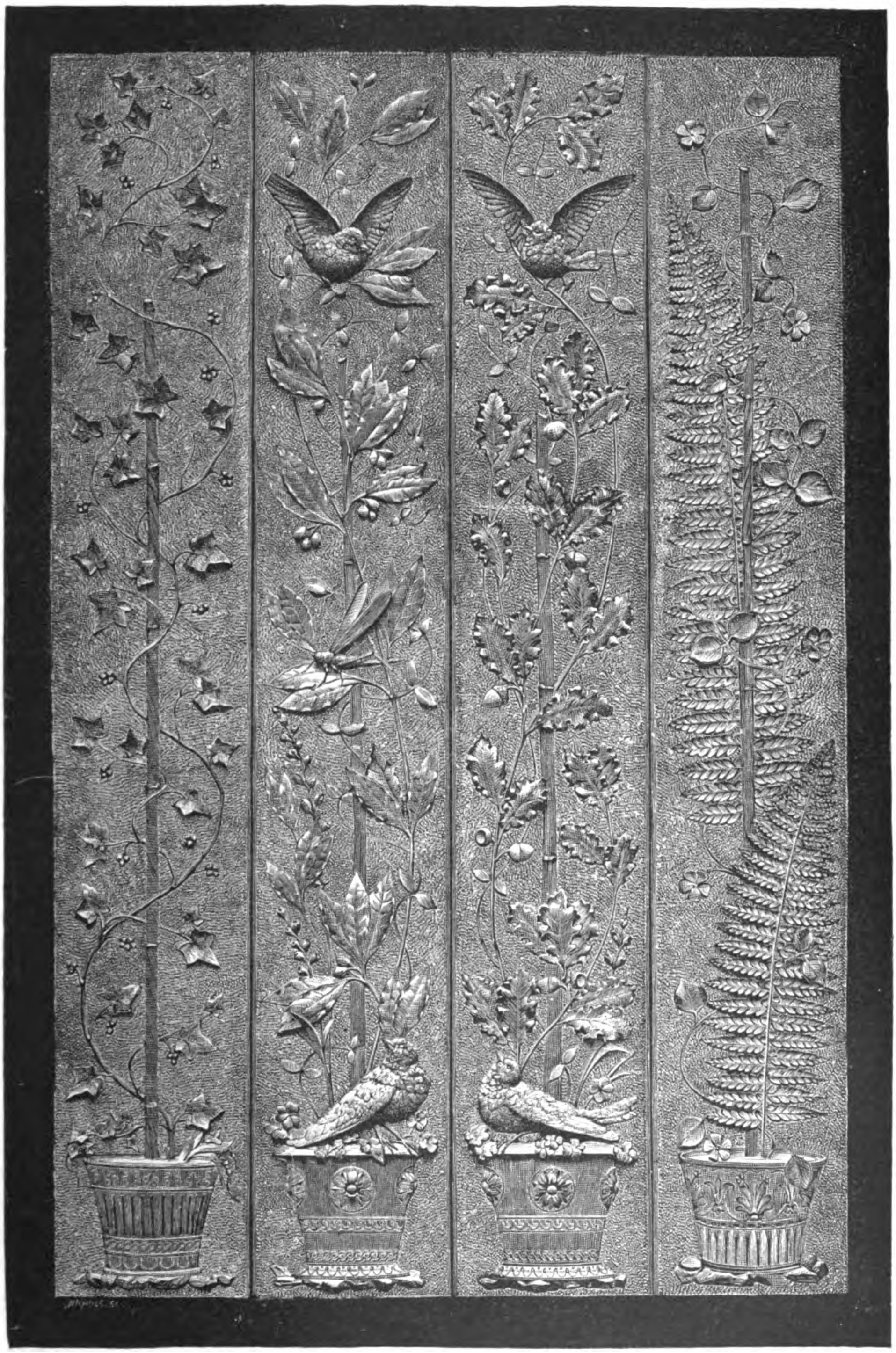
Carv'ing Lathe. A lathe, Fig. 555, tachment which qualifies it for groovin ing, and ornamenting columns, balusters piano-legs, and similar articles of irregul

The carving attachment is placed on a travel and supported on an adjustable cylindrical which the balanced arms of the cutter shaft are latter being revolved by a pulley and belt conn traveling pulley of the cutter-actuating shaft. shaft is movable on its bearings by a lever l the pulley is retained by a clutch connection brace of the weighted arms, and it is raised o means of a curved arm and guide-roller pass pattern of the form. When a table-leg or ot held in position of rest in the lathe, the cutti longitudinally along the same, and works out i or channel. The dividing disk being turned fo of one sub-division after each channel is compl

Fig. 556.



Carving and Paneling Machin



PANELS CARVED IN WALNUT BY PROF. LUIGI FRULLINI, OF FLORENCE.

PLATE VII. SHOWN IN PARIS IN 1878, NOW IN THE MUSEUM OF BUDA-PESTH. *See page* 174

channel is then produced by the return motion of the carriage. By turning the object slowly in the lathe, simultaneously with the revolving and traversing motion of the cutter, helicoidal channels or grooves are formed. For grooving conical parts, the cutter shaft is guided along an inclined guide pattern, or its axis is placed at an angle to the longitudinal axis of the lathe. The cutter adjusts itself to the shape of the object, and carves, by its uniform forward motion, an ornamental groove of equal depth throughout the entire length. For the purpose of pearling or doing other ornamental carving, the cutting tool is guided to the work by a handle, while the object is turned in the regular manner by the dividing disk, so that the pearls may be formed at uniform distances.

The adjustability of the cylindrical standard, in connection with the balanced cutter shaft and handles, admits of the convenient and accurate handling of the carving attachment, so that a large variety of ornamental work may be accomplished on this machine quickly and economically.

Fig. 557

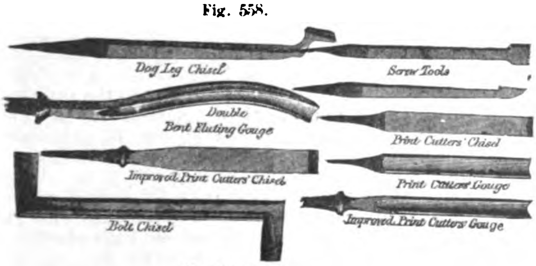
Carving Tools.

Carv'ing Ma-chine'. A machine for producing carvings and recessed or relieved panels on the surface of work; for making edge-molding, ornamental, fret, or bracket work, etc. Fig. 556.

A hollow iron column supports the cutter spindle and the table, which latter is adjusted and regulated to form the required depth of moldings or carvings by means of a hand-wheel and screw, and has sufficient vertical movement to admit of working stuff of 4″ thick and under. The table is elevated by a notched treadle to bring the material in contact with the cutter, and the piece, after being carved, is removed by an auxiliary treadle which disengages a pawl and allows the table to drop to its original position. The cutter may be driven in either direction.

And molding, *Boult* . . * "*Engineer*," xli. 430.
* "*Scientific American Sup.*," 580.
And paneling, *Fay* . . * "*Scientific American*," xxxiv. 391.

Fig. 558.



Carving Tools.

Pantograph principle.
Blackman . . . * "*Scientific American*," Aug. 14, 1875.
Arbey, Fr. . . . . * "*Scientific American*," xli. 243.

Carv'ing Tools. Figs. 557, 558 show a number of carving tools, each with its name subscribed. Selected from a still greater number, these yet show considerable variety.

Car'-wash'ing Ma-chine'. An invention of Lord Caithness for washing the sides of carriages.

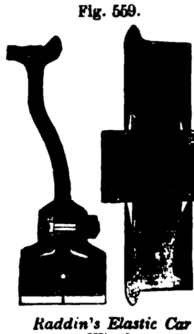
It consists essentially of two large vertical brushes driven by a steam engine. A number of dirty carriages, making up a train of any length, is passed slowly between these revolving brushes; water is thrown upon the side of each railway carriage, 2′ in advance of the brush, from a vertical iron pipe pierced with small holes, placed at an average distance of 8″ from each other. A second water pipe, pierced with similar holes, directs another series of small jets of water directly upon the brushes. The whole arrangement is not very dissimilar in principle to that of hair brushing by machinery.

Car Wheel. Car wheels, cast, wrought, compound, and compressed are shown on pp. 493, 494, "*Mech. Dict.*"

Fig. 559 shows two forms of car wheels, the Raddin and the Bryant.

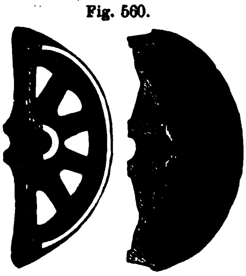
The former, on the left, is an elastic wheel. Being cast in three parts, rubber cushions are interposed between the web and the hub, so that iron does not touch iron, and jars and concussions are absorbed by the rubber.

Fig. 559.



Raddin's Elastic Car Wheel.
Bryant's Self-lubricating Car Wheel.

Fig. 560.



Lobdell's Car Wheels.

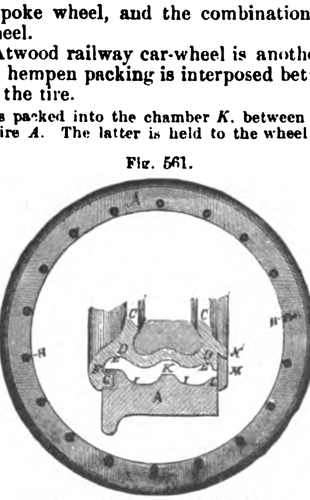
The Bryant wheel, on the right, runs on, not with, the axle, and has a large chamber for oil which oozes through a sponge to the axle.

Fig. 560 shows two of Lobdell's wheels: the hollow-spoke wheel, and the combination double-plate wheel.

The Atwood railway car-wheel is another elastic in which hempen packing is interposed between the rim and the tire.

Hemp is packed into the chamber *K*, between the rim *D* and the tire *A*. The latter is held to the wheel by a lock

Fig. 561.



Atwood Railway Car Wheel.

joint *F G*, and a dovetail ring *M N*. *C C* are the spokes. *H* bolts to secure plate. *F* grooves in rim.

"*Herr Krupp* has lately patented an ingenious mode of manufacturing car wheels. A skelp is first formed of a long flat plate of iron, with a central rib above and corresponding groove beneath, and wide at each end. One end is secured to a rotating mandrel and is coiled on itself, forming the hub; the coiling being continued, the narrow portion of the skelp is wound on itself, forming the web; the coiling of the outer wider end forms the rim. The blank thus formed is placed in the furnace, heated to a welding heat, and welded under pressure into a homogeneous mass of the proper shape, forming the completed wheel. Apart from the facility of manufacture, the invention results in the production of an article of very superior merit, as the fibres of the iron are all arranged parallel to the periphery instead of being tangential or radial, as in wheels constructed by processes hitherto pursued." — "*Railway Review*," xiii. 172.

The endurance of some cast-iron car wheels is very great. Some of the Salisbury wheels of Barnum, Richardson & Co., have made the following record on the Lake Shore and Michigan Southern Railroad: —

4 wheels averaged	185,049 miles.
2 wheels averaged	220,528 miles.
2 wheels averaged	196,967 miles.
3 wheels averaged	189,397 miles.

Lobdell showed at the Centennial wheels which had been 25 years in service on the New York & Erie Railway.

Austrian car wheels by Ganz & Co., Buda-Pesth, made on the American style, were shown in Paris, 1878, one having run 329,400 miles, and another 380,000 miles.

"The paper car-wheels of the Pullman Palace Car Co., are calculated to run 450,000 miles." — "*Chicago Railway Review*."

See Report on "Chilled Cast-wheels for Railways," by *F. Slataper*, "*Centennial Exhibition Reports*," vol. vi., Group XVIII., p. 38 *et seq.*, giving the early history, from Losh & Stevenson, 1826, Bonney, 1829, Elgur, 1833, etc., including —

Truscott, Wolf, and Dougherty, * 1838.
Bonney, Bush & Lobdell, * 1838.
Bush & Lobdell (double plate.) *
G. W. Eddy, * 1845.
Whitney.
Washburn, * 1850.
Lobdell (single plate). *
Lobdell (combination). *

Forney's "*Car-builder's Dictionary*," gives the following list with descriptions. See Figs. 181-184: —

Broad-tread.
Combination Plate.
Combination.
Compromise.
Double-plate.
Elastic.
Hand-car.
Hollow-spoke.
Narrow-tread.
Open-plate.
Pair of Wheels.
Paper.
Plate.
Sax and Kear.
Single-plate.
Spoke.
Steeled.
Steel-tired.
Steel
Street-car.
Washburn.
Wrought-iron.

The parts of a car-wheel are, according to its construction:

Flange.	Plate.
Tread.	Ribs.
Rim.	Spokes.
Face of Rim.	Center.
Tire.	Hub.
Retaining Rings.	Axle-seat.

See also PAPER CAR-WHEEL.

Paper, *Allen*	"*Iron Age*," xxi., Jan. 31, p. 18.
Tire-fastening, *Atherton*, Br. .	* "*Engineer*," xlv. 198.
Steel tired, *Atwood* . . .	* "*Railroad Gaz.*," xxi. 445.
Atwood	* "*Engineer*," xli. 463.
Hamilton	* "*Engineer*," xli. 463.
Baltimore Car Wheel Co. .	* "*Railroad Gaz.*," xxi. 464.
Barnum, Richardson & Co. .	* "*Railroad Gaz.*," xxi. 516.
Cast and wrought	* "*Railroad Gaz.*," xxi. 307.
Composite, *Cleminson*, Br. .	* "*Engineer*," xlviii. 427.
Wood-centered, *Cleminson*, Br.	"*Iron Age*," xx p. 1.
Large *vs.* small	* "*Railroad Gaz.*
For collieries, *Hadfield* . . .	* "*Sc. Amer. Sup*
Disk, *Handyside*, Br.	* "*Engineering*,"
	* "*Engineer*," xlii
Mold	* "*Iron Age*," x 15, p. 1.
Securing to axles, *Jessop & Sons*	* "*Sc. American*,"
Tire fastening, *Kaselowsky*, Ger.	* "*Engineering*,"
Wooden disk, *Kitson*, Br. . .	* "*Engineering*,"
Turned chilled, *Lobdell* . . .	"*Sc. American*
	* "*Railroad Gaz.*
Paige	* "*Sc. American*
Paper	"*Iron Age*," x 21, p. 9.
	* "*Railroad Gaz.*
Balancing, *Paris, Lyons & Medit. R. R.*	* "*Sc. Amer. Sup*
Foundry, Penn. Railway . .	* "*Engineering*,"
	* "*Engineering*,"
Tires, fracture of. Paper on .	"*Sc. American*
Self oiling, *Phillips*	* "*Sc. American*,
Steel-tired	* "*R. R. Gaz.*,"
Large *vs.* small, *Wallis* . . .	* "*Sc. Amer. Sup*
Swedish wrought iron . . .	* "*Railroad Gaz*

Car Wheel Bo'rer. A machine tool true the axle holes in car-wheels. It is boring machine of special adaptation. is chucked centrally and horizontally o and the boring tool brought upon it axia

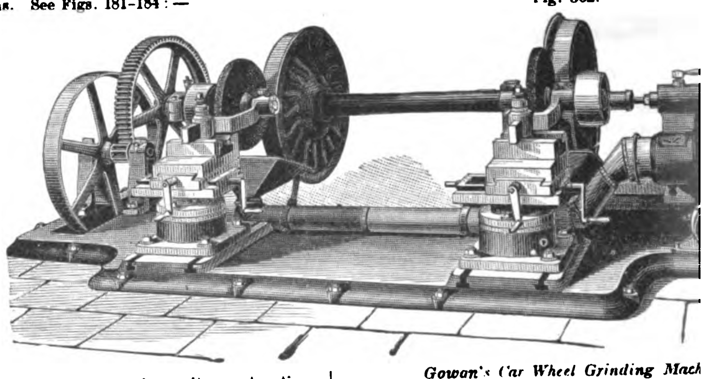
The car wheel lathe, Fig. 1172, "*Mech* adapted for similar work, while it is capab duties also.

Car Wheel Chuck. A chuck adapte ing a car wheel centrally upon a face pla ing or trueing the rim. *Horton.* It of universal chuck in which the jaws ar neously and equally approached by a sin ment, so as to maintain exactly equal tance from the center of the chuck.

Car Wheel Grind'ing Ma-chine chine for trueing worn car wheels by di rim and flange.

In Gowan's machine, shown in Fig. 56

Fig. 562.



Gowan's Car Wheel Grinding Mach

of wheels is chucked in a lathe, and wheels, mounted on tool rests, are appl The object is to dress them to absolut and normal shape of tread and flange, all flat places and every irregularity. car wheels revolve the reverse way to t lathe, at a rate of 1¼ revolutions The abrading wheels are of No. 16 strong and porous, running at 600 rev minute, 18″ wheel. A pair of 18″ × will true up 200 pairs of new 33″ ch provided they are truly fitted to the a haust fan withdraws the dust from bot

"*Railroad Gazette*" . . . . . *

Case. *Add.* (*Mining.*) *b.* A vein of quartz, not containing ore, and forming an angle with the lode.

8. (*Founding.*) The cope.

9. (*Fire-arms.*) The capsule of a cartridge.

Case'mate. A vault with an embrasure.

The *Gruson* chilled iron casemate (German) is shown in Plates XXVI.-XXX., Barnard & Wright's report on "*Fabrication of Iron for Defensive Purposes*," U. S. Engineer Department, Washington, 1871.

Casemate carriage for British 10-ton and 25-ton guns. Same report, p. 99, and Plate XVIII.

Casemates. Addendum to Supplement 21 of same report.

Case Trim'mer. (*Cartridges.*) An implement or machine, one or the other, used for trimming the mouths of shells for cartridges. These are fed by a funnel to the tool, which has a knife to cut them to an adjusted length.

Case Smooth'ing Ma-chine'. (*Bookbind-*

Fig. 563.

Sanborn's Case Smoothing Machine.

ing.) A machine for smoothing cloth cases for books; an efficient substitute for the bone folder. The cases are passed between the rubber rollers, two at a time, insides face to face. The top roller is adjustable by means of set screws, to suit any thickness of cover.

Cash'mere. (*Fabric.*) 1. A fine-wool French dress goods, woven with a twill on one side and piece-dyed.

Merino has both sides twilled.

2. A mixed fabric with cotton warp and XX. merino wool weft, made in imitation of the Cashmeres d'Écosse, which are all wool.

This goods is called Coburg in England.

Cashmere shawls. Hayes in "*Centennial Reports*," v. 75, 76.

Cash Re-cord'ing Ma-chine'. A machine on which is made and kept a tally of sums received or recorded.

A given sum being received by a salesman, for instance, he touches the knobs corresponding to (say) $, 1, 2, ., 4, 7, and the record $12.47 appears at a slot, and is at the same time printed on a slip (along with the date and name of the firm) which serves as a receipt, and on a second strip the series of sums which constitute a record of the day's receipts.

"*Scientific American*" . . . . . * xxxviii. 95.

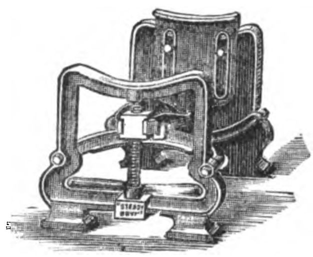
Cas'ing. (*Add.*) 4. (*Glass.*) Enclosing a blown object in another blown piece of similar shape and different color, and then blowing the inner one so that it expands against its envelope, when they may be firmly united by firing, and then finished as one piece.

5. (*Mining.*) A plank partition.

Cask. See Barrel.

Cask Stand. A support or stillion for casks, having an adjustable back support to tilt the cask when necessary. The lift is by a square chased screw, in order to give a steady movement to avoid disturbing the liquor.

Fig. 564.



Cask Stand.

Cas'se-role. A small pan, like a French stew-pan, used in laboratories.

Cas-so-lette'. A pan or tray for perfumes.

Cas'ter. A rolling foot.

Martin	* "*Iron Age*," xxii., August 8, p. 1.
Glass ball, *Adgate* . .	* "*Scientific Amer.*," xxxviii. 374.
Ball, *Konz*	* "*Scientific Amer.*," xxxviii. 6.
Anti-friction rollers.	
Gardner	* U. S. Patent, 111,193.

Cas'ter Rol'ling-col'ter. A wheel colter mounted on a swivel, so as to present in any direction the plow may be guided. Fig. 1391, p. 596, "*Mech. Dict.*" See Colter.

Cast Gate. (*Founding.*) The channel through which metal flows into a mold. *Ingate.*

Cast'ing. References to devices may be found as follows: —

Preventing honeycombs in	"*Sc. Am. Sup.*," 1842.
Small objects, *Hopkins*	* "*Sc. Amer. Sup.*," 272.
Steel, *Wright, Smith & Butler*, Engl.	"*Sc. Amer. Sup.*," 904.
Case hardening	"*Sc. Am. Sup.*," i. 353.

Cast'ing Net. (*Fishing.*) A net in extensive use in the West Indies, Florida, and elsewhere on the southern coast.

It consists of a circle of netting, varying in diameter from 4' to 15' or more, to the circumference of which are attached, at short intervals, leaden weights. There is a ferrule of bone or metal at a central opening in the net. One end of a long rope passes through this ferrule, and to it are attached numerous cords extending to the lead rope. The net is used by gathering up the casting-rope in a coil on one arm, and taking the net itself on the other. By a dexterous fling of the arm containing the net, this is thrown in such a way as to spread out completely, and it is hurled so as to fall perfectly flat on the surface of the water. The leads sink immediately, forming a circular inclosure, and imprisoning any fish that may happen to be under it at the time. The rope is then hauled in from the other end, causing the entire circumference to pucker inwardly, and the leads and puckered portion come together in a compact mass, in which the fish are entangled.

Cast Por'ce-lain. 1. A milk-white, somewhat translucent glass made from pure cryolite.

2. A uniformly colored or marbled variety of opaque glass made from impure cryolite.

The mixture for the milky variety is: 1 part of oxide of zinc, 4 parts of cryolite, and 10 parts of sand ore, fused in a common pipe-clay crucible, developing a large amount of fluosilicic acid. The pipe-clay is, however, not attacked much by it. This development continues throughout the fusion, and even after it, during the working to a small extent. This glass possesses a considerable hardness and power of resistance; even as a powder it is not attacked by strong acids. According to an analysis of Mr. Hagemann the composition is as follows: —

	Per cent.
Oxide of zinc	6.50
Silicic acid	68.40
Alumina	8.67
Soda	5.85
Oxide of iron and manganese	4.40
Undecomposed cryolite	15.14

The properties of this glass probably depend upon the presence of the undecomposed cryolite; for glass of the above composition, without any combinations of fluorine, is transparent and not colored. Glass with a small amount of cryolite has a milky-white, translucent color, and great brilliancy, refractive power, and strength. With a higher proportion it becomes opalescent, and with more cryolite, opaque and like porcelain.

Cat'a-lan Forge. (*Metallurgy.*) See Fig. 1185, p. 502, "*Mech. Dict.*," and BLOMARY, *supra*.

See also *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," tome ii., article "*Forges Catalanes*," Fig. 1035.

"Catalan forges for smelting iron ore and blomaries for refining pig-iron are largely used in Italy, their number being about 200. Charcoal is the principal fuel used in the furnaces, forges, and blomaries, the Appenine forests furnishing the most of it.

"In the island of Elba they are of unsurpassed richness. The iron ores on this island, and in other parts of Italy, were used long before the Christian era. There are three principal iron districts in Italy additional to Elba — Lombardy, Piedmont, and Tuscany. In all Italy there are about 40 blast furnaces, many of which, owing to the scarcity of fuel, have not recently been in operation.

"There are yet in operation in the United States 64 Catalan forges, for the direct conversion of iron ore into wrought iron; these forges are mainly in New York and Tennessee, and in the former State they are wholly engaged in the production of iron for the manufacture of steel." — *Morrell.*

Saranac . . . . "*Iron Age*," xviii., Sept. 7, p. 9.
* "*Scientific American Sup.*," 628

See also TROMPE.

Cat'a-ma-ran'. 1. A fishing raft used on the Coromandel coast of India. The name signifies "tied-trees," and correctly describes the raft made of 4 or 5 pieces of timber 6' or 7' long lashed together to form a width of 2½', narrowed to a point at one end. The fisherman kneels, and sits on his heels, as shown at Fig. 1186, p. 502, "*Mech. Dict.*"

2. The name has been applied to other craft, especially used on the Hudson River, and in New York harbor. These vessels have twin hulls united, and carry a cloud of canvas, being remarkably staunch.

3. A steam twin vessel similar to the last described, except in the means of propulsion and the necessary appendages of each respectively.

* "*Scientific American Sup.*," 3911.
Malay rig . . . * "*Scientific American Sup.*," 1860.
Herreshoff . . . * "*Harper's Weekly*," July 27, 1878.
N. Y. Yacht Club, "John Gilpin."
* "*Scientific American Sup.*," 1661, 1679.
Steam . . . . * "*Manufacturer & Builder*," xii. 177.

Cat'a-ract In'stru-ment. (*Surgical.*) Knives, needles, scissors, forceps, scoops. Specifically, —

The Figures refer to *Tiemann's* "*Armamentarium Chirurgicum*," Part II.

	Figs.
Cataract knife	113–115.
Cystotome, for lacerating the capsule	116, 117.
Linear knife	118, 129, *b*, *c*.
Tractor	119.
Lens scoop	120, 125, *b*, *c*.
Lens spoon	121.
Hooked needle	122.
Cataract scissors	126.
Bistoury, for enlarging the section	127.
Iridotomy scissors	127, *b*.
Keratome scissors	128, *b*.
Forceps needle, for false membranes	129.
Iris forceps	130, 131, 141, *c*.
Knife needle	132.
Iris knife	134, 135, 141.
Iris scissors	137, 139, 141, *b*.
Canulated forceps	140.
Stop needle	142.
Cataract needle	143–145.
Grooved needle, for soft cataract	147.
Tattoeing needle, for coloring white spots on the cornea	148–150, *b*.
Soft cataract exhauster	151, 152.
Canulated needle	138.
Lens forceps	140, *b*.

Ca-tarrh'al Douche. (*Surgical.*) A syringe for irrigating the fauces.

Fig. 364 *d*, p. 90, Part II., *Tiemann's* "*Armame Chirurgicum*."
See, also, Fig. 3297, p. 1512, "*Mech. Dict.*"

Cat Boat. A small boat, with a tria sail, without yard or gaff.

A very common rig of fishing-boat, b known among pleasure-boats of small and r size.

They may have one or two masts. See models Nos 25,026, 29,537, 26,585 in the U. S. Fishery Museum.
See, also, "*Scientific American Supplement*," * vi

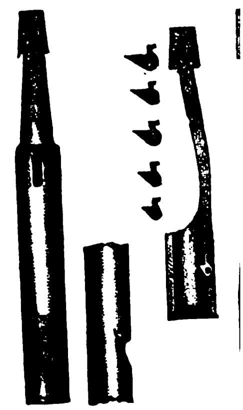
Catch'all. A tool, Fig. 565, for withd from drilled wells broken tools or bars whi have fallen in. Several forms are shown i LXXIV., p. 2756, "*Mech. Dict.*"

Catch Hook. A tool used in hauling pipe. It is pushed into the pipe, the tongue

Fig. 566.

Catch Hook.

Fig. 565.



Catchalls.

lying flatly on the shank. When the hitched to the stem, the tongue is lifted against the inside and prevent retraction.

Cath'e-ter. (*Surgical.*) A tube for off a liquid. The word is principally a urethral and Eustachian instruments. 1190, p. 504, "*Mech. Dict.*"

The specific names refer to shape, material, a etc.

Compound.	Soft rubber.
Double current.	Velvet-eye.
Eustachian.	Vulcanized.
Prostatic.	Sigmoid.

The surgeon's case also contains catheter holder syringes. The insulated catheter electrode is for tion of the male genital organ. Fig. 379, Part I., "*Armamentarium Chirurgicum*."

"The flexible metallic catheter is without eyes. is a hollow silver tube which continues for 4"; th then twisted spirally, diminishing gradually till it in a point not more than 1-32" diameter. Throug ter a strong wire is passed, the point terminating steel bend which is riveted to the wire. When t ment is to be introduced, the wire is drawn tigh the bend up to the point and protecting the men the catheter passes through. After the bladder entered, the wire is pushed forward, and the urine freely through every portion of the spiral tube." — *Thompson's* Report on Group XXIV., p. 63; vol. *tennial Exhibition Reports*."

Tiemann's "velvet-eye" catheter has a perfec eye, avoiding the irritation due to the use of *Nel* those of *Jacques'*, the eyes of which are punched.

Cath'e-tom'e-ter. An instrument by *Dulong & Petit*, and employed in p measure the vertical distance between tw

Described on page 504, "*Mech. Dict.*" An i may be found, if desired, on page 146, *Deschanel' Philosophy*," Part I., American edition.

Prof. Mayer's cathetometer, * "*Sc. Amer. Sup.*

Ca'tion. (*Electricity.*) The product evolved at the zinc pole in a voltaic battery. The positively charged molecules in a voltaic battery. — *Gordon*.

Anion is the product which is evolved at the copper pole of a voltaic battery. The negatively charged molecules in a voltaic battery. — *Gordon*.

Cat'ling. (*Surgical.*) A delicate concave-curved amputating knife.

Cat Rig. (*Nautical.*) See CAT BOAT.

Cat'tle Car. (*Railway.*) A car for live stock. A *stock*-car. Among the various kinds may be mentioned: —

Double deck, for sheep and hogs.
Single deck, for cattle and horses.
Combined cattle and box car, convertible into either.
Box cattle-car, with grated windows, closing in cold weather.
Slat cattle-car, open sides for air in warm weather.

Feeding en route, *Tingley* .	* "*Railroad Gazette*," xxiv. 436.
	* "*Manuf. & Builder*," xii. 172.
	* "*Scientific Amer.*," xliii. 374
Walter	* "*Scientific American*," xl. 407.

Caun'ter Lode. (*Mining.*) A lode which forms a considerable angle with others in the vicinity.

Caus'tic Hold'er. (*Surgical.*) A staff or cup to hold and apply caustic to a deep-seated part.

Caustic probes, and caustic syringes are instruments for the like application in specific manners.

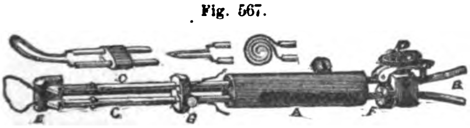
The use of the electric cautery has to a large extent superseded the devices used in potential cautery.
The figures refer to *Tiemann's* "*Armam. Chirurgicum.*"
The caustic holder may be like a porte-crayon to hold the stick of luna caustic, Figs. 154 *b*, 159 *b*, 155, Part I.; Fig. 45, Part III.

Or a scoop . . .	Fig. 200, Part II.
Or a brush . . .	Fig. 349, Part II.
Or a tube . . .	Fig. 345, Part II., 49, 365, Part III.
Or a probe . . .	Fig. 346, Part II., 310, Part III.
Or a forceps . .	Figs. 286, 297, 298, 577, Part III.
Or a syringe . .	Figs. 54, 366, Part III.

Cau'ter-y. (*Electricity.*) A burning instrument usually consisting of an electro-resisting wire or band of platinum, used in surgical operations instead of the heated spatula. See also ELECTRIC CAUTERY.

Fig. 567 is Dawson's universal electrode for galvanic cautery operations. The various attachments constitute it a

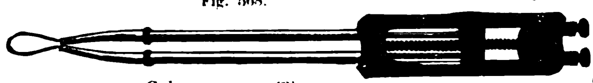
Fig. 567.



Dawson's "Universal" Cautery Electrode.

cautery écraseur, cautery knife, needle, applicator, etc. As an écraseur in the principal instance, Fig. 567 *A* is a solid hard rubber handle, through which pass the conducting rods *CC*, connected with the conducting wires at *B*. The rods *CC*, being hollow half their length, admit of the rods running from the ivory tip *E* to slide in and out like a telescope, which they are made to do by turning the small wheel *F*. This telescoping of the rods keeps up perfect current connection, and at the same time causes a slow contraction of the wire cautery loop at *E*, the ends of the wire being secured in the ivory clamps *G* on the rods *CC*. The current is regulated or cut off and on from the battery by the screw *D*

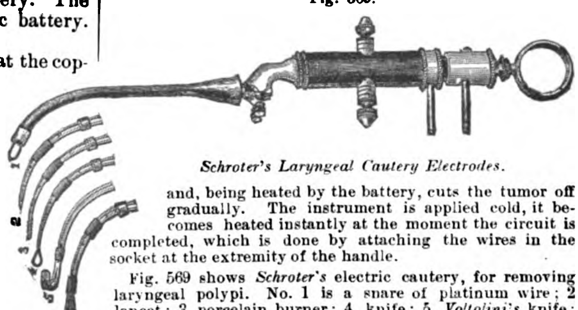
Fig. 568.



Galvano-cautery Sling.

Either of the three smaller instruments is used by withdrawing the tip with its rods and adjusting the substitute into the open ends of the rods *CC*.
In Fig. 568, the loop is formed of flexible platinum wire. By turning the wheel on the handle, the loop is contracted,

Fig. 569.



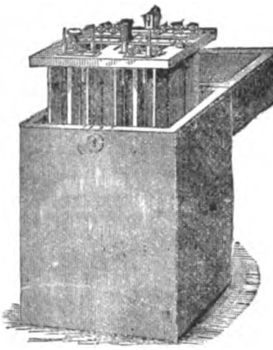
Schroter's Laryngeal Cautery Electrodes.

and, being heated by the battery, cuts the tumor off gradually. The instrument is applied cold, it becomes heated instantly at the moment the circuit is completed, which is done by attaching the wires in the socket at the extremity of the handle.

Fig. 569 shows *Schroter's* electric cautery, for removing laryngeal polypi. No. 1 is a snare of platinum wire; 2 lancet; 3, porcelain burner; 4, knife; 5, *Voltolini's* knife; 6 blunt cautery. Hard rubber handle, sea-horse mounted.

Cau'te-ry Bat'te-ry. A galvanic battery of relatively large electro-motive force and low internal resistance, to be used to heat the platinum wire of a cautery electrode.

Fig. 570.



Cautery Battery.

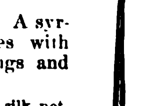
Cau'ter-y In'stru-ments. (*Surgical.*) The application of actual cautery by the battery has many media; among these are —

Écraseurs.
Moxas.
Scoops.
Knives.
Olives, etc.
See CAUTERY, etc.

Cav'al-ry Bit. One having an extended S check-piece, with a loose ring at the lower end, and a loop above the mouth-piece for receiving the bridle-strap. The check and mouth are solid, the latter being made with or without a port.

Ca'ves-son. (*Manége.*) A portion of the apparatus used in breaking a colt, the main feature of which is the nose-piece, which is buckled around the nostrils, having a long rein attached, and by which a colt is controlled until he becomes accustomed to the bit.

Fig. 571.



Cavil.

Cav'il. (*Stone Working.*) A heavy stone hammer with one blunt face and one pyramidal or pointed peen. It is used in a quarry for rough dressing stones for transportation. Weighs from 15 to 20 pounds.

Cav'i-ty Dry'er. (*Dental.*) A syringe for drying dental cavities with warm air, and removing cuttings and bur-dust from excavations.

The rubber air-bulb is covered with silk netting. The other bulb is metallic, and heated over a spirit lamp. In using, the air is expelled, the bulb heated, and the air is then heated by inspiration, and again by expiration as it passes to the tooth.

Fig. 572.

Cavity Dryer.

Ce-les'tial In'di-ca'-tor. An apparatus by which the relative positions of the constellations and principal stars are indicated, so as to enable a person to find them by setting the instrument so that its meridian is in a line with the observer and the north star.

Invented by *Mauperin*, * "*La Nature*," reproduced in "*Scientific American Supplement*," * 622.
See also COSMOGRAPH.

Cell. 1. (*Optics.*) A little frame or shallow box to hold or surround a microscopic object; lying sometimes on a slide, and surmounted by a glass cover.

They are made of glass, block-tin, ebonite, etc., and are of many shapes and sizes.

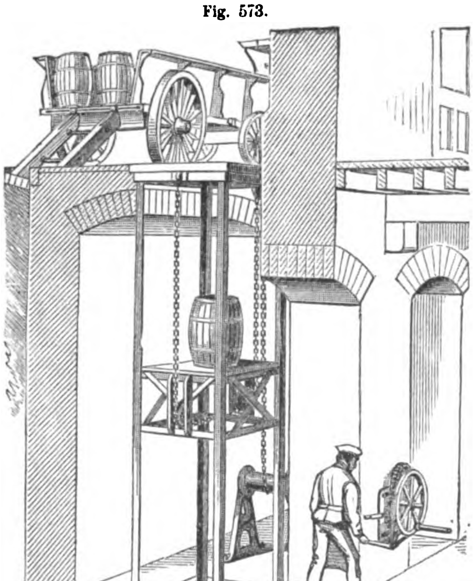
2. (*Electricity.*) A jar or vessel containing the exciting fluid of a battery. See GALVANIC BATTERY.

Cel'lar Crane. A device used in confined situations in streets and warehouses.

The jib of the crane is fixed in the cellar and is made telescopic, so that the load is first lifted from any point within the radius of the crane, and is afterward lifted and carried in a diagonal direction through the doors or flaps until it is high enough to be deposited in the street or on a truck.

Cel'lar Lift. A hoist for raising or lowering

Fig. 573.



Appleby's Cellar Lift.

goods to or from the pavement and the cellar. It works vertically in guides, or on the incline of a ladder, according to convenience.

It is shown in the act of lowering, the man holding the brake.

Cell Cut'ter. A tool for cutting cells out of thin wax: it resembles a wad cutter; any circular tube with a sharp edge will answer the purpose.

Cel'lu-loid. A product having pyroxyline or soluble gun-cotton as its base. A substitute for hardened caoutchouc. Inflammable and dangerous.

Parkesine. Pyroxyline incorporated with linseed oil. Used for knife handles, etc. Named after the English inventor, Mr. Parkes.

Celluloid. Pyroxyline and camphor: —

A solution containing about equal parts of camphor and tetrachloride of carbon, dissolves or softens pyroxyline very readily; and if such a solution is incorporated wit ficient proportion of the soluble nitro-cellulose, a do mass is obtained, which hardens on the evaporatio tetrachloride of carbon; but the material may b made plastic and workable by being heated to a tem between 100° and 125° Centigrade.

Or: the materials may be mixed mechanically at lated temperature.

Or: the camphor may be dissolved in carbon di-s liquefied sulphurous acid, or other solvents.

Parkes process: Nitro-cellulose softened in alco forced into molds under pressure.

The business in this country is understood to b cally under the Hyatt patents, and celluloid made o sue paper and camphor treated with chemicals by ented process. The material is made by the comp sold to parties to make into various articles, the pri graduated according to the ability of the article to given price. The material, while of one quality, is stance, 60 per cent. cheaper for umbrella-handle than for jewelry.

Celluloid may be any color, or mottled. Imit ivory, coral, ebony, horn, tortoise-shell, porcelain, m amber, are easily made.

Celluloid, in its use as a substitute for ivory, ha exercised a great effect upon the ivory industry.

This composition is used for: —

Billiard balls.	Pocket-books.
Combs.	Mouth-pieces for pip
Backs of brushes.	Cigar-holders.
Hand mirrors.	Musical instruments
Toilet articles.	Doll heads.
Whip and cane handles.	Porcelain imitations
Umbrella handles.	Hat bands,
Harness trimmings.	Neckties.
Foot rules.	Optical goods.
Chessmen.	Shoe tips and insole
Knife and fork handles.	Thimbles.
Pencil cases.	Emery wheels.
Dental plates.	Shirt cuffs.
Jewelry.	Collars, etc.

The French process is thus given in the "*Bull.* *Industrielle de Rouen:*" —

"Paper is treated by a continuous process with sulphuric acid and 2 of nitric acid, which convert sort of gun-cotton. The excess of acid is removed ure, followed up by washing with abundance The paste when thus washed, drained, and parti is ground in a mill, mixed with camphor, grou strongly pressed, dried under a hydraulic pres leaves of blotting-paper, cut, bruised, laminated, pressed again in a special apparatus suitably hea said to be hard, tough, transparent, elastic, fusib ing plastic and malleable at 125° C. It ignites with is decomposed suddenly at 140° C. without inflamm gives rise to reddish fumes. It is inodorous, an become electric on friction."

Other compositions of various materials may b follows: see also list under COMPOSITIONS.

Bone-silate.	Ebonite.
Bois-durci.	Eburine.
Boulinikon.	Ebony, artifici
Coral, artificial.	Ivory, artificia
Cellulose.	Hemacite.

The following list includes the United States Pa to January 1, 1881, on celluloid and allied compo lodion, pyroxyline, xyloidine. Processes, apparat plications: —

65,267	*Pierson*, Plastic compound of vegetable f
77,304	*McClelland*, Plastic for dental plates.
79,261	*Seely*, Solidified collodion.
81,089	*Hulbert & Follett*, Fabric coated with col
86,841	*Kendall & Trested*, Coating of fabrics wit
88,228	*Streeter*, Veneering articles with pyroxyl
88,229	*Streeter*, Dentists' flasks.
*88,260	*Streeter*, Compound for dental plates.
88,624	*Hyatt*, Coating billiard balls.
*88,633	*Hyatt*, Compound for artificial ivory.
*88,634	*Hyatt*, Coating billiard balls.
89,253	*Streeter*, Dental plate.
89,254	*Streeter*, Treating pyrole, pyroxyline, etc
89,582	*Hyatt & Blake*, Ivory dust, etc., compou
*90,765	*McClelland*, Celluloid dental plate.
90,766	*McClelland*, Treating collodion.
91,341	*Hyatt & Hyatt*, Solid collodion.
91,377	*Spill*, Xyloidine compound.
91,378	*Spill*, Telegraph wire insulator.
91,393	*Whitehouse*, Xyloidine insulator.
90,765	*McClelland*. Dental plate.
90,766	*McClelland*, Machine for treating collod
93,076	*Hill*, Dental plate.
96,182	*McClelland*, Forming collodion articles.

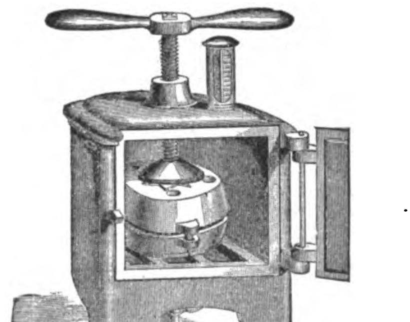
3,777	(Reissue) *McClelland*, Collodion compound.
3,778	(Reissue) *McClelland*, Material for dental plates.
97,454	*Spill*, Dissolving pyroxyline.
101,175	*Spill*, Manuf. of xyloidine, etc.
105,338	*Hyatt & Hyatt*, Molding pyroxyline. (Reissue, 5,928.)
105,823	*McClelland*, Coating objects with collodion.
113,065	*Hyatts & Perkins*, Pyroxyline dental plates.
113,272	*Deitz, Wayne & Stone*, Billiard balls.
113,735	*Brockway*, Molding apparatus.
113,736	*Brockway*, Dental plates.
114,242	*Winsborough*, Pyroxyline for dental plates.
114,945	*Hyatt*, Billiard balls, handles, etc.
119,710	*Hyatt*, Inlaying.
120,130	*Troutman*, Attaching teeth to plates.
121,522	*Hyatt & Hyatt*, Molding dental plates.
125,979	*Newton*, Attaching pyroxyline base to teeth.
126,575	*Pursell*, Apparatus for attaching teeth to base.
127,656	*Smith*, Composition for dental plates.
128,729	*Hyatt & Hyatt*, Enameling, checkers.
133,229	*Hyatt & Hyatt*, Apparatus for making pyroxyline.
133,969	*Dietz & Wayne*, Manufacture of pyroxyline.
135,918	*Hyatt & Hyatt*, Toilet combs.
136,735	*Jones*, Truss pads.
138,254	*Hyatt*, Manufacture of pyroxyline articles.
143,772	*McClelland*, Collodion compound.
143,865	*Anthony*, Preparing soluble cotton.
150,722	*Smith*, Artificial coral.
152,232	*Hyatt*, Apparatus and process celluloid.
153,196	*Hunt*, Molding celluloid for dentists.
156,352	*Hyatt & Hyatt*, Solidified collodion.
156,353	*Hyatt & Hyatt*, Manufacture of celluloid.
156,354	*Hyatt & Hyatt*, Factitious ivory.
162,128	*White*, Dental pots.
162,752	*Hunt*, Softening and molding celluloids.
165,234	*Hyatt & Hyatt*, Grinding mill.
165,303	*Cannon*, Treating celluloid for dental vases.
172,995	*Greening*, soluble gun cotton.
173,865	*Reagles*, Composition for dental plates.
177,153	*Pitman*, Celluloid boat.
184,481	*Sweeney*, Graphite and collodion lubricant.
195,010	*Hyatt*, Brushes.
199,908	*Hyatt*, Celluloid, sheets of.
199,909	*Hyatt*, Celluloid combs.
200,939	*Sanborn*, Cuffs, collars, etc.
201,348	*Hyatt & Hyatt*, Imitations of celluloid.
202,441	*Hyatt*, Coating with celluloid.
203,631	*Lockwood*, Martingale rings, coated with celluloid.
203,838	*Hyatt*, Shoe-tips.
204,227	*Hyatt*, Covering cores and tubes of celluloid, etc.
204,228	*Hyatt*, Tubes, etc., of celluloid.
204,229	*Hyatt*, Apparatus for coating bars with celluloid.
205,271	*Hyatt*, Sheets of celluloid, etc.
205,880	*Lockwood*, Strips for coating articles.
206,584	*Fontayne*, Ornamenting glass.
210,611	*Hyatt*, Apparatus manuf. nitrocellulose.
210,612	*Hyatt*, Apparatus for washing pulp.
210,780	*Hyatt*, Piano keys.
212,948	*Kanouse*, Sweat band for hats.
214,665	*Kays & Hulsey*, Lathe for turning celluloid.
216,474	*Tribouillet & Besaucele*, Solid collodion.
217,111	*Johnson*, Molding celluloid, etc.
217,232	*McCaine*, Treating pyroxyline.
218,019	*Halsey*, Neckties and bows.
218,122	*Hyatt*, Cards and labels of celluloid.
219,218	*Carpenter*, Celluloid taper tubes.
219,235	*Edson*, Drying celluloid.
219,279	*Lefferts*, Pitchers and vessels.
220,336	*Kanouse & Sanborn*, Collars and cuffs.
220,502	*Spencer*, Frames for optical instruments.
221,070	*Hyatt*, Manufacture of celluloid.
221,977	*Sanborn*, Collars and cuffs.
222,229	*Beals & Thomas*, Handles for cutlery, etc.
222,678	*Dobbins*, Celluloid dental vases.
223,311	*Booth*, Combs from celluloid.
224,682	*Halsey*, Thimbles, blanks of celluloid.
229,477	*Schmerber & Arrault*, Grinding and mixing.
230,216	*Arrault & Schmerber*, Nitro-derivatives from cellulose.
232,037	*Hyatt*, Applying veneers of celluloid.
232,095	*Whiting*, Celluloid boxes.
233,076	*Corvin*, Celluloid ornamentation.
233,414	*Hays & Hays*, Celluloid wearing belt.
233,558	*Schmerber*, Treatment of nitro-derivatives of cellulose.
233,558	*Schmerber & Schmerber*, Treating pyroxyline.
233,604	*Deutsch & Kanause*, Drumhead of celluloid.
233,824	*Whittemore*, Crutch top.
233,851	*Hart & Bacon*, Decorating celluloid.
233,878	*Sanborn*, Elastic pressing die.
233,898	*Villiers*, Die for molding thimbles.
234,665	*Fox*, Cuffs and fronts.
234,823	*Trested*, Faucet and gage-cock.
235,932	*Carpenter*, Celluloid tubes.
325,933	*Carpenter*, Celluloid dolls.
235,953	*Lefferts*, Syringes.
235,954	*Lefferts*, Spoons and forks.
235,958	*Otto*, Bougies, pumps, etc.
235,959	*Otto*, Pessaries.

See also the following references: —

Man. & uses . .	"*Iron Age*," xxiii., May 22, p. 7; xxiv., Dec. 25, p. 13.
Applications . .	"*Iron Age*," xxvi., July 29, p. 7; Aug. 19, p. 13.
Explosions . .	"*Iron Age*," xxiv., Dec. 11, p. 20.
Patent decision .	"*Iron Age*," xxv., June 24, p. 5.
Incendiary .	"*Iron Age*," xix., May 3, p. 15.
Uses, etc., . .	"*Manuf. & Builder*," vii. 219; viii. 206–208; ix. 47; xii. 7, 73, 95, 144.
Emery wheels .	"*Manuf and Builder*," viii. 233; ix. 125.
Printing plates .	"*Manuf. and Builder*," xii. 255.
Paper celluloid .	"*Manuf. and Builder*," x. 18.
Preparation of .	"*Eng. and Min. Jour.*," xxiv. 208.
Uses, etc. . . .	"*Eng. and Min. Jour.*," xxvii. 279, 409; xxviii. 300; xxix. 50.
Printing Plates .	"*Eng. and Min. Jour.*," xxx. 125, 141.
	"*Mining & Scientific Press*," xxxii. 166, xxxviii. 23.
Cloute	"*Technologiste*," xxxviii. 346.
Uses	"*Am. Man. & Iron World*," xxv., May 23, p. 8; xxvi., Jan. 23, p. 13.
Veneers . . .	"*Am. Man. & Iron World*," xxvi., July 23, p. 8.
Stereotypes . .	"*Am. Man. & Iron World*," xxvi., Sept. 3, p. 8.
	"*Leffel's Mill. & Mech. News*," ix. 119, 188.
Applications . .	"*Sc. American*," xxxvii. 147, 204; xl. 225.
	"*Sc. American Supplement*," 1101, 3617.
	"*English Mechanic*," xxiii. 416.
Parkesine . .	"*English Mechanic*," xxvi. 223.
Apparatus . .	"*English Mechanic*," S. S. White's Dental Catalogue, * ed. 1878, pp. 56, 335.

Cel'lu-loid Heat'er. A small oven for packing while heating celluloid plates. It has an inner

Fig. 574.



Heindsmann's Celluloid Heater.

and outer chamber, the latter affording a continuous circulation of heated air. The bottom is ribbed, and the intercostal space filled with plaster to prevent too rapid heating. The door is hinged. The flask containing the teeth and plate is set in, and a clamp screw set through the top of the heater impinges upon the top of the flask. The plaster of the bottom is heated, and the evaporation produces the moist heat which is desirable in the earlier part of the process.

Cel'lu-lose'. The fiber of vegetables; useful especially in the industrial arts as the foundation material for paper; but also of importance as ingredient in the group of objects of which pyroxyline, celluloid, etc., are examples, and as a material which is saturated with nitro-glycerine to produce explosives, under various names.

Refer to . . .	"*Manufacturer & Builder*," x. 231.
	"*Scientific American*," xxxv. 41.
	"*Scientific American Supplement*," 3341.
Mitscherlich .	"*Technologiste*," xxxvii. 76.

Ce-ment′. A material for uniting objects or protecting their surfaces.

The compositions differ greatly, and the term is of so wide a signification that it includes mortar, building cements, sticking compositions of gum or resin in solution, pastes, and badigeon for stopping cracks or hiding faults in work; luting for glass or ceramic tubes and vessels. See also CEMENT, pages 507–509, "*Mech. Dict.*"

Besides the recipes and directions found in the following list, there are numerous varieties known under special names, such as BADIGEON, BÉTON, BRECCIA, CONCRETE, HYDRAULIC CEMENT, MORTAR, POZZUOLANA, SCAGLIOLA, STUCCO, etc., in "*Mech. Dict.*" *et infra.* See list on page 1405 of the work cited.

Acid proof: Melt caoutchouc, and add 6 to 8 per cent. of tallow: stir: add dry slaked lime to bring it to the consistency of paste; then add 20 per cent. of red lead.

Or — To a solution of caoutchouc add twice its weight of raw linseed oil; then an equal weight of pipe-clay.

As a lining of cells to make them acid proof: line them with slats of barytes joined with a cement of —

Caoutchouc	1
Turpentine	2
Pulv. barytes	4

To protect a cork from nitric acid: Soak it in a solution of silicate of soda; when hardened, insert cork, and cover with a paste of silicate of soda and pounded glass; wash with solution of chl. calcium. Good for luting.

For protecting wood from acids, alkalies, and corrosive gases: 6 parts colophony, 3 wood tar, fused together, and 4 parts of brickdust stirred in; apply warm.

To unite metal to glass: Powdered litharge . . . 2
Dry white lead 2

Mix; and work up with linseed oil (3) and copal (1) to a dough. The cement is attached to the metal, the glass pressed on, and superfluous cement scraped off.

Or take — Thick solution of glue 2
Linseed oil varnish 1

Boil and stir.

Or — Rosin	8
Caustic soda	1
Water	5

boiled and mixed with half the weight of gypsum.

For fastening letters on glass: Dilute white of egg with water, and add carbolic acid to prevent decomposition; filter: paint the glass with a badger brush; apply the gold or silver leaf; dry; mark the letters with a stencil; put in a warm bath, and remove with the nail superfluous metal.

To stop cracks in glass: Dissolve casein in cold saturated solution of borax; with this solution paste strips of softened bladder on the cracks; dry.

Strong transparent cement, for glass, wood, porcelain, stone. Rub together in a mortar —

Nitrate of lime	2
Water	25
Powdered gum arabic	20

For glass: 1 part India-rubber, dissolved in 60 parts chloroform: 34 mastic; digested at a gentle heat.

Another: Orange shellac, bruised 4
Rectified spirits 3

Put in a warm place, and shake occasionally till dissolved.

To attach wood to glass: Solution of isinglass in acetic acid.

To attach tin to metal: Mucilage tragacanth. . 10
Honey of roses . . . 10
Flour . . . . 1 Mix.

Waterproof cement: Gelatine 5
Soluble acid chromate of lime 1

Cover the broken edges, press together, and expose to sunlight.

To attach wood to wood, or to make cracks in wood water-tight: Lime clay, and oxide of iron; kept dry till wanted, then mix with water and use.

To stick paper, leather, or wood to metal: To a gill of glue dissolved in water add a tablespoonful of glycerine.

To stick leather to metal: Powdered nutgalls dissolved in 8 parts of distilled water; settle 6 hours and filter. Apply this to the leather. Then take a similar quantity of water and add to it 1 part (by weight) of glue. Let it remain in solution 24 hours. Apply to the metal, which should be roughened and heated.

Lay the leather on the metal and dry under pressure.

Rubber Cement: 1 part India-rubber dissolved in 2 parts linseed oil; add quantity sufficient bole, say 3 parts.

For tortoise-shell, amber, etc.: Equal parts mastic and linseed oil, gently warmed, make a good cement, applied warm.

For uniting wood to wood: Shellac dissolved in alcohol. It is well to interpose gauze or thin fabric between the two surfaces. Or shellac, mastic, and turpentine heated, to which isinglass, in small pieces, is added, may be employed.

Attaching small articles to hard surfaces: Coloph pentine, yellow wax, with a small proportion of p sealing wax.

For bone, ivory, mother of pearl, etc.: Glue, dis water and quicklime; pulverized chalk may als ployed.

For ivory: Place pure gelatine in a strong solutio mina. When penetrated by the latter withdraw an mediately. When dry polish.

For porcelain: White of eggs mixed with solutio

Or: 4 parts pulverized oyster shells, and 2 gu preserve in a tightly stopped bottle and when requir mix with white of eggs or warm water to a dough ency.

Or: 8 parts well-burnt alabaster gypsum, 2 parts arabic, mixed with water into a thick paste and drops oil of turpentine added to each ounce of the c

Caseine Cements, for glass, porcelain, stone, a Old cheese rubbed fine and mixed with water, formi to which ¼ part of pulverized lime is added.

Or: 1 part quicklime in water, ¾ pulverized lime stone, 1 pulverized cheese.

Caseine water glass: The caseine is separated fron milk by adding acetic acid, filtering and washi mixed with 6 times its bulk of concentrated water

For artificial meerschaum, coating artificial flo Two to 4 parts of the above is rubbed up with col lution till a thick liquid is obtained that become standing. This is useful for stiffening and wat goods.

Water glass cement. For glass, porcelain, earthen Rub together 1 part finely pulverized glass and 2 fluor spar, add water glass solution till the proper c is attained.

For the joints and edges of stone and marble sl glass, mixed with hydraulic cement to form a thi

For cementing stone, and filling up crevices p painting; fresh blood, slaked lime, brick-dust, hammer-slag, and sand in various proportions.

For the joints of water-pipes, etc.: 2 parts fine 2 quicklime, and 2 hammer-slag, made into a doug or hot oil.

For rendering Hessian clay retorts impenetr slaked lime rubbed into concentrated solution of solution is applied with a brush and after drying heated until the glazing begins to fuse.

German cement for closing joints of stoves: with water, fresh warm blood, and quicklime; i while hot. A compound of wood ashes, fire cla mixed with water is also employed.

Iron cement: 5 parts clay, 1 salt, and 15 i Good to resist heat.

White marble cement: Take 8 parts of resin an to which, when melted together, add 4 parts c Paris. This is used while hot. Apply only a th

Or: Mix 12 parts of Portland cement, 6 par lime, 6 parts of fine sand, and 1 part of infusoria make up into a thick paste with silicate of soda. to be cemented does not require to be heated. twenty-four hours, and the fracture cannot be re

For wood, porcelain, or glass: To a strong sol arabic, 8½ fluid ounces, add a solution of 30 gra of aluminium dissolved in ⅔ of water.

For outside brick-work: Mix 20 parts clean riv quick lime, and sufficient linseed oil to form a This is also useful as a cement for broken stone.

Oil cements. 1. *For porcelain and for luting paratus:* Fine brick-dust mixed with an equal red lead and rubbed or ground with old boiled after being applied, sand is strewn upon it.

2. 6 litharge, 4 pulverized fresh burned lime, bole, mixed with cold linseed oil.

3. *For iron water-pipes:* 12 parts Roman cem lead, 1 litharge, ¼ colophony — pulverize, mix. a 2½ or 3 pounds with old linseed oil, in which 2 o has been boiled.

Or: Equal parts lime, Roman cement, and p finely ground, sifted, and well mixed with linse

4. *Common lead luting* is made of litharge mixed with old boiled oil.

Another is composed of 2 parts red lead, 5 wh 5 fine clay — mix with boiled oil.

5. *For wood:* 1 part pulverized slaked lime flour, mixed with linseed oil varnish.

6. *To make water-holders tight:* Pulverized and cod-liver oil: chemical apparatus may be n oil cake or pressed almond cake, rubbed up wit

7. 10 parts red lead, 25 white lead, 20 pi with boiled oil.

Water cement: 10 parts slaked lime, 19 brick- 5 blacksmiths' dross, 5 powdered quick lime water.

Iron and blood cement: 100 parts pulverize rated with bullocks' blood, 200 parts cement parts iron filings.

Ce-ment′, Plas′ter, Glue, etc.

See under the following heads: —

Alabaster, imitation.	Lime screen.
Amber cement.	Marble, artificial.
Asphaltum, artificial.	Marble cement.
Belting cement.	Marbleizing iron.
Béton.	Marine glue.
Black mortar.	Mixing machine.
Caoutchouc cement.	Mortar.
Carbonated stone.	Mortar machine.
Cement (see list).	Mortar mill.
Cement cask.	Mortar mixer.
Cement mill.	Mouth glue.
Clay mill.	Mucilage.
Clay tempering mill.	Plaster.
Concrete.	Plastering.
Cutler's cement.	Plastering machine.
Distemper.	Plaster mill.
Floor cement.	Portable glue.
Glass cement.	Portland cement.
Glue.	Pozzuolana.
Glutine.	Rust cement.
Glycerine cement.	Sand dryer.
Hammond artificial stone.	Sand screen.
Hydraulic cement.	Sand sifter.
India-rubber cement.	Screen.
Insoluble cement.	Slag cement.
Iron cement.	Stamp mucilage.
Jewelers' cement.	Steam proof cement.
Lamp cement.	Stone, artificial.
Leather cement.	Stone, carbonated.
Lime cracker.	Stucco.
Lime kiln.	Water-proof cement.
Lime mill.	Whitewash.

See the following references to cements: —

Acid proof	"*Scientific Am.*," xxxvi. 218.
Architectural, "*Engineer*" .	"*Van Nost. Mag.*," xix. 498.
Bottle sealing	"*Scientific Am.*," xxxix. 231.
Caoutchouc to metal . . .	"*Scientific Am. Sup.*," 454.
Calcimine	"*Scientific Am.*," xxxiv. 394.
Cement-making plant.	
Michèle	* "*Engineer*," xlvii. 186.
Cutlers'	"*Scientific Am.*," xxxvi. 214.
Castings, holes in	"*Scientific Am.*," xxxix. 197.
Cast iron	"*Scientific Am.*," xl. 182.
Glass	"*Scientific Am.*," xxxvi. 218.
	"*Scientific Am.*," xl. 184.
Hydraulic, American . . .	"*Iron Age*," xxv., June 3, 15.
Iron	"*Scientific Am.*," xxxiv. 181.
Insoluble	"*Scientific Am.*," xxxix. 399.
Manufacture, *Goodridge* . .	"*Man. & B.*," ix. 282.
Metallic to non-metal. articles	"*Scientific Am.*," xxxv. 23.
Metals to glass	"*Sc. Am.*," xl. 104, 243.
Metals to glass windows . .	"*Scientific Am.*," xxxvi. 25.
Ornaments	"*Scientific Am. Sup.*," 692.
Philadelphia, 1876, at . . .	"*Scientific Am. Sup.*," 1011.
Pipes	"*Engineering*," xxii. 408.
Portland (tests)	"*Scientific Am.*," xxxv. 209.
Making	* "*Man. & Builder*," ix. 32.
Faija	"*Van Nost. Mag.*," xxii. 463.
Adulteration of	"*Van Nost. Mag.*," xxiii. 27.
"*Building News*" . . .	"*Van Nost. Mag.*," xxii. 156.
Sewage dryer, *Wilson*, Br.	"*Engineering*," xxviii. 378.
Tester, *Fairbanks*	* "*Man. & B.*," xii. 280.
Holste, Ger.	* "*Engineering*," xxvi. 163.
Jacob, Br.	* "*Engineer*," xlviii. 397; * xlviii. 438.
Adelaide water works . .	* "*Engineer*," xlix. 100.
Valuation of, *Michaelis* . .	"*Scientific Am. Sup.*," 1818.
Waterproof	"*Scientific Am.*," xxxvi. 199.
	"*Scientific Am.*," xxxv. 353.
Wooden baths	"*Scientific Am. Sup.*," 1105.

See Report on Cements by Gen *Q. A. Gillmore*, "*Centennial Exhibition Reports*," Group II., vol. iii., p. 147 *et seq.* Including —

Puzzuolana.	Vicat's cement.
Trass.	Hydraulic lime.
Roman cement.	Artificial stone.
Portland cement.	Phœnix stone.

See also: —

Gilmore's Practical Treatise on Limes, Hydraulic Cements, and Mortars."

Gillmore's "*Coignet Béton and Other Artificial Stone.*"

Reid's "*Practical Treatise on Manuf. of Portland Cement.*"

Reid's "*Pract. Treatise on Concrete, and How to Make it.*"

Austin's "*Practical Treatise on Calcareous and Hydraulic Limes and Cements.*"

Dobson's "*Foundations and Concrete Works.*"

Burnell's "*Rudimentary Treatise on Limes, Cements, Mortars, Concretes, Mastics, Plastering,*" etc.

Ce-ment′ Cask. Casks, or rather cisterns of cement have been used in Zurich since 1871, by M. Bollert, for storing wine.

First coat selected portions of the cellar walls roughly with cement-mortar, and then with the best pure Portland cement form the other portions of the vessels by pouring the material into suitably constructed wooden molds. The finished vessels may be similar in external appearance to the wooden ones if desired. After the interior is sufficiently hardened, fill with water for 10 days, to ascertain whether they are tight, and also to extract the caustic ingredients of the cement. The latter object is, however, better accomplished with a solution of carbonate of ammonia and subsequent rinsing with water.

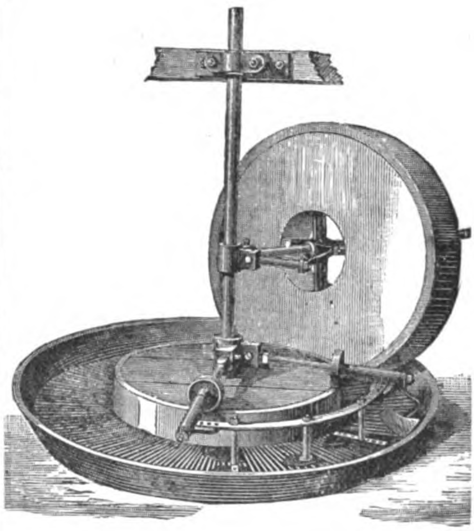
Ce-ment′ Mill. 1. A mill for crushing the auriferous gravel cemented with clay found in the placers of California.

One belonging to the New York & Calaveras Mining Company is cylindrical in form, 41′ long and 6¼′ diameter, set on an incline of ½″ to the foot and revolved. Interior flanges break the cement in passing, water being supplied freely and spaces left to allow the crushed cement to pass out. The bowlders and blocks of cement grind against each other in transitu and the cement is degraded.

2. A mill for grinding cement stone to powder suitable for making mortar, béton. etc.

The machine of *Jannot fils*, of Triel (*Seine-et-Oise*), France, has a Chilian edge-stone traversing in an annular

Fig. 575.



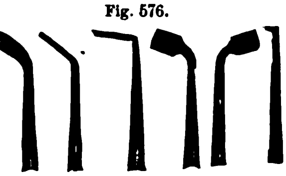
Cement Mill. (*Jannot fils, Triel, France.*)

pan, and with various scrapers which lift the cement and throw it again and again into the path of the stone. A horse is hitched to the horizontal axis of the stone.

It is used for grinding plaster for building, pozzuolana, charcoal, etc.

Ce-ment′ Plug′ger. (*Dentistry.*) An instrument for plugging carious teeth with oxychloride cement.

Fig. 576.

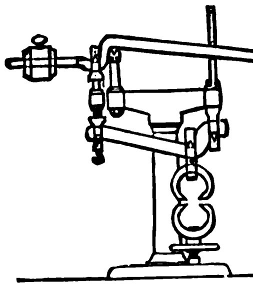


Atkinson's Cement Pluggers.

Ce-ment′ Steel. (*Metallurgy.*) Steel obtained by piling bars of wrought iron in a furnace interstratified with charcoal and exposure to heat without access of air. See Figs. 1197, 1198, p. 509; also p. 2364, "*Mech. Dict.*," *Blister Steel.*

Ce-ment′ Test′er. A machine for ascertaining the breaking strain, or the crushing resistance of cement.

Fig. 577.

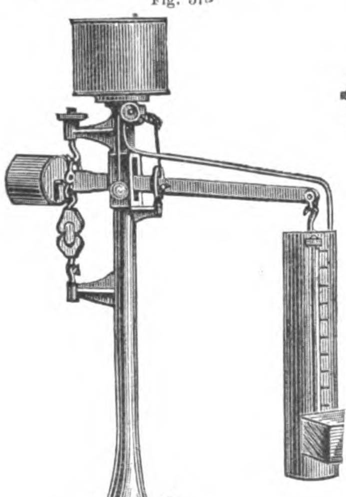


Michaelis' Cement Tester (German).

Fig. 577 shows the apparatus devised by *M. Michaelis*, of Berlin, and which is largely used in Germany.

It has a standard 15″ high, to which are attached two levers, the power of the upper one being 10 to 1, and the lower 1 to 1. The lower lever carries one of the jaws for holding the briquette, while the other jaw is attached to the base plate of the machine, and is vertically adjustable by means of a hand-wheel and screw. From the end of the long limb of the upper lever is suspended a weight-pan, with hooks at the lower end of its framing for carrying a receiver for holding shot. When at rest, the knife-edges of the levers should be on a level, their adjustment being effected by means of the counter-weight on the short limb of the upper lever. In operating with this apparatus the briquette is placed in the holding jaws, which are then adjusted by means of the hand-wheel and screw. Fine shot is then poured into the suspended receiver until the fracture of the briquette takes place. The receiver with the shot is then weighed by an ordinary pair of scales, or it may be weighed on the apparatus itself by hanging it on the hook of the connecting link between the two levers, the weights being placed in the weight-pan. Weighing by independent scales, however, is more expeditious. The weight of the receiver and shot, multiplied by 50, represents the tensile strength of the briquette per square inch of sectional area. The apparatus is portable and does not require to be fastened down for use. It is about 23″ high and 25″ long, and only weighs a little over 50 pounds.

Fig. 578



Bailey & Co.'s Cement Tester (English).

Another machine, on the same principle, is made by Bailey & Co., of Salford, England; but the weight consists of a can, into which water flows from a small reservoir or the summit of the ı
A graduated glass tube indicates the weigh
liquid in the can, and when the cement is
a trigger closes the tap and stops the flow c

The cement tester of M. Hervé Mang
structed for the *Laboratoire des Ponts et C*
of France, is shown in Fig. 579.

The block of cement, molded into the form shov
held between two clasps, the upper one of whi
pended from the short arm of the beam and the
retained by a rod fastened to the frame of the
and capable of adjustment as to length by a hand-
which screws on the thread of the rod. Weight
imately sufficient for the purpose, are placed on the
platform, which is suspended from the end of the
and the smaller weight *P* is then advanced along
uated beam by means of the hand-wheel *C* and
or, for still more delicate movement, by the wheel
moves the worm by pinion and cog-wheel.

M. Mangon remarks that mortar formed of cem
sand 2, should not be subjected to test in less th
hours; and that a test-block 0.04 m. on each side
rowest part, or 0.16 m. square in cross-section shou
after five days at least, 70 kilos before breaking.

The machine made by *Paupier*, of Paris, is ada
for traction or crushing.

M. Hervé Mangon speaks as follows of the P
ment: —

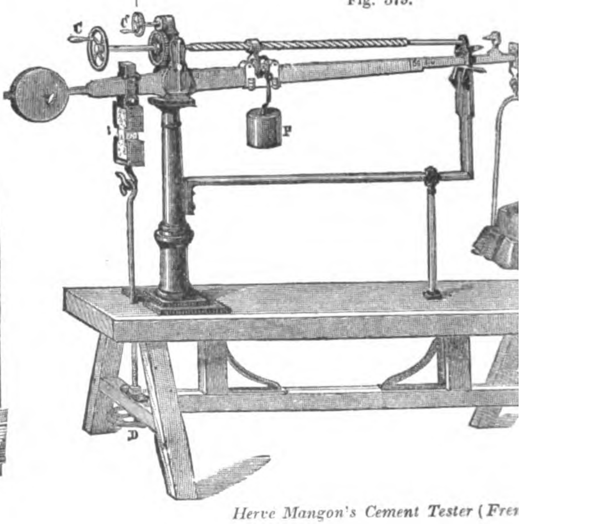
"The applications of Portland cement are ext
merous. Mortar of cement is about as easily e
that made from hydraulic lime. Mason-work i
cement has a solidity, proof against all tests, and
the action of sea-water. With this cement are
light and bold arches and vaults which are among
ishing constructions of the day. It serves to bui
the great reservoirs of the cities. It gives surfa
and moldings as delicate as plaster, with absolut
bility. It furnishes flagging stones of a durabili
stone, and a much cheaper rate. It enters into
sition of the *bétons agglomérés* of M. Coignet, e
extensively in the public works of Paris, and par
the construction of the grand aqueduct for co
water of the Vanne to Paris."

The hydraulic lime of Teil, France, is said to
per cent. of silicate of lime, and to form one of t
cements known. It is used by the "Fire-pro
Co." of New York.

The following references may be consu

Holste . . . . * "*Engineering,*

Fig. 579.



Herve Mangon's Cement Tester (Fren

Michaelis . * "*Scientific American Supplement*
"*Van Nostrand's Engineering M*
Richle . . * "*Manufacturer and Builder,*" xi.
Fairbanks . "*Manufacturer and Builder,*" xii
* "*American Railroad Journal,*" x
Bailey . . "*Scientific American,*" xxxviii.

Cen'ter Bear'ing. (*Railway.*) The bearing for a car on the center of the truck frame. The *body center-plate* rests on the *truck center-plate d*, Fig. 1159, p. 488, "*Mech. Dict.*," and *N*, Fig. 1161, p. 489, *Ibid.*

See also pp. 242–247, **Forney's* "*Car Builder's Dictionary.*"
Center Plate, "*Railroad Gazette*" . . * xxii. 409.

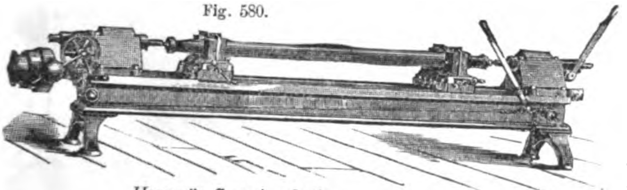
Cen'ter Board. A board lowered on the longitudinal central line of a boat, acting as an extension of the keel, to keep the vessel from drifting to leeward when under canvas.

Roller center board, . * "*Scientific American Sup.*," 2126.

Cen'ter-ing Lathe. A machine-tool for centering car axles and shafting, at both ends at the same time. It has a long bed, head and tail stock, and two rests, with adjustments vertical and lateral.

Centering tool . . . * "*Scientific American*," xl. 100.
Lathe attachment, *Brown*, * "*Scientific American*," xliii. 326
Chuck . . . . * "*Scientific Amer.*," xxxviii. 210.

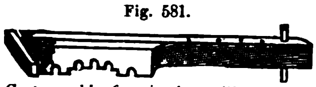
Fig. 580.



Howard's Centering Lathe.

Cen'ter-mold. A templet sweeping upon a center, and used to make circular moldings in plaster, such as those around rosettes on ceilings.

Fig. 581.



Center-mold, for circular ceiling ornaments.

Cen-tes'i-mal Al'co-hol'me-ter. An instrument by *Gay Lussac* for testing the relative quantity of alcohol in a solution of the same. It has a glass spindle, scale 0° to 100°, each degree showing 1 per cent. by volume of pure alcohol of sp. gr. 0.795, in any mixture of spirit and water, at the temperature of 15° Centigrade, or 59° F.

Tralle's alcoholmeter also has centesimal graduation.

Cen-tes'i-mal Scale. 1. A scale in which the poise and the object bear the relation 1 to 100.

2. A scale graduated in hundredths. The French meter; the Centigrade thermometer, invented by Celsius; and the Gay Lussac alcoholmeter, are instances.

Cen-trif'u-gal Ma-chine'. Called also *Dryer, Wringer, Hydro-extractor, Centrifugal Filter, Sugar Dryer*, etc.; under all or some of which heads it is noticed in the "*Mech. Dict.*," *et infra.*

* "*Scientific American Supplement*," 455.
* "*Scientific American*," xxxiv. 147.
Maumené, Fr., * "*Dept. Agric. Report*," Special 28, Plate xxix.

Cen-trif'u-gal Pump. The term *rotary* is usually applied in America to those which have rotary pistons, and the term *centrifugal* to those of the *Gwynne* and *Appold* class.

Rotary pumps, preserving this distinction, are illustrated by 17 Figs. 4465, 4466, pp. 1988, 1989, "*Mech. Dict.*" In Fig. 4466 are also one centripetal and four centrifugal pumps. The rotary blowers, p. 1985, and rotary steam-engines, p. 1991, *Ibid.*, are many of them exactly similar in construction.

Fig. 1216, p. 515, *Ibid.*, illustrates some of the forms of *centrifugal pumps*, and among them the pump of Cogniard *C*, Fig. 1216), as shown at the Paris Exposition of 1867.

Attention has of late been much drawn to the centrifugal pump for draining and wrecking purposes, cases involving the lifting of large bodies of water to a moderate height, and the French have exploited the systems of Appold and Gwynne, the English engineers of most prominence in this line. Cogniard at Paris, Malo-Belleville at Dunkerque, and Dumont & Neut at Lille, are among the principal Continental manufacturers in this line.

Gwynne of Hammersmith, England, has built at Codigoro, near Ferrara, a set of immense centrifugal pumps for the purpose of draining the Ferrara marshes of Italy, which cover an area of 200 square miles, and from which they are expected to be capable of lifting 2,000 tons of water per minute to a height of 12′ as a maximum. The mean lift will be 9′ 3″. Eight pumps are to do this work. They are arranged in pairs, each pair driven by a compound engine. The diameter of the disks of the pumps is 5′, that of the pipes 4½′. The casing is 15′ in diameter. The driving-engines have cylinders 27¾″ and 46⅝″ diameter, with a stroke of piston of 2½′. The cylinders are steam-jacketed. The cranks are so placed as to make an angle of 130° with each other. Surface-condensers are used of 750 square feet of cooling-surface each. Steam is supplied by ten boilers, each having 30 square feet of grate and 730 square feet of heating-surface. These are probably the largest centrifugal pumps, and the whole constitutes the most powerful set of pumping apparatus ever constructed.

The capacity of each of the 8 pumps at the mean lift of 7′ 3″ is 57,000 gallons per minute: the aggregate 456,000 gallons per minute or 656,640,000 gallons per day of 24 hours. This is about 6 times the supply of London, 6 times the capacity of the Croton aqueduct, and double the quantity passing down the Thames above Hampton Court.

A model of the Codigoro pumps was shown at the Centennial Exhibition, 1876.

The drainage pumps of the Haarlem Meer, South Holland, are shown on pp. *116, *739, *1830, "*Mech. Dict.*" These engines are 3 in number, and raise 2,000,000 tons of water per 24 hours, a maximum height of 17.75 feet.

The Heald and Sisco centrifugal pump, exhibited in Philadelphia in 1876, has two forms: A concave arm piston and a hollow arm piston. In the latter case the piston may be described as a wheel having four curved box-shaped hollow spokes, through which the water is drawn from the center through a hollow journal and forced out at the periphery of the wheel. Between the outer face of the latter and the walls of the shell there is a space which gradually widens as the water approaches the exit until it attains the full dimensions of the discharge pipe.

The Andrews centrifugal pump, also shown in Philadelphia, is illustrated at *F*, Fig. 1216, p. 515, "*Mech. Dict.*" Gwynne's at *A*, Coignard's at *B C*, same Fig.

The Enterprise Hydraulic Works (Phila.) pump is under Alden's Patent, April 18, 1848, No. 5513. It has a cast-iron volute-shaped case, in which rotates a disk that has curved tapered wings bolted to each side.

MM. Dumont & Neut's later improvements in this line are shown in Fig. 582, which is a central vertical section and partial elevation. The improvements particularly concern the withdrawal of air which collects at the apex of the turbine chamber and which is a cause of diminution of effectiveness and frequently of stoppage; the latter particularly in cases where the lift is moderate and air is apt to enter at the inlet which may not be entirely submerged at all times. In some cases the air gathers in the center of the turbine where the pressure is least and throws the pump out of action. M. Cogniard devised a plan for removing the air from the center of the turbine by means of a small pump, but the device shown in Fig. 582 is considered more simple and efficacious.

It frequently happens in drainage operations, that air enters at the foot valve of the induction pipe. In this case a communication is established between the circumferential chamber and the center of the turbine by openings *s s′*. When a certain quantity of air is introduced into the turbine it escapes in part by virtue of its levity at these openings, but a portion remains around the central axis. When a quantity of air has thus accumulated, the openings *s s′* eject jets of water at high pressure and drive the air into the vortex of water with which it passes to the eduction pipe, or rising into the apex of the chamber is withdrawn by faucet at the foot of the vase *J*.

The stuffing box is in two parts *o o′*, with a metallic ring *c*, and water from the turbine chamber reaches the journal by pipes *q* and holes *p p*.

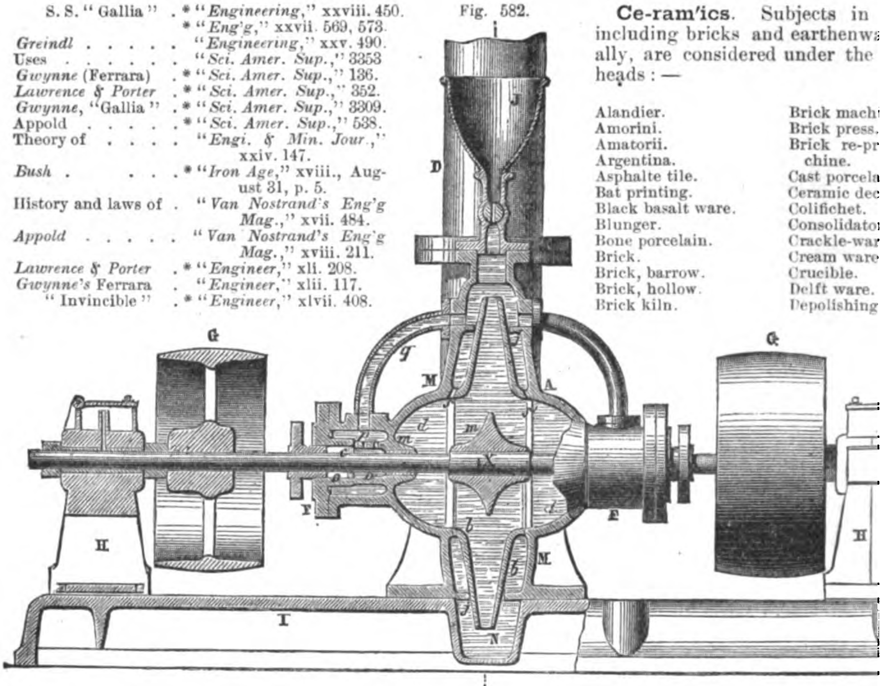
D is the discharge pipe; *G G* the driving-belt pulleys; *H H* the standards of the pillow blocks; *I* the bed plate; *F F*, the stuffing boxes; *A M*, the case of the turbine *N b*.

The following references may be consulted: —

Brotherhood . . . . . . * "*Engineering*," xxi. 532.
Gwynne . . . . * "*Engineering*," xxi. 8, 9, 12.
(Ferrara Marshes) . . * "*Engineering*," xxv. 60, 62.
(Dordrecht) . . . . * "*Engineering*," xxi. 192–197.

S. S. "Gallia"	. * "*Engineering*," xxviii. 450.
	* "*Eng'g*," xxvii. 569, 573.
Greindl	"*Engineering*," xxv. 490.
Uses	"*Sci. Amer. Sup.*," 3353
Gwynne (Ferrara)	. * "*Sci. Amer. Sup.*," 136.
Lawrence & Porter	. * "*Sci. Amer. Sup.*," 352.
Gwynne, "Gallia"	. * "*Sci. Amer. Sup.*," 3309.
Appold	* "*Sci. Amer. Sup.*," 538.
Theory of	"*Engi. & Min. Jour.*," xxiv. 147.
Bush	* "*Iron Age*," xviii., August 31, p. 5.
History and laws of .	"*Van Nostrand's Eng'g Mag.*," xvii. 484.
Appold	"*Van Nostrand's Eng'g Mag.*," xviii. 211.
Lawrence & Porter	. * "*Engineer*," xli. 208.
Gwynne's Ferrara	. "*Engineer*," xlii. 117.
"Invincible"	. * "*Engineer*," xlvii. 408.

Fig. 582.



Dumont & Neut's Centrifugal Pump.

Gwynne, Ferrara .	"*Scientific American*," xxxiv. 129.
	"*Scientific American*," xxxviii. 246.
Heald & Sisco . .	* "*Min. and Sci. Press*," xxxiv. 369.
Poillon	"*Technologiste*," xxxix. 305.

Thurston's "Vienna Report," 1873.

Gwynne. London	ii., 195.
Bernay. London	ii., 197.
Neut & Dumont. France	ii., 197.
Coignard. France	ii., 198.
Nagel & Kaemp. Hamburg	ii., 198.
Scheile. Germany	ii., 199.
Boulton & Imray. Britain	ii., 199.

Cen-trif'u-gal Screw. The centrifugal screw has many applications in CENTRIFUGAL PUMPS and VENTILATORS. See under those heads. The screw propeller itself has many features in common with the centrifugal pump, and though now it acts free in the sea, in one of the early forms (*Ericsson's*) the screw acted in a cylindrical trunk. Shaw's propeller pump is shown in Fig. 3977, p. 1810, "*Mech. Dict.*" On pages * 516, 517, are other illustrations of the same principle, and on p. * 2073, *Ibid.*, the same feature is shown as applied to a marine governor; the screw working in a resisting medium is employed to regulate the throttle valve of a propeller engine. The pulley shaft is driven by a belt connection with the engine, and the apparatus is so adjusted that any excess of speed translated by the propeller shaft to the screw in the governor, partially closes the throttle.

Screw ventilator. *Pelzer* . . . . * "*Sc. Am. Sup.*," 4073.

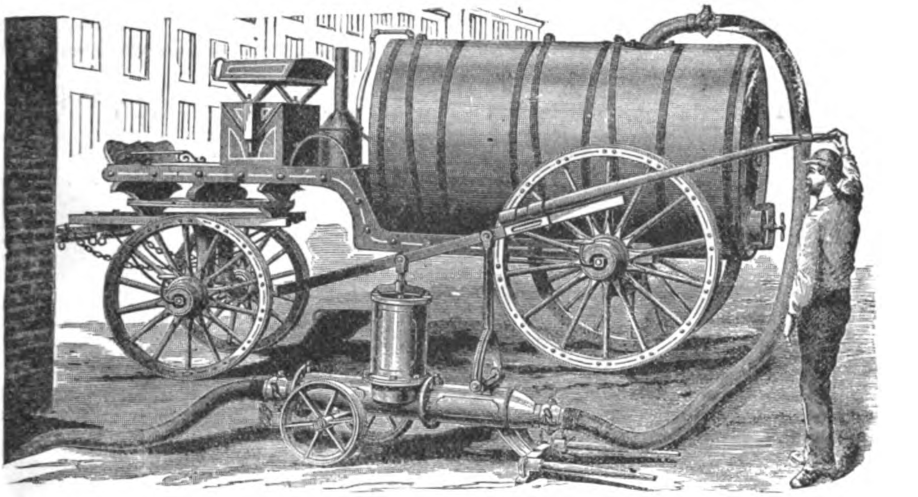
Cen-trip'e-tal Rail'way. It consists of a central or bearing rail, and lateral steadying rails. The running stock has double-flanged wheels bearing upon the central rail, and wheels without flanges on the side-rails. Each set of wheels has a separate and independent axle, and all are arranged to have a swinging and lateral, as well as perpendicular motion, each independent of the other. — *Buzby.*

Ce-ram'ics. Subjects in including bricks and earthenwa ally, are considered under the heads: —

Alandier.
Amorini.
Amatorii.
Argentina.
Asphalte tile.
Bat printing.
Black basalt ware.
Blunger.
Bone porcelain.
Brick.
Brick, barrow.
Brick, hollow.
Brick kiln.
Brick machi
Brick press.
Brick re-pr chine.
Cast porcela
Ceramic dec
Colifichet.
Consolidato
Crackle-war
Cream ware
Crucible.
Delft ware.
Depolishing
Dipping vat.
Doulton ware.
Drain-pipe machine.
Drain tile machine.
Drying room.
Earthenware.
Egg-shell ware.
Electro-plating china.
Enamel.
Enameling.
Encaustic.
Encaustic tile.
Etching.
Faïence.
Faïence d'Oïron.
Faïence stannifère.
Fire brick.
Flint brick.
Flooring tile.
Frit.
Frit furnace.
Frit mill.
Glaze.
Grafito.
Grand feu.
Granite ware.
Green ware.
Handling.
Hard paste.
Henri-deux ware.
Iron-stone china.
Ivory paste.
Ivory porcelain.
Jasper ware.
Kiln.
Luster
Majolica.
Mezza-majolica.
Mixed clay ware.
Mixing mill.
Modeling clay.
Mold.
Muffle.
Mural tile.
Oïron ware.
Palissy ware.
Parian biscuit.
Paste.
Pâte changeante.
Pâte-sur-pâte.
Pernette.
Pipe.
Pipe press.
Plaque.
Plate machine.
Porcelain.
Porcelain colors.
Porcelain, electro-
Porcelain kiln.
Porcelain molding
Porcelain muffle.
Porcelain pâte ten
Porcelain plate ma
Porcelain stove.
Potter's wheel.
Pottery.
Pottery furnace.
Pottery mill.
Printing.
Pug mill.
Queensware.
Rafaelle ware.
Re-pressing press.
Scroddled ware
Seggar.
Sèvres.
Sgraffito.
Slip.
Soft paste.
Sole tile.
Spur.
Staffordshire ware
Stanniferous glass
Stilt.
Stone-ware.
Stone-ware kiln.
Tempering wheel.
Tender porcelain.
Terra cotta.
Terre-cuite.
Throwing wheel.
Tile.
Tile machine.
Tortoise-shell war
Transfer printing.
Under-glaze.
Wedgewood.
White brick.

See also list on page 1779, "*Mech. Dict.*"

Fig. 584.



Excavating and Deodorizing Apparatus.

Ceph'a-lo-trite. (*Surgical.*) An instrument for crushing the fetal skull in obstructed labor.

Lusk's cephalotrite is shown at Fig. 1219, p. 516, "*Mech Dict.*"; Braun's and Simpson's are shown at Figs. 534, 534 *b*, Part III., "*Tiemann's* "*Armamentarium Chirurgicum.*"
The *Craniotomy forceps* (*Meigs* and *Thomas*), and *Simpson's Cranioclast*, are crushing instruments of a more distinctly forceps-shape.

Ce-ram'ic Kiln. One for baking, burning, and firing pottery. The term *baking* is applied to the comparatively moderate heating of green ware to bring it to the biscuit condition. *Firing* and *burning* are optional terms, referring to the final heating where the glaze is melted and the colors vitrified. See various terms in list on page 186.

See PORCELAIN KILN, POTTERY KILNS, etc., "*Mech. Dict.*"
Also Report by Gen. *Q. A. Gillmore*, "*Centennial Exhibition Reports*," vol. iii., Group II., p. 222 *et seq.*
Including the kilns of —
Morand . . . . * p. 222.
Gregg . . . . * p. 225.
Menheim (Gas) . . . . * p. 229.
See also BRICK KILN, *supra.*

Cer'a-tome. (*Surgical.*) A knife to divide the iris. *Keratome.*

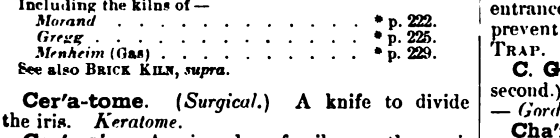
Cer'e-sin. A mineral or fossil wax, the purified product of *ozocerite*, found near the extensive coal-beds of lower Germany and Austria. A substitute for beeswax.

Amber, kauri, ozocerite, are fossil gums.

See list of gum resins and gums, p. 1921, "*Mech. Dict.*," and list of fossil resins, etc., p. 51, *supra.*

Cer'vix U'te-ri Di-la'tor. (*Surgical.*) The internal os is expanded by the instrument, which is introduced while closed, and then expanded with parallel jaws by pressure upon the lever.

Fig. 583.



Dr. John Ball's Cervix Uteri Dilator.

Dr. *Hawk's* dilator is of hard rubber.
Dr. *Sussdorff's* of tupelo wood; a species of *Nyssa*, growing in Florida.

Cer'vix U'te-ri Scis'sors. (*Surgical.*) Bent scissors, smooth or tooth-edged, for amputation of the cervix.

Figs. on p. 81, Part III., *Tiemann's* "*Armamentarium Chirurgicum.*"

Cess'pool Pump. An apparatus for emptying cesspools by means of pump, hose, and wheeled reservoir. Fig. 584.

A 600-gallon tank is mounted on wheels, and has inlet and outlet valves. A 4″ smooth-bore rubber hose, with imbedded spiral to prevent collapse, is used in lengths of 15′ for suction and discharge, having the usual couplings. The air in the tank, as displaced, is driven through a deodorizing can shown in front of the tank, on the rear of which is an indicator. A force-pump connects by suction hose with the vault, and by force hose with the tank. A peculiar flexible rubber tube forms the valve.

Cess'pool Trap. A water joint made at the entrance to a cesspool or pipe leading thereto, to prevent reflex current of fetid gas. See SEWER TRAP.

C. G. S. (*Electricity.*) (Centimeter-gramme-second.) An abbreviated expression for one *dyne.* — *Gordon.*

Cha'fing Plate. A metallic plate interposed between two objects to take the wear. Instances are to be found in the *transom chafing-plate* and the *truck-bolster chafing-plate* of a car truck.

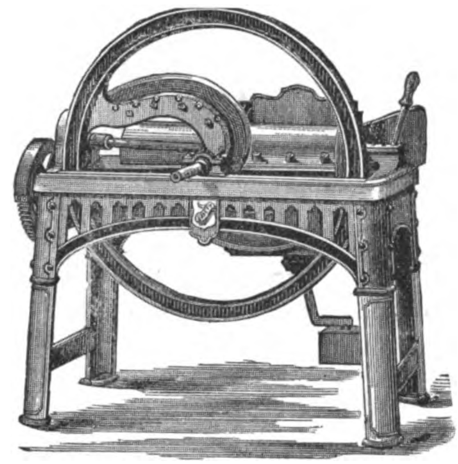
Chaff Sift'er. A machine used to separate seeds and dust from the chaff which comes from the thresher.

Chaff Cut'ter. The machine, with the Edwards (Br.) improvement, for preventing accident, is perhaps the safest machine extant. One can stop the machine, change the direction of feed, or change the length of cut, by a single lever. This is shown at the right of the machine, and is convenient to the left hand of the person who might find his right hand about to be nipped by the rollers. Fig. 585.

Another machine places the shifting lever in such position that a simple pressure even of the body in leaning against it, will stop and reverse the machine.

In another British machine, the same handle which alters the length of cut also acts as a stop-motion, instantaneously arresting the progress of the rollers. Should any hard substance get into the feed when working by power, the attendant moves the handle, which at once stops the rollers and

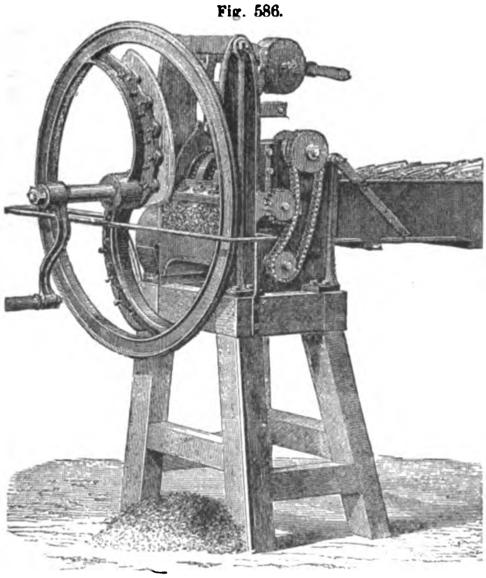
Fig. 585.



Edwards's Chaff Cutter.

throws back the feed about ¾" from the knives, so that the hard substance cannot be struck again. To draw the feed quite back into the hopper the attendant has only to pull round the wheel at the end of the machine, which can be done while the fly-wheel is running at full speed.

Fig. 586.



Albaret's Chaff Cutter (French).

Albaret's Chaff Cutter (French), Fig. 586, shows the favorite French feed motion, by chain. The knives have the same disposition as the British, the best principle as it appears to the writer, that is, a curved knife (or knives) revolving in a plane across the direction of feed. See ENSILAGE CUTTER.

Chain. See the following references: —

Belt	* "*Scientific American Sup.*," 89.
Brake, railway automatic, *Park & Webb*, Br.	* "*Engineering*," xxx. 73.
L. & N. W. Railway, Br.	* "*Engineer*," xxv. 46, 104.
Making, hand	* "*Sc. American Sup.*," 677.
Coupling, *Vidal*, Br. . .	* "*Engineering*," xlix. 190.
Pump, *Wallis*	* "*Scientific Am.*" xxxviii. 393.
Testi[n]g machine, *Richle* .	* "*Am. Manuf.*," Jan. 17, 1879, p. 13.

See also CABLE TESTER, *supra*.

Chain Bit. (*Manége.*) One having a chain mouth-piece.

Chain Hook. (*Add.*) 3. (*Surgical.*) with claw-hooks at the ends, used in post-
and dissecting to keep parts distended.

Figs. 317, 319, Part I., *Tiemann's "Armamenta rurgicum."*

Chain Tag. A steam vessel which moves by winding on a chain laid in the bed of the stream.

Probably derived from *taglia*, It., a pulley; a word adopted into English and recognized by Brande; now but little used. See TOWAGE, p. 2605, "*Mech. Dict.*" CHAIN TOWING, p. 521, *Ibid.*

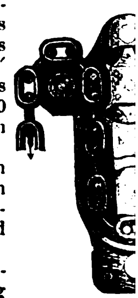
Fig

Chain

Chain Buck'et. The valve on the chain of a pump. It is elastic, fills the pipe in ascending, and lifts and discharges the water. See CHAIN PUMP.

Chain-Ca'ble Shear. A heavy sh
jaws specially fitted for cutting iron fo
chain cables. The knife is made stepped
cut only on one side of the cable at once, which reduces the diameter of the cylinders. Tweddell's hydraulic chain-cable shear is made double, to suit cables varying from 3" to 1¾" diameter. The water works under a pressure of 1,500 pounds per square inch in the cylinder.

Fig. 58



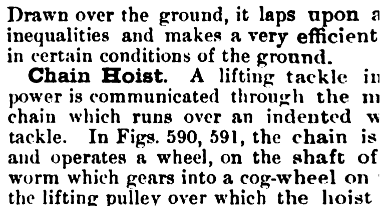
Chain G

Chain Dog. A chain with a driving dog at each end, to be driven into adjacent logs in a raft to hold them together.

Chain Guide. A directing course for a lifting chain in a tackle-block of the differential class. See DIFFERENTIA BLOCK.

Chain Har'row. A land harrow
chain net-work, with teeth at the in

Fig. 589.



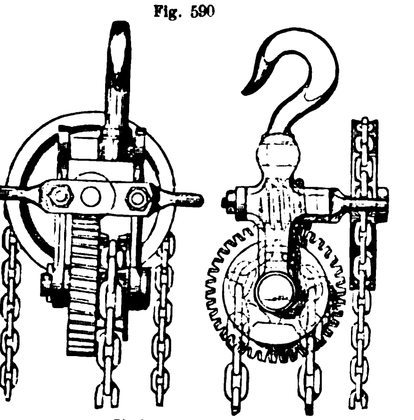
Chain Harrow.

Drawn over the ground, it laps upon a
inequalities and makes a very efficient
in certain conditions of the ground.

Chain Hoist. A lifting tackle in
power is communicated through the m
chain which runs over an indented w
tackle. In Figs. 590, 591, the chain is
and operates a wheel, on the shaft of
worm which gears into a cog-wheel on
the lifting pulley over which the hoist
When one hook of the latter is elevate
is down, and the hoist chain is used bac
alternately.

Chain Loom. A loom in which t
are controlled by patterns on a chain
guished from those operated by cams
quard.

Fig. 590



Chain Pulley Blocks.

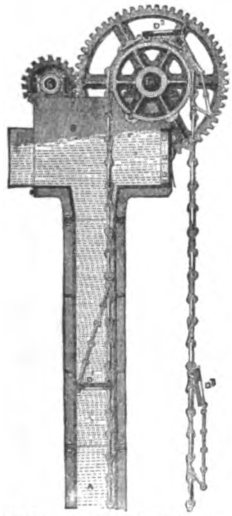
Chain Pump. In which the buckets are attached to a continuous chain. See Figs. 1228–1231, pp. 520–522, "*Mech. Dict.*"

Murray's chain pump is specially adapted for hydraulic constructions, drainage, sewage works, etc., having no clacks nor valves proper to be obstructed by mud, sand, or weeds. The lift is pivoted and slung to the chain, and assumes its position in the up-shaft. If any obstruction enters, a back turn of the chain immediately releases it, the lift folding up, and allowing the obstruction to be carried up in the stream.

Fig. 591.

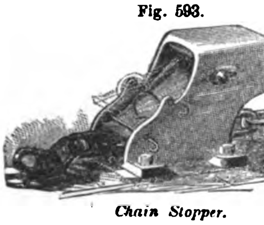
Chain Hoist.

Fig. 592.



Murray's Contractor's Chain Pump.

Fig. 593.



Chain Stopper.

Chain Stop'per. A tunnel with a pivoted flap to engage a link of chain to prevent the paying out of the latter.

Chain-tap'pet Loom. A loom for fancy weaving, in which the harnesses are operated by tappets upon a pattern-chain.

Chair. (*Add.*) 4. (*Glass.*) The bench of the glass-blower at which he sits, rolling the ponty to the end of which the glass under treatment is attached. Fig. 2243, p. 980, "*Mech. Dict.*"

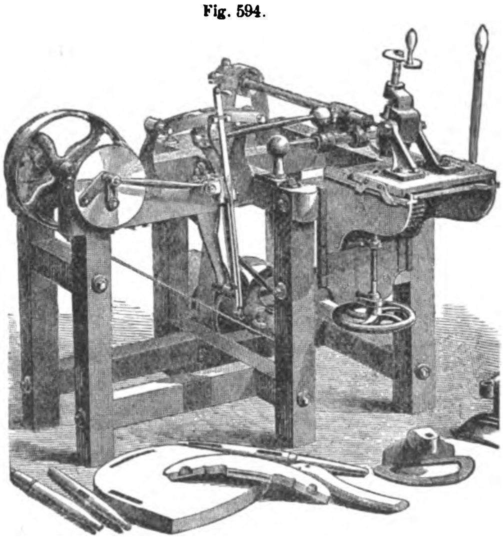
While thus being rotated, rolling by the left hand, the right has the *pucellas*, *shears*, *battle-dore*, to shape or trim; and the swinging, rolling, reheating, blowing, and shaping by tools constitute the manipulations by which the workman, principally guided by his eye, gives the form desired to the plastic mass. *Compasses*, *calipers*, a *rule*, and a *marver* complete the equipment. The *cage*, and the *forked stick* for removing the articles, belong to the boy who runs with them to the annealing oven, technically known as the *leer*.

Chair Mor'tis-er. Fig. 594 is a machine adapted to all kinds of chair mortising, straight or round work; also as a horizontal boring and mitering machine.

The principle of the machine is rotary; the fixed end of the boring bar moves in a ball-and-socket joint, allowing the bar to revolve and the vibrating end to be moved in any direction desired.

The variations from straight to mortises of different curves, are produced by the position of the curved bar, upon which the bearing of the movable end of the boring bar slides; when the bar is placed with the curve horizontal the mortises are straight, and changed to its greatest curve when perpendicular.

Fig. 594.



Lemman's Chair Mortiser.

The range in length of mortise is, from boring a hole to a length of mortise equal to the greatest travel of the cutting bit, and is changed by the stroke of the crank pin being made greater or less, and also by the arrangement of a handle moving the end of the connecting rod, to any position desired, upon a curved rod which produces a greater or less length of the connecting rods, giving any length of mortise desired within the capacity of the machine.

The depth of the mortise is regulated by moving the table, holding the stuff, by a lever in connection with a pinion and rack. The table is raised vertically, by a screw and hand wheel, and provided with three clamps, of different forms, for holding the stuff in the position required for the work.

Chair-stretch'er Lathe. A lathe with a hollow head; like a broom-handle lathe. It has four feeding rolls, two forward and two back of the hollow cutter, and heavy gearing with reversible feed.

Chal'lis. (*Fabric.*) A French worsted dress goods woven upon a gauze or open taffeta loom. It has a silk *grège* warp, and merino-wool weft. It is generally printed. It differs from *barége* in the material of the warp, which in *barége* is of cotton.

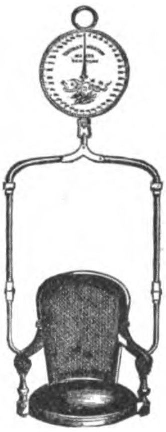
Cham'ber. (*Add.*) 10. (*Fire-arm and Ordnance.*) The space, enlarged or otherwise, occupied by the charge.

Cham'ber Kiln. A brick or tile kiln in compartments; sometimes capable of being heated in succession as with *Hoffman's*, Fig. 903, p. 371, "*Mech. Dict.*"

Johnson, Br. . . . . * "*Engineer*," xlix. 210.
See also BRICK KILN.

Chair Bal'ance. A chair suspended from a spring balance to weigh persons.

Fig. 595.



Chair Balance.

Cham'oied. (*Leather.*) Shamoyed. See TAWING, p. 2500, "*Mech. Dict.*"

Champ-le-ve'. (*Fine Art Metal Working.*) A species of enameling on metal.

Lines are engraved on the metallic surface and are filled with enamel. It is allied to *Niello*.

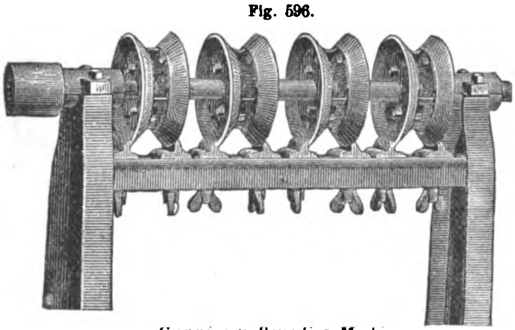
Differs essentially from *cloisonné*, which see. See also INLAYING.

Cham'fer-ing Ma-chine'. 1. A machine for beveling the ends of staves after being set in a cask. See BARREL-CHAMFERING MACHINE.

2. A machine for rounding or cornering timbers, preparatory to putting on the sand-belt; especially used in carriage and implement work.

In the cornering and rounding machine, Fig. 596, the several heads of the spindle are each provided with differently shaped cutters. The amount of corner to be taken off is governed by the distance the bevel-guards are set apart, they being adjustable and retained in position by a set screw in the foot of each. A chamfer of any bevel may be made by having the guards of a bevel to correspond to it. Also known as a *radial planer.*

Fig. 596.

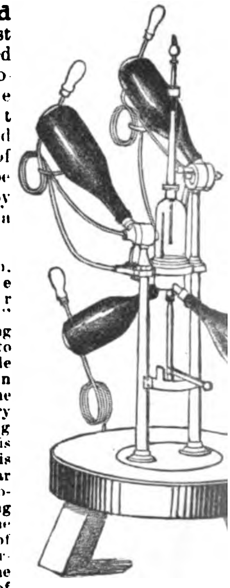


Cornering or Rounding Machine.

Cham'pagne Do'sing Ma-chine'. An apparatus for *dosing*, that is, adding to the wine a portion of sirup, which produces the sparkling ebullition peculiar to this class of wines. Fig. 597.

The bottle of champagne being uncorked, the mouth is placed against the cork-covered mouth of the spout, the bottom of the bottle being pressed by a spring-pad. The handle of the interior faucet is then turned and replaced, a jet of sirup being injected into the bottle. The faucet is of silver, moving on glass, and the pipes all of silver, p side, in order to prevent oxidation or lodgment matters. When the bottle is removed, it is rea corking and wiring.

Fig. 597.



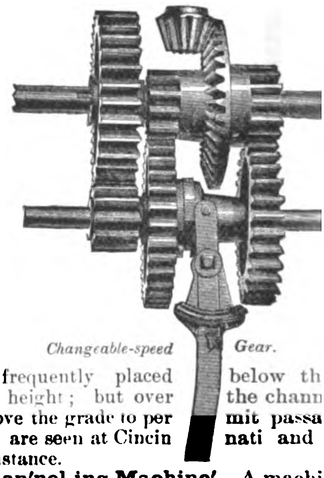
Machine à doser. Tricourt &

Change'a-ble-speed Gear. A nest of gearing placed between the motor and the driven object and so arranged that the speed of the latter can be varied at will by the motion of a lever.

The illustration, Fig. 598, is the changeable gear of the "Climax" mower. By moving the shifting lever to the left, the double clutch is thrown into gear with the slow or ordinary motion. By moving it to the right, this same clutch is thrown into gear with the fast motion. By moving this lever on to the pin in the center of the shifting lever-holder, the machine is thrown out of gear entirely.

Chan'nel Span. (*Bridge.*) In bridges over shallow rivers, the trusses o

Fig. 598.



Changeable-speed Gear.

are frequently placed below th save height; but over the chann is above the grade to per mit passa Such are seen at Cincin nati and for instance.

Chan'nel-ing Machine'. A machi ing channels or grooves in stone in th make a line of separation.

Vermont Stone-cutter Co. . . * "*Engineerin*

Chap'let. (*Add.*) 2. (*Founding.*) iron stud for holding a core in posi the mold. Also called a *grain.*

Char'coal Grind'ing Mill. (*Making.*) Shown in "*Ordnance Re* Appendix I., Plate I., Fig. 1, and descri 98, 99. It is in the style of a bark mill grinder in a case of corresponding shap

British . . . . * "*Engineer*

Char'coal Pen'cil. The charcoal crayon of Heilmann is made from the saw-dust of willow, lime, or poplar, pressed in molds, dried in air, charred in a retort. The crayons are rubbed smooth, cased in paper, packed for sale. — "*Papier Zeitung.*"

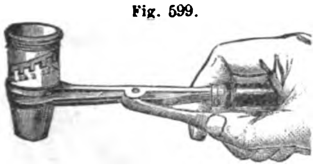
"*Scientific American*" . . . . . . xxxviii. 326.

Char'coal Wash'er. A machine for washing bone-black for sirup filters. See ANIMAL CHARCOAL WASHER, *supra*, and BONE-BLACK CLEANING-APPARATUS, p. 327, "*Mech. Dict.*"

Kluseman . *Dept. Agric.*, *Sp. Report*, xxviii., Plate XXIX.
Schrieber . . *Dept. Agric.*, *Sp. Report*, xxviii., Plate XXX.

Char'ger. An instrument for measuring powder and shot, and loading into a fowling-piece. One is shown at Fig. 1250, p. 528, "*Mech. Dict.*"

Fig. 599.

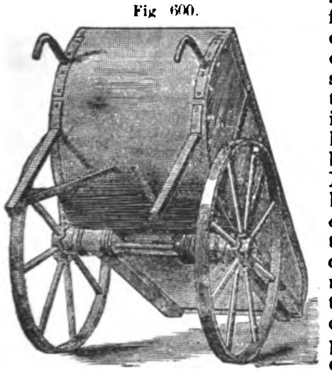


Dougall Charger.

Dougall's charger is a dipper, graduatable by slide for quantity, and discharging the contents into the gun by pressing the lever with the thumb.

Char'ging Bar'row. A double-wheel barrow, for use in iron furnaces for conveyance of coal, coke, limestone, and ore, to be dumped in at the tunnel-head of the blast furnace. It is made of a height in accordance with that of the curb of the furnace mouth, in order to insure the charge being properly dumped. See BELL AND HOPPER, p. 92.

Fig. 600.



Charging Barrow.

Cha'ser. (*Add.*) 3. A *billet*. A short strap on the curtain of a carriage, fastening to a buckle on the back-stay of the top.

Made raised and creased. See BILLET.

Cha'sing. 1. (*Fine Art Metal Working.*) A mode of ornamenting silver ware. It ordinarily follows the snarling tool used in *repoussé* work.

The vessel being filled with a resin composition is placed on a pad, and the surface indented by punches of various forms according to the pattern, and the texture of surface required. Fig. 1256, "*Mech. Dict.*" Fig. 11, p. 290, vol. xxxvi., "*Scientific American.*"

2. Thread cutting on a lathe, by slide rest tool or by comb. See Fig. 1256, above cited.

See also admirable collection of tools, "*Scientific American*," * xl. 223.

Check Chain. (*Railway.*) A chain connecting the car body with its truck, and intended to keep the truck from swinging cross-wise of the track if the truck should become derailed.

Check Guard. A means of preventing tampering with bank checks, raising the figures, etc.

Check-testing apparatus, bank, *Grafelman*.
* "*Scientific American*," xxxvii. 227.

Check protector, *Adair*. U. S. Patent, March 5, 1872, perforates amounts, both figures and words.

Check'ing. Engraved cross-hatching on certain parts of a rifle, gun or pistol stock, to increase the security of grip in handling.

Checking machines are used in armories for cross-hatching the swivel keys of rifles, etc.

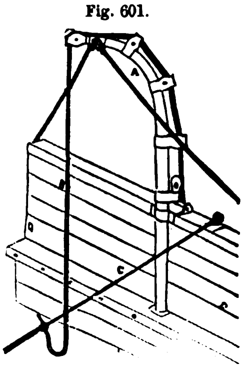
Check Row'er. 1. A corn planter.

2. An attachment to a corn planter by which it is made automatically to drop the seed corn at regular intervals of distance across a field; dispensing with the furrowing out of a field previous to crossing it with the planter, and dispensing also with the assistant at the dropping lever. Haworth.

See CORN PLANTER.

Check Stop. A device used in dredging. The light line *c* breaks when the dredge fills or is foul, brings the slack of the drag-rope *d* on the davit *A* into play, and gives time for the *check stop* — a drum of rubber — to come into play. See DREDGE; also ACCUMULATOR 3, p. 3, *supra*. See also DREDGE.

Fig. 601.



Check Stop for Dredge Lines.

Check Strap. (*Manége.*) *a.* The strap of a harness whereby the collar is connected between the fore-legs to the belly-band, to keep the collar from riding up when the horse is holding back in descending a hill or backing.

b. A strap which couples back the bit of the off-horse to the gears of the one on the near side, to hold back the off-horse when hitched on the *single-line method*, common in the West. A *hold-back* strap.

Check Valve. A valve to prevent reflux of a liquid.

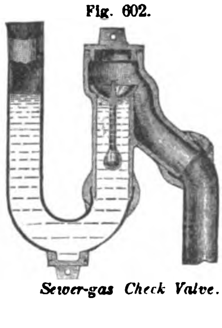
The most familiar instance is the valve below the plunger barrel of a pump, which prevents the return to the well of the water in the stock.

The most familiar distinction of check valves arises from

Shape.	Position.	Purpose.
Globe.	Upright.	Injector.
Disk.	Horizontal.	Pump.
Flap.	Angle.	Sewer gas.
Ball.	Oblique.	Trap.
Butterfly.	Swinging.	Brake.
Piston.		Alarm.
Cone.		Back pressure, etc.

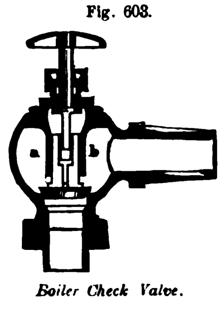
(*Railway.*) In the Westinghouse driving-wheel brake; a valve which is placed in the pipe which connects a driving-wheel brake-cylinder with the air-reservoir. The pressure in the reservoir causes the valve to seat itself or close. The air must then flow through a small hole which is drilled in the valve, which prevents the brakes from being applied too

Fig. 602.



Sewer-gas Check Valve.

Fig. 603.



Boiler Check Valve.

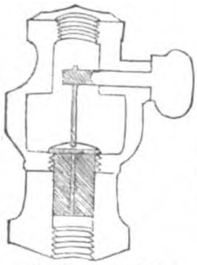
suddenly. When the brakes are released, this valve unseats, and permits a quick escape of the air. *Forney.*

Fig. 602 is *Waring's* check valve for sewer gas traps.

Fig. 603 is the boiler check valve of the injector apparatus of locomotives.

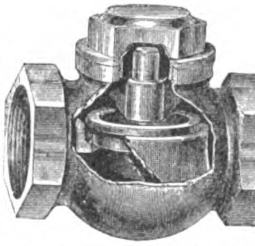
Fig. 604 is the lower check valve of the Douglas pump, placed in the suction pipe of the pump, at a convenient point to get at to let back the water to avoid freezing. Turning the thumb-screw lifts the valve, so that the water will run back.

Fig. 604.



Pump Check Valve.

Fig. 605.



Cushion-seated Check Valve.

Fig. 605 shows Shaw's cushion-seat check valve, designed to prevent hammering on the seat. A portion of the pumped liquid is confined in the annular space around the disk, which in falling seats itself upon a cushion of liquid.

Ball, *Hay & Bassett* . * "*Scientific American*," xxxvii. 182.
Swinging . . . . . * "*Manufacturer & Builder*," x. 220.

Check. (*Add.*) 13. (*Mining.*) The side or wall of a vein.

14. (*Manége.*) That portion of a bit outside of the horse's mouth.

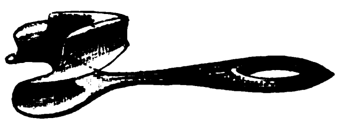
15. (*Nautical.*) Of a block; one of the pieces forming the sides of the shell. These have *scores* on the outside for the *strap*, and holes with *bushing* for the *pin*.

Cheek Re-tract'or. (*Surgical.*) A smooth flat hook to hold the cheek retracted and mouth distended when operating for cleft palate, *staphytorraphy*; or in grafting in cases of deficiency of the soft palate, *uraniscoplasty*.

See Figs. 298, 298 *b*, Part II., *Tiemann's* "*Armamentarium Chirurgicum*."

Dr. Roe's mouth-gag and cheek retractor is a modification of the instrument of *Luer*, in respect of the addition of a

Fig. 606.



Roe's Cheek Retractor.

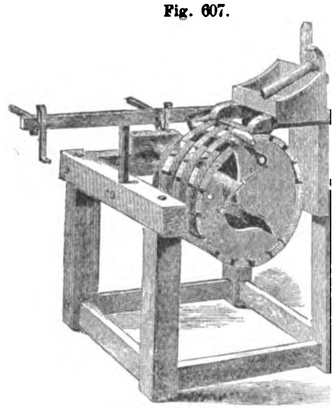
triangular or wedge-shaped block to the external surface of the cheek retracting portion of the instrument, this portion passing between the teeth and distending the jaws. A cord is passed through the hole in the handle and tied behind the head.

Cheese Box Ma-chine'. A bench used in making cheese boxes. A horizontal stem holds the former on which the box is to be built. The box is in fact a cage of slats and hoops which are put together on the former, the latter acting as a core for the frame during construction. Fig. 607.

Cheese Knife. A device for cutting a given weight of cheese in retailing. Fig. 608.

The cheese is weighed and placed on the platform, which is rotatable by the small crank at the side. By referring to the table on the column supporting the knife, there is found opposite the number representing the weight of the cheese the number of revolutions or fractional parts thereof the small crank has to be turned to measure off a pound. Then by turning the large crank, the knife blade descends, cutting off the required sector by a single stroke.

Fig. 607.



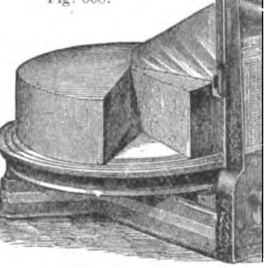
Cheese-box Machine.

Cheese Press. A press for sque curd in the hoops to expel the whey and form cheeses. See pp. 533, 534, "*Mech. Dict.*"

A cheese press for acting upon a whole row of cheeses in their hoops, is shown in Fig. 609.

The hoops (and contents) are placed

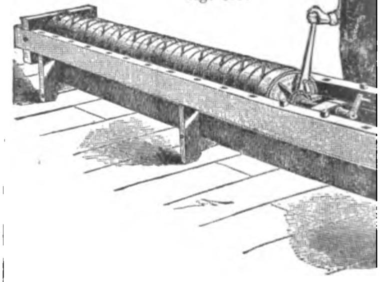
Fig. 608.



Retailer's Cheese Knife.

in a horizontal frame, and advanced by a screv device is adjustable on such part of the length as may suit the number of cheeses to be o The crank handle being then turned gives the first pressure; the power is increased by the use of the lever, — a ratchet on which acts upon a

Fig. 609.



Frazer Gang Cheese Press.

wheel upon the screw. A trough beneath pressed whey.

Compound lever cheese press . * "*Sc. Americ*

Chei'lo-an'gi-o-scope. An appar by *Dr. Huber*, of Greifswald, to enabl tion of blood of a person to be examin

The previous methods of ocular demon circulation have been, by placing the foot o stage of the microscope, exhibiting the ci web. *Perkinje's* experiment, by which an observer is enabled to observe the circulation in his own retinal blood-vessels, is also familiar.

Dr. Huber fixes the head of the subject to be examined in a frame not unlike that used by photographers, on which is fixed a holder for the microscope and a lamp. He then draws down the lower lip of the subject upon the stage of the instrument, with its delicate inner surface upward for inspection, throws a strong light on the same with a condenser, and focuses the microscope, provided with a low-power objective, down upon the delicate net-work of blood-vessels, which can be seen there even with the naked eye. By this simple means the circulation can be observed with the greatest ease and perfection.

Chem'i-cal Fire En'gine. A fire extinguisher which depends upon the evolution of carbonic acid gas, alone or in company with water, for the extinction of fire. See FIRE ANNIHILATOR, "*Mech. Dict.*"

Che'not Steel. (*Metallurgy.*) A peculiar iron is carbonized with such matters as fat, resin, tar.

Chick'en Feed'er. See ÉPINETTE.

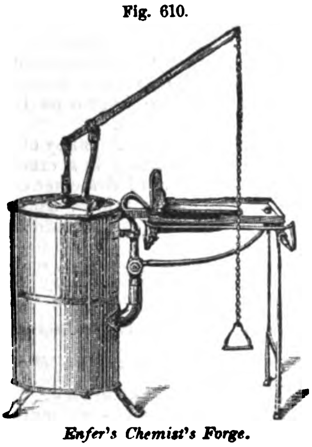
Chick'ley. A gum resembling gutta-percha, obtained from one of the *sapoteæ*, in Guiana.

Chif'ney Bit. (*Manége.*) A curb-bit having a movable short arm attached to the cheek-piece, just above the mouth-piece, for receiving the check-straps of the bridle, the gag-rein or strap being attached to the short arm of the cheek-piece.

Chill. 1. The hardened part of a casting: as the tread of a car-wheel.

2. A portion of a mold against which the molten metal is suddenly cooled in order to harden the casting.

Fig. 610.



Enfer's Chemist's Forge.

Chilled Plow. A plow the mold-board of which is cast on a chill to harden it and increase its wearing and polishing qualities.

Chilled Roll. See CALENDER ROLL.

Chem'ist's Forge. A laboratory forge. That shown in Fig. 610 is by *Enfer*, of Paris. It has a Chinese-lantern bellows in the cylinder, worked by a treadle and lever. It is primarily intended for lamp or gas blow-pipe, but has many convenient applications. Other forms are shown under LABORATORY FORGE, BLOWPIPE, etc.

Chime. 1. (*Music.*) A succession of bell sounds. Bells are usual; wires or bars are occasionally used. Evelyn mentions a chime of porcelain dishes.

Electric chime for clocks . .	"*Sc. Amer. Sup.*," * ii. 702.
Chiming clock, Bombay Univ.	"*Sc. Amer. Sup.*," * iii. 946.
Centennial chime	"*Iron Age*," xvii., June 29, 8.
French carillon	"*Sc. Amer. Sup.*," * 2093.
Carillon	"*Manuf. and Builder*," x. 252.

See also CARILLON.

2. (*Casks.*) See CHINE.

Chim'ing Ma-chine'. The chiming machine consists of a drum studded with pins and turned by a crank, after the manner of a barrel-organ, whereby the ropes of the bells are pulled so as to produce particular tunes mechanically. See CARILLON.

Chim'ney. 1. A flue.

Climbing apparatus, Ger.	* "*Engineer*," xli. 23.
Exterior	* "*Scientific American Sup.*," 149.
Construction, *Bancroft* .	"*Scientific American Sup.*," 1841.
Climber	* "*Scientific American*," xlii. 386.
Glasgow (454 feet) . .	"*Van Nostrand's Mag.*," xvi. 91.
Cowl, Engl.	* "*Scientific Amer.*," xxxv. 69.

See *Armstrong's* "*Chimneys for Furnace, Fire-places, and Steam-boilers.*"

2. (*Mining.*) Chimneys are the richer spots in lodes as distinguished from poorer ones.

Chi'na Grass. A fiber resembling the Rhea. It is prepared for manufacture by treating with a hot solution of carbonate of soda.

Chine. 1. The end of a stave at the head of a cask or tub.

2. The edge formed by the ends of the staves.

Chi'nese Pa'per. Commonly known as rice paper. This is prepared by the Chinese from the stems of a leguminous plant, *Aralia papyrifera*; these are cut so as to form a continuous spiral film, which is then pressed flat, and afterwards dyed or otherwise prepared. They also make a true paper from bamboo stems by pulping and forming into sheets.

The Egyptian papyrus was also a pith paper, but the description of its manufacture by Pliny does not convey (as translated) the right impression as to the mode. The stem is a triangular prism; the sides were pared off, and the slips thus obtained united by their edges while yet damp, by means of pressure.

The Japanese and Chinese make paper also from *Broussonetia papyrifera*. See p. 1606, "*Mech. Dict.*" This source yields also the *tapa* cloth of Hawaii, the *masi* of the Fijians. See "*Atlantic Monthly*," xxxi. 233.

Chin-chil'la. (*Add.*) (*Fabric.*) *b.* A camel's hair French goods.

Chintz. (*Fabric.*) From Hindu, *chint* or *chete*, "variegated" or "spotted," whence *cheta*, the hunting leopard.

Chip Syr'inge. A rubber bulb syringe used by dentists to wash away detritus from a tooth under treatment. See BULB SYRINGE.

Chip Break'er. 1. A plate on the back of a plane bit, to bend up the chip and prevent splitting of the board.

2. A clip or piece on the side cutter-head frame in a matching machine; breaking the chip prevents splitting of the edge of the board.

Chis'el. (*Surgical.*) An instrument driven by a mallet for cutting bone. The gouge is a chisel with a curved edge, and has a similar use. Used in *osteotomy*, post-mortems, and dissecting. Chisels are edge or end sharpened, and some have specific names.

The figures refer to *Tiemann's* "*Armamentarium Chirurgicum.*"

Knife chisel	Fig. 86 *b*, Part I.
Chisel	Figs. 86, 331, Part I.
Gouger	Figs. 84, 84 *b*, 85, 86 *c*, Part I.
Rachitome	Fig. 321, Part I,
Costotome	Figs. 322, 333, Part I.

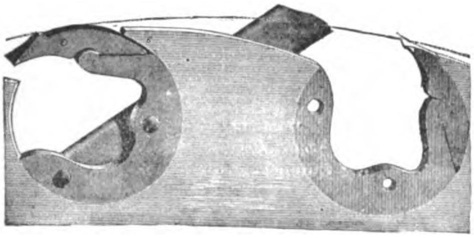
MacOwen's bone chisel is used in operations for bow-legs and knock-knees.

Chis'el Tooth Saw. A saw tooth which exposes a chisel edge to the wood in sawing, aiming rather to cut than to tear. Fig. 611 shows the Hoe insertable tooth saw, two only of the teeth of a circular saw being included in the cut. Behind the saw is the tool with two studs, by which the tooth is set in or removed from its socket by a movement of rotation.

See INSERTABLE TOOTH SAW, Fig. 4596, p. 2035, "*Mech. Dict.*"

Chlo'ride of Lime Bat'te-ry. (*Electricity.*) *Niaudet.* The positive electrode is a plate of zinc, and the negative a plate of coke, surrounded with

Fig. 611.



Chisel-edged Insertable Tooth Saw.

coke fragments. The zinc is in a solution of chloride of sodium, and the coke surrounded with chloride of lime in a vessel of biscuit ware or parchment paper.

Niaudet . "*Scientific American Sup.*," 3341, 3359, * 3490.

Chlo'ride of Sil'ver Bat'te-ry. (*Electricity.*) Marie-Davy appears to have been the first to use chloride of silver in batteries. It has become more important since improved by De la Rue. A positive element of zinc and a negative element of chloride of silver are suspended in a solution of chloride.

"*Niaudet*," American translation . . . 201, * 206.
"*Telegraphic Journal*" . . . . . . * vi. 50.
Gaiffe "*Telegraphic Jour.*," . . . . . * vi. 398.
"*Scientific American Supplement*" . . * 2490, * 1829, 1922.
"*Jour. Soc. Tel. Engineers*" . . . . * vii. 54.

Chlo'ride of Tin Bat'te-ry. (*Electricity.*) Invention of Adolph Gutensohn. One in which a salt of tin, preferably the chloride, is used in the chamber containing the negative plate.

"*Scientific American Supplement*" . . . . 3791.

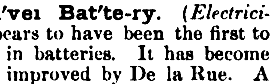
Chlo'ri-na'tion. (*Metallurgy.*) A solution process in extracting metals. See p. 542, "*Mech. Dict.*"

Copper process . "*Painter's Report, Vienna Exp.*," iv. 130.
Furnace, *O'Harra*, * "*Mining & Scientific Press*," xxxiv. 297.

Chlo'ro-form In-ha'ler. (*Surgical.*) An instrument for administering this anæsthetic. See INHALER, "*Mech. Dict.*"

Chock. (*Add.*) (*Nautical.*) 4. A block with recess and horn-shaped projections, between which a cable or hawser is rove when being hauled on or in.

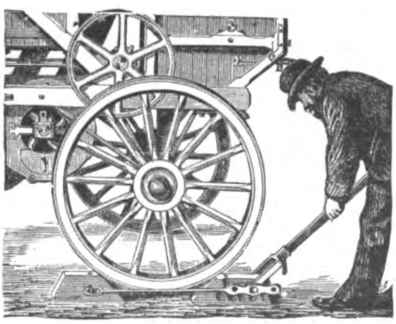
Fig. 612.



Chock.

Chock Block. A scotch for the wheels of

Fig. 613.



Chock Block for Thresher.

machinery to be used without dismounting, such as threshing-machines.

See "*Engineering*" . . . . * xxii. 151.

Chop'ping Mill. A mill for coarse-[…] grain for stock. In France it is an *aplatiss[…] casseur*, or *broyeur*. In England a *kibbl[…]* grinding mill, etc.

Chop Sep'a-ra'tor. (*Milling.*) A […] for treating the meal coming from the rol[…] to separate the flour from the cracked grai[…]

Lampert . . . . . * "*American Miller*," vi[…]

Chro'ma-trope. A device in a ste[…] to illustrate color effects; kaleidoscopic […] etc.

Morton . . * "*Scientific American*," xxxiv. 5; […]

Chrome Leath'er. Hides tanned b[…] of chrome. Invented and patented by I[…] zerling, in Germany.

"*Chemical Review*," Eng. . "*Scientific Amer. S*[…]

Chro'mic Ac'id Bat'te-ry. (*El*[…] One in which a solution of bichromate of p[…] takes the place of nitric acid in the Bu[…] tery.

Scientific American Supplement" . . . .

Chro'mo-graph. An apparatus for […] cing maps, plans, etc. It consists of a sh[…] box containing a white gelatinous co[…] The writing is made with a special ink, […] downward on the composition, and the ha[…] lightly over it; about one minute is re[…] secure a transfer. A number of copies, f[…] 40, may be obtained, according to the co[…] the ink and the composition, by laying t[…] successively upon the transfer and lightl[…] by the hand. The writing may be wash[…] composition. Also known as HECTOG[…] by many other names.

Chrome Steel. An alloy of iron an[…] It is made by melting in a crucible of […] material a mixture of Bessemer or Sieme[…] steel, and of pig or refined iron with a […] of chrome iron and of calcined and gr[…] stone. — *Kern.*

"*Iron Age*," xvii., Jun[…]
"*Iron Age*," xvii., Aug[…]
Chromeisen . . . . "*Scientific American S*[…]

See also Baur's U. S. Patents, Nos. 47,510, 49[…] 123,445.
See also CHROME STEEL, p. 2366, "*Mech. Dict.*"

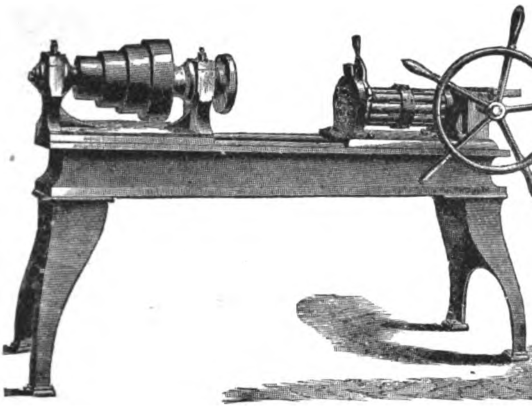
Chro'mo-li-thog'ra-phy. Picture[…] successive impressions in various colors f[…] See pp. 545, 546, "*Mech. Dict.*"

History and Technics, "*Silcox's Vienna Exh.*

Chro-mom'e-ter. An instrument […] Professor Koenig for making delicate […] tions of the amount of metals in ores. […] upon the optical fact that complemen[…] extinguish each other if mingled in pro[…] tions. Professor Koenig has applied th[…] to the colors which certain metals — as […] ganese, copper, etc., — produce when […] borax.

He prepares glasses or beads containing known […] a metal in one hundred parts, and observes how […] of the complementary color must be to produc[…] To accomplish this the instrument is furnished […] wedge of a green or red color, cut at a very […] By moving this wedge before the glass bead, […] of a suitable rack movement, a scale moves […] time, and when the point of extinction of co[…] at, the reading of the scale refers to a table […] percentage of metal contained in the examin[…] By this method of analysis a correct determin[…] ganese in an iron ore can be made in 15 minute[…] estimation in 30 minutes

Fig. 614.



Chucking Machine.

Chro'mo-pho-tog'ra-phy. Photographing in colors.

Processes . . . . . "*Scientific American Sup.*," 2079.
"*Scientific American*," xli. 260.
"*Scientific American*," xlii. 83.

Chro'mo-strob'o-scope. An instrument invented by Prof. A. Ricco, with colored glass and various designs. It is one of a class of scientific toys depending for its effects upon the persistence of visual impressions.

* "*English Mechanic*," xxiii. 168.
Ricco . . . . . . * "*Scientific American*," xxxiv. 212.

See ANORTHOSCOPE, STROBOSCOPE, CHROMATROPE, THAUMATROPE, PHENAKISTOSCOPE, ZOETROPE, in "*Mech. Dict.*"

Chron'o-graph. The British test of powder is by the velocity of the projectile, a given quantity with a service projectile from a proof-service gun.

The Boulengé chronograph is used. The first target is 45' from the gun, the second 165'. The pressure in the bore is determined by the crusher-gage, — a modification of Rodman's pressure piston. See INTERNAL PRESSURE-GAGE, CUTTER, DYNAMOMETER, PIEZOMETER.

The Boulengé chronograph used at the arsenal of Spandau, Prussia, is shown at Fig. 36, Appendix L., "*Ordnance Report*," 1877, and p. 533.

See *Laboulaye's* "*Dictionnaire des Arts*," etc., tome iv., article "*Instruments d'Optique*," ed. 1877.

"*Scientific American Supplement*," 417.

See also ELECTRIC CHRONOGRAPHS AND CHRONOSCOPES.

Chron'o-scope. An instrument for measuring small intervals of time.

The following electro-chronoscopes are described by Dr. Barnard in his Report on the Paris Exposition of 1867: —

Prof. Wheatstone.	Col. Benton.
Prof. Henry.	Capt. Martin de Brettes.
Capt. F. P. E. Schultz.	Prof. Bashford.
Capt. Navez.	

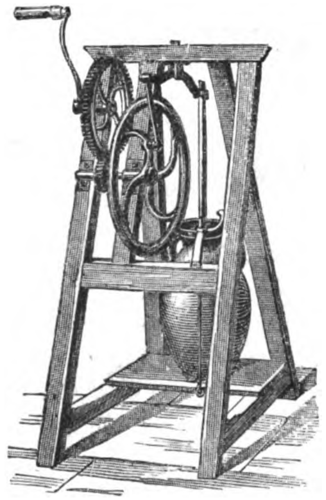
Dr. C. W. Tiemens . . "*Scientific American*," xxxv. 328.

See also ELECTRIC CHRONOGRAPHS AND CHRONOSCOPES.

Chro'no-ther-mom'e-ter. An instrument, the invention of Mr. R. P. Wilson and used in the testing room of the petroleum association of London. The design is to raise the temperature of the oil at the rate of 20° in 15 minutes.

The invention consists of a watch movement in conjunction with a circular thermometer. The watch is provided with but one hand, and the balance-wheel is so adjusted that this hand moves through 20° of the thermometer scale in 15 minutes. It is, therefore, merely necessary, in making an experiment, to set the hand when the mercury reaches 80°, and to regulate the lamp so that the quicksilver and the watch-hand travel round the dial *pari passu*. If the thermometer is observed to be getting ahead of the watch, the light under the water-bath is slightly lowered (this being easily effected by the mechanical arrangement in the wick-holder), and, of course, *vice versa*.

Fig. 615.



Breton Churn.

The inner line of degrees marked on the thermometer scale represents minutes (1 to 15), and the outer line, degrees of Fahrenheit's scale, 20 of which (80 to 100), it will be observed, are equivalent to the 15 minutes, though, of course, in the construction of the instrument, any other desired rate of heating may be provided for.

"*English Mechanic*" . . . . *
"*Scientific American Supplement*" . . . . . * 181.

Chry'soid. A name given by Farmer to his alloys of aluminum which resemble gold and are adapted for watch-cases, chains, and jewelry.

Four series of formulas, —

Cu. Al. Ag.	Cu. Al. Fe.
Cu. Al. Zn.	Cu. Al. Ni.

are given with varying proportions, on p. 71 of "*Mech. Dict.*"

Chuck'ing Ma-chine'. A form of machine lathe. Fig. 614 shows a revolving-head drilling or chucking machine with 8 spindles. Instead of a common tail-stock there is a revolving or rocking head, revolving in a vertical plane, with several spindles, for facing, drilling, reaming, and counterboring small work.

By this means a piece may have several operations performed upon it without being removed from the chuck or face-plate. The several tools are brought forward as desired or in turn by the hand-wheel.

Churn. The Breton churn is shown in Fig. 615. The cream jar is clamped upon its stand and the dasher reciprocated vertically and rapidly by hand crank and gearing.

Churn Drill. A form of drill, the earliest type of which is in one of the forms of implements for obtaining fire by friction of one piece of wood on another.

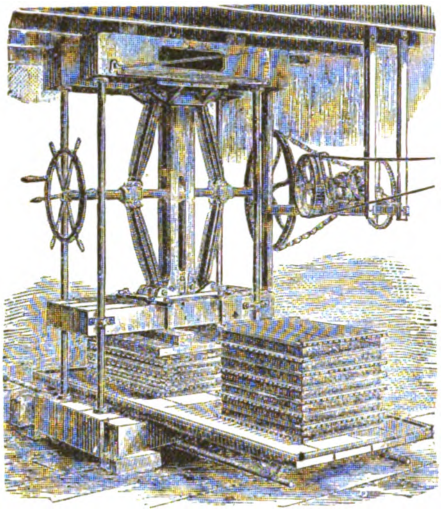
For an improved form see HAND DRILL.

Ci'der Press. The Boomer & Boschert cider press, Fig. 616, has a special grinder with an iron cylinder furnished with 8 steel knives placed in planed grooves across the face of the cylinder and held in place by iron bands at each end. Five concaves of flat steel springs are adjustable to any required distance from the cylinder, and each regulated to any degree of stiffness, but giving way to any foreign matter, such as stones.

The power press has a double platform which runs on rollers so that one cheese may be building while another is pressing.

In running down the press the right-and-left screw is rotated approaching the knees of the pair of toggles, passing through nuts in the knees, and rotated by the hand wheel at first but by means of the pulley, gearing, and chain as the work proceeds and more power is required. The movement

Fig. 616.



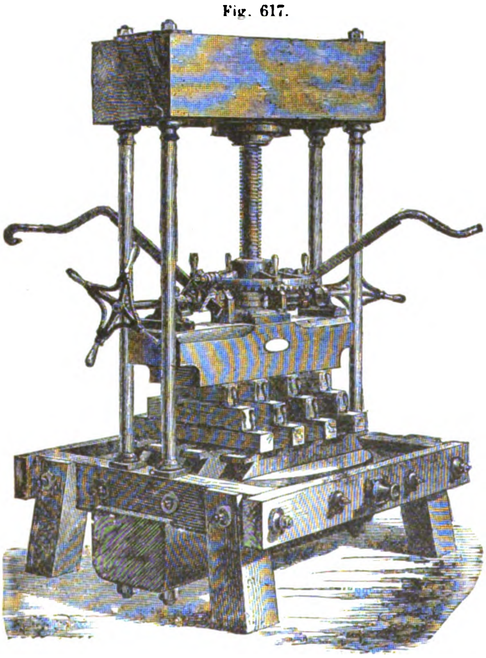
Power Cider Press.

becomes relatively slower as the toggles straighten, and the power increased in a like proportion.

The follower is permanently attached to the end of the toggle arms so that it does not require placing and replacing.

The cheese consists of regular successive layers of pomace, each about 4″ thick, completely enveloped in cloth, each being shaped in a square frame which is raised, leaving the

Fig. 617.



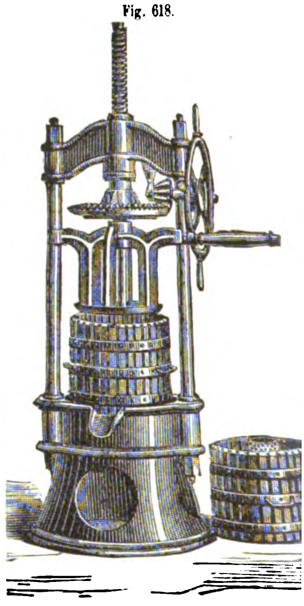
Press of David of Orleans.

same in position. Racks of wooden strips are laid between each layer of pomace.

The press, Fig. 617, made by David of Orleans, is one of the screw-presses of a type so common in France. Its general features will be readily understood from the illustration: The nut is revolved upon the screw and pushes down the follower or upper member of the press. What is notable is the compact mode of obtaining the three powers. Quick motion and relatively small power at the first, the motion decreasing in rate and increasing in power at each subsequent stage.

The first motion is by the central wheel, which has handles projecting upward. The next power is by the hand wheels at the ends, pinions on the wheels engaging the crown wheel. Third and lastly, the brake levers which act by pawl and ratchet upon the pinion shafts in the manner of windlass brakes.

Fig. 618.



Wine & Cider Hand Press. (*Nain Terrel del Chênes.*)

The cider and wine hand-press made by Nains, of Terrel des Chênes, is shown in Fig. 618. It has an exterior and interior crate, so that the pomace is in a comparatively thin body, rendering the escape of the juice more ready and complete It may be said to have two powers; that is, in the first stage the master wheel is rotated by the crank arm, and subsequently by swinging the weight up on the spokes. The follower, it will be seen, is guided upon the standards and descends in the annular space between the crates.

See also WINE PRESS; OIL PRESS; OLIVE PRESS.

Mill, portable, *Sikes* . * "*Scientific American*," xxxviii.
Press, toggle motion.
Boomer & Boschert . * "*Scientific American*," xlii. 24

Ci-gar′-box Tel′e-graph. Named from compactness and portability of the instrument.

"*Scientific American*" . . . . xxxvi. 2(

Cig′a-rette′ Ma-chine′.

French cigarette machine, * "*Scientific Amer.*," xxxvii

Cil′i-a For′ceps. (*Surgical.*) Tweezer removing the eyelashes. A species of depi forceps.

Figs. 7, 9, Part II., *Tiemann's* "*Armamentarium Ch cum.*"

Cin′der Notch. (*Metallurgy.*) A not the top of the dam of a blast furnace, to all slag to run off.

Cin′der Wool. A fibrous glass obtai the action of a jet of air or steam upon molt as it issues from the blast furnace. See SL MINERAL WOOL.

Cin′na-bar. (*Mining.*) Sulphuret of m

Ci′pher-wri-ting Frame. A writing paneled or otherwise, arranged for writin messages on a preconcerted plan.

Berghold . . . * "*Scientific American*," xxx

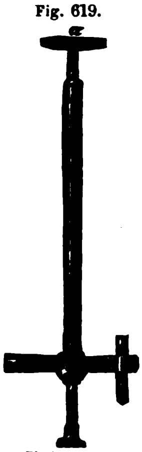
Cir-cas′sienne. (*Fabric.*) A Fren goods woven on a taffeta loom; it has a sil warp, and a mohair or silk-and-mohair war *Llanov* has a cotton warp.

Cir′cle. A *traverse-circle*. An arc-shap on the terre-plein or gun platform, on w wheels beneath the chassis of a gun traverse as the gun is horizontally adjusted. Two such circles are shown beneath the Krupp gun-carriage, Plate VIII., p. 448, "*Mech. Dict.*"

In British practice known as *racers*.

Cir'cle Cut'ter. An optician's tool with a diamond on the arm, for cutting circles in thin glass for covers for objects on slides.

Fig. 619.



Circle Cutter.

Cir'cuit. (*Electricity.*) The path along which the current travels.

Cir'cuit Break'er. (*Electricity.*) A device by which the circuit is closed or opened at pleasure. or automatically. See TELEGRAPH KEY.

Cir'cuit Clo'ser. A key, for instance, for making a contact to complete a circuit. The *breaker* and *closer* are usually one, the alternate motions of the key closing and opening the circuit.

See TELEGRAPH KEY.

Streitinger & Doerflin . * "*Engineer*," xliii. 153.
For torpedoes, *Abel*, Br. . * "*Engineering*," xxi. 96.
Mathieson, Br. . . . . * "*Engineering*," xxi. 96, 224.
McEvoy, Br. . . . . * "*Engineering*," xxi. 96.
For torpedoes, *Livermore* . "*Engineering*," xxi. 404.

Cir'cu-lar Bal'ance. A spring balance having a pointer which traverses a graduated and numbered dial.

Cir'cu-lar Com'pass. An instrument invented by *M. Duchemin*, in which an annular piece of metal is substituted for the needle. The annulus has its N. and S. poles at opposite points of the same diameter. The advantages claimed are greater sensibility and less disturbance from the vessel's motion.

Cir'cu-lar Knit'ting Ma-chine'. One with a circular race, making a tubular knitted fabric. See Figs. 2769, 2771, pp. 1236, 1237, "*Mech. Dict.*"

Cir'cu-lar Loom. One for weaving tubes, hose, etc.

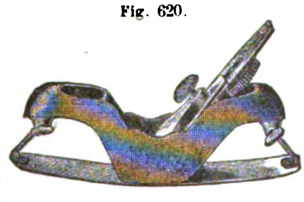
United States Patents in circular looms.

No.	Inventor.	No.	Inventor.
16,248	Nelson.	51,040	Greenough.
17,353	Carney.	52,718	Hull.
26,585	Grunwald.	53,372	Danby.
32,461	Bonard.	59,138	Slayton *et al.*
39,197	Darker.	72,362	Buser.
41,466	Slayton.	81,438	Wagner.
43,937	Veerkamp *et al.*	91,305	Brooks.
44,902	Walton *et al.*	98,738	Bryant.
45,208	Slayton.	* 124,288	Reed.
45,629	Palmer.		

* Reissued.

Cir'cu-lar Plane. A plane with a flexible steel face, capable of adjustment to the arc required, within specific limits.

Fig. 620.

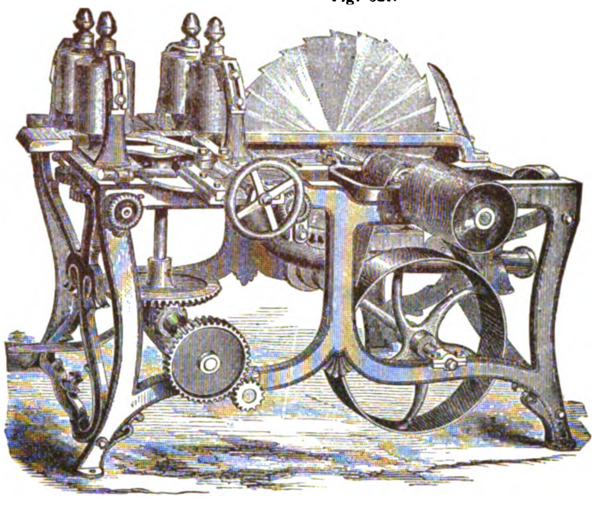


"*Victor*" *Circular Plane.*

Cir'cu-lar Re-saw'ing Ma-chine'. A machine for making bevel-siding and weather-boarding from thicker stuff.

The lumber is fed to the saw by four rollers, which are expansively geared in pairs, so that at whatever point they may be placed, the gearing

Fig. 621.



Circular Re-sawing Machine.

has the same effective feeding force. The rollers are hung upon ball-and-socket joints, which gives them an adjustment for bevel-sawing, and presents the center of the stuff to the saw, however the thickness may vary. The saw arbor has a lock attachment to keep it from moving while the saw is being sharpened or replaced. There are three speeds of feed to accommodate different widths of lumber.

Cir'cu-lar Rib'bing Ma-chine'. A knitting machine having a circular race, and adapted for rib-work, such as Cardigan jackets and sleeves.

The machines of *Gimson & Coltman*, of Leicester, England, are described in G. W. Gregory's report on knitting machines, Group XXII., "*Centennial Exhibition Reports*."

Cir'cu-lar Saw. (*Add.*) 2. (*Surgical.*) A round saw used in osteotomy in deep-seated parts. A substitute for *Hey's* saw.

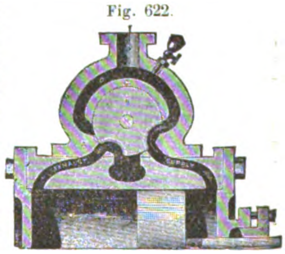
Græfe's . . . . Fig. 66, Part I.
Tiemann's . . . . Fig. 57, Part I.
Tiemann's "*Armamentarium Chirurgicum*."

Cir'cu-lar Spring Bal'ance. See CIRCULAR BALANCE.

Cir'cu-lar Slide Valve. A species of faucet valve. A cylindrical valve with ports made by depressions in its periphery, bringing the respective ends of the cylinder in alternate connection with the steam chest and exhaust port.

The term is not a peculiarly happy one, and will apply as well to the valves of the Corliss and Wheelock engines. See CUT OFF.

Fig. 622.



Circular Slide Valve.

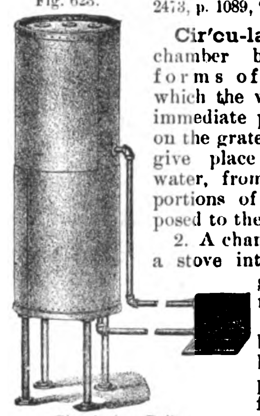
Cir'cu-la'ting Boil'er. A boiler in connection with a heater, through which latter the water circulates to become heated.

Fig. 623 shows a heater for a domestic range, connected by circulating pipes with the boiler.

A circulating boiler, one of the very earliest of its class, is shown under INCUBATOR, "*Mech. Dict.*," which see. The invention of *Bonnemain*, 1777.

See system of steam-heating, Fig. 2473, p. 1089, "*Mech. Dict.*"

Fig. 623.



Circulating Boiler.

Cir'cu-la'ting Drum. 1. A chamber belonging to some forms of steam-boilers, into which the water, heated by the immediate proximity of the fire on the grate, is caused to flow to give place to other bodies of water, from the feed, or from portions of the boiler less exposed to the urgency of the fire.

2. A chamber above or around a stove into which the heated gases pass in order to radiate heat.

3. A water-chamber in a hot-water heater into which passes the hot water from the coil exposed to the fire.

Cir'cu-la'ting Pump. 1. One for supplying water for the condensers of engines. The speed should be in proportion to the temperature of the circulating water and the working conditions of the engine.

2. The air and circulating pump is specially adapted for marine condensing engines. It is a direct-acting pump, and the two pumps are driven from the same steam cylinder.

Cir'cu-la'ting Steam Boil'er. One consisting of two portions unequally exposed to the heat of the furnace, and with connecting pipes or passages by which the water rises from the over-heated and descends from the relatively colder, maintaining a circulation.

Stead's . . . * *Scientific American*," xxxviii. 243.
Other illustrations may be found in Plate LXI., opposite p. 2326, "*Mech. Dict.*"

Cir'cu-la'ting Tube. In a steam boiler; a tube leading from one part of a boiler to another to establish a circulation in a given direction, as from the hotter to the portions more removed from the direct contact with the furnace or flue plates.

There are numerous illustrations of this feature. See Plate LXI. and pp. 2327, 2328, "*Mech. Dict.*"
See also *Oke*, "*Engineering*," * xxii. 328.
See list under STEAM, "*Mech. Dict.*," *et infra.*

Cir'cum-cis'ion In'stru-ment. (*Surgical.*) An instrument for excising the projecting portion of the prepuce beyond the glans in cases of phimosis.

Phimosis instruments, Figs. 1-7, Part III., *Tiemann's* "*Armamentarium Chirurgicum.*"

Dr. Baruth's circumcision scissors have a guard finger upon one blade which acts to prevent the clinging of the prepuce to the other blade when the blades are parted.

The phimosis instrument of Dr. Levis is for the excision of the inner inelastic membrane of the prepuce, or a partial ablation of the preputial integument, instead of complete removal.

Cire Per-due'. Bronze casting in wax. A model in wax is inclosed in a plaster mold, the wax melted out and bronze poured in. Thus the wax is *perdue*, or wasted. The plaster being removed the bronze object appears. See JAPANESE BRONZES; also pp. 500 and 1462, "*Mech. Dict.*"

Cis'tern.

Filtering, *Moscucci*, Fr. . .	* "*Scientific Amer. Sup.*," 2305.
	"*Scientific Amer.*," xliii. 340.
Day	* "*Scientific Amer.*," xliii. 403.
Rain water	"*Scientific Amer. Sup.*," 2393.
Filter	"*Scientific Amer. Sup.*," 1748.

Clam'mer. A forceps closed by a wei as a tongs in deep-sea soundings to obta mens of the bottom, shells, or of living thereof.

Clam'ond Bat'te-ry. A thermo-ele tery. See p. 2545, "*Mech. Dict.*"

An improved form consists of an alloy of two timony and one of zinc as the negative metal, a tinned sheet iron as the positive element — the the heated junction flowing from the iron to This alloy is cast in the form of a flat bar, br middle than at the ends, and measuring from 2 length by ⅜" to 1" in thickness. The sheet ir stamped out, is placed in a mold into which the is poured; before the alloy has cooled, the mol and the bars are removed. This alloy melts a and expands considerably on cooling. It imp casting, but is always very brittle. The bars radially around a temporary brass cylinder, a mica being inserted between the iron and the vent contact except at the point of junction. of these bars form a ring, and the several ring one above another, insulated from each other b asbestos. The inner ends of the bars are heat sen burner, the flame issuing in small jets in space between the burner and the bars.

See also THERMO-ELECTRIC BATTERY.

Clamp. (*Add.*) 8. (*Surgical.*) A ja to maintain parts in apposition, to prev tion on a line of excision, etc.

Harelip clamp	Figs. 252, 25
Nasal clamp (*Epistaxis*) . .	Fig. 239 *c*.
Ovariotomy clamp . . .	Figs. 439-444
Pile	Fig. 579,
Scrotal	Figs. 175, 17

Tiemann's "*Armamentarium Chirurgicum.*"

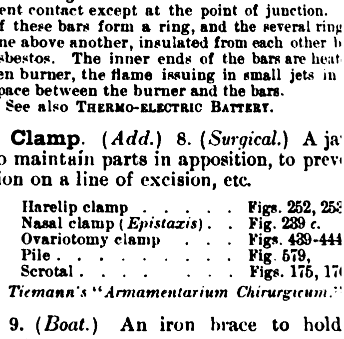
9. (*Boat.*) An iron brace to hold mast.

10. (*Leather.*) A wooden bench-scr two checks, used to prevent the leathe ing during the operation of stoning or

11. A stirrup-shaped metallic pie ing screw to hold one of the elements and make the electric connection. CLAMP.

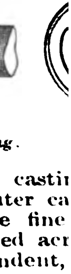
Clamp Coup'ling. A means of adjacent ends of two shafts in a t

Fig. 624.



Clamp Coupling.

coupling is formed from one casti the inner clasps with the outer ca which are inserted lengthwise fine screws. The clamps are divided acr of the coupling, and are independent, ends of the respective shafts, which may thus differ slightly from each other without impairing the bite.



See also COMPRESSION COUPLING.

Clamp Dog. Used for finished work and many other purposes: a means of holding them in the lathe so as to partake of the motion of the head spindle.

Clamp For'ceps. (*Dentistry.*) A forceps for holding the little sheet-metal clamp

Le C

which holds the rubber dam in position on the tooth. See DAM CLAMP.

Clamp'ing Tools, Vises, Wrenches, etc. See under the following heads: —

Adjustable vise.
Alveolar forceps.
Anvil vise.
Arrow-head forceps.
Artery forceps.
Backing boards.
Band-saw brazer.
Band-saw holder.
Band-saw tongs.
Basin wrench.
Bench cramp.
Bench screw.
Bench stop.
Biscuspid forceps.
Boring bar clamp.
Boring bar wrench.
Brazing tongs.
Burner pliers.
Cabinet-maker's clamp.
Calking vise.
Cant hook.
Carpenter's clamp.
Castrating clamp.
Chemist's tongs.
Clamp dog.
Clamp forceps.
Clamp screw.
Clevis tongs.
Cock wrench.
Condensing forceps.
Cork presser.
Cow-horn forceps.
Craniotomy forceps.
Crow.
Crowded teeth forceps.
Dental forceps.
Dentes-sapientiæ forceps.
Die dog.
Die holder.
Dilating forceps.
Door clamp.
Double-jaw vise.
Double-screw vise.
Dressing forceps.
Drilling clip.
Ear forceps.
Excising forceps.
Floor cramp.
Foot vise.
Frame clamp.
Gas-tube vise.
Hand clamp.
Hand vise.
Horse-shoers' vise.
Hose wrench.
Incising forceps.
Incisor forceps.
Joiners' clamp.
Laryngeal forceps.
Main-spring vise.
Matrix pliers.
Molar forceps.
Needle forceps.
Nose compress.
Nut wrench.
Parallel vise.
Pinchers.
Pipe-fitter's vise.
Pipe grip.
Pipe tongs.
Pipe vise.
Pipe wrench.
Placenta forceps.
Plate nippers.
Pliers.
Plug pliers.
Polypus forceps.
Ratchet wrench.
Rigger screw.
Root forceps.
Rubber-dam forceps.
Sash clamp.
Saw cramp.
Saw filing clamp.
Saw-filing vise.
Screw clamp.
Screw forceps.
Screwing stock.
Screw wrench.
Scrotal clamp.
Seizing forceps.
Separating forceps.
Shackle jack.
Spanner.
Spicula.
Sudden grip vise.
Swan's-neck needle forceps.
Swivel vise.
Tape forceps.
Tap wrench.
Tenaculum forceps.
Tire-bolt clamp.
Tire shrinker.
Tire upsetter.
Tongs.
Trachea forceps.
Tube chuck.
Tube tongs.
Upending tongs.
Upright vise.
Uterine forceps.
Vesico-vaginal clamp.
Vise.
Vise clamp.
Wrench.
Wrench handle.
Y.

Clamp Mill'ing Ma-chine'. (*Fire-arms.*) A machine used for special parts of the Springfield rifle, such as the firing-pin, etc.

Clap'pers. Two thick plates of iron, between which thin steel springs are placed while hot to be hardened.

Clap Net. One having hinged sections; used in bird-catching.

Clap'per Stay. A detent for the clapper in a bell. Used in silent practice on tower or church bells; a substitute for muffling with pieces of rope.

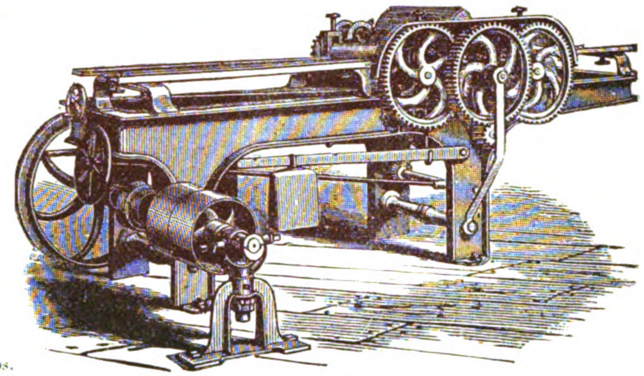
"Engineer" . . . . * xlvii. 243.

Clap'board Pla'ner. A machine for planing clapboards. This, in the Eastern States, means siding or outside weather-boarding for houses. In the West, the term is applied to a 3′ or 4′ board used for roofing.

Referring to the first meaning, as the machine under consideration is of Vermont manufacture, the practice is to saw clapboards directly from the log, towards the center, making a thick and a thin edge. Such boards are 4′ or 6′ long, subsequently planed to a thickness as far back from the thicker edge as will be exposed to the weather; and the exposed edge jointed or molded.

The frame of the clapboard planer is of iron, and

Fig. 626.



Clapboard Planer.

the feed-rollers have a length for taking two clapboards at a time, *sticking* a molding on the edge of each while running through.

The countershaft and pulleys are shown on the floor alongside of the machine.

Clar'i-net. (*Music.*) A reed instrument having a compass of three and a half octaves written on the G clef. Four registers are reckoned on the clarinet: the *low*, the *chalumeau*, the *medium*, and the *high*. There are four clarinets in general use. The *small* clarinet in E♭; the clarinets in C, B♭, and in A. The *alto clarinet* is one in F (low); the *bass clarinet* an octave below the B♭ clarinet.

See also CORNO DE BASSETTO.

Clasp Bend'er. A dentist's tool, for making clasps for teeth. It is a simple pliers in which the respective prongs are convex and concave so as to bend to a circular form anything pinched between them.

Fig. 627.

Dentist's Clasp Bender.

Claude Lor-raine'. (*Optics.*) A landscape mirror. It condenses or diminishes the view into a true perspective effect.

Clav'i-cle Ap'pa-ra'tus. (*Surgical.*) Braces, supporters, splints, and bandages for dislocation and fracture.

Figs. 66, 123-127, 147, 150, Part IV., *Tiemann's "Armamentarium Chirurgicum."*

Clay Heat'er. A heater for houses and halls in which baked clay is substituted for iron in order to avoid the disagreeable or injurious effects of the "burning of the air." It is a rude return to brick stoves, the ultimate quality of which is porcelain. See PORCELAIN STOVE.

Crary clay-heater . * *"Manufacturer and Builder,"* xi. 139.

Clay Tem'per-ing Wheel. A wheel for working clay with water to develop the plasticity. See CLAY MILL, p. 563, *"Mech. Dict."*

Mill, *Hind*, Br. . . . . . * *"Engineer,"* xli. 247.
Mill and Engine, *Jackson*, Br. * *"Engineering,"* xxiii. 154.
* *"Sc. American Sup.,"* 1105.
Tempering mill . . . . . * *"Manuf. & Builder,"* ix. 33.

Clean'ing Hole. (*Locomotive.*) A term applied to the means for cleaning; cleaning plugs being placed in the corners of the fire-box, and blow-off cock in front.

Clear. (*Glass.*) Said of glass, ware or window, which is free from depolish, etching, or other process which dulls the surface.

The depolishing may be made by grinding, acid, sand-blast, etc.

Half-clear is applied to objects which are partly depolished.

Clear'ing Bat'te-ry. (*Brewing.*) A device used in straining the wort from the vat; operating to moderate the flow when the depth of wort is considerable.

Austrian . . . "*Scientific American Sup.*," Fig. 5, * 4077.
"*Engineer*," * 1. 266.

Clear'ing Ring. (*Fishing.*) One to lower down the line to detach a hook from a root or other obstruction: or from the mouth of a fish. The latter is known also as a *disgorger*.

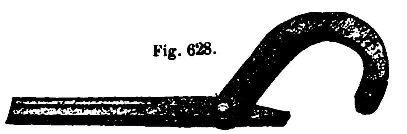
Clear'ing Stone. (*Leather.*) A fine whetstone, used to remove from the currier's knife the scratches made by the rub-stone. The Water-of-Ayr and Welsh clearing-stones are generally octagonal slips, 4″ thick, and from 6″ to 8″ long.

Clear Sto'ry. (*Railway.*) An upper row of windows in a passenger car, above the main-roof, and on the side of the raised or monitor roof.

Clear Way. Said of a valve, hydrant, etc.

One which lifts its valve entirely out of the way of obstructing the flow; not compelling the water to flow around it. Also called *full-way*.

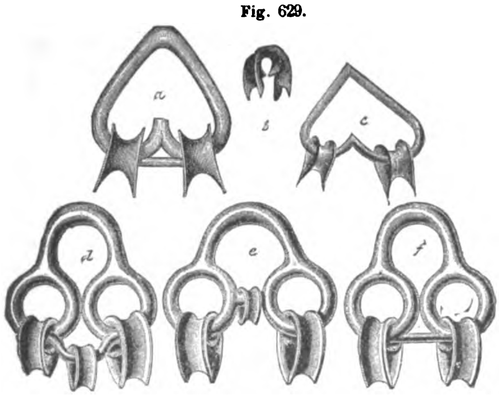
Fig. 628.



Clevis Tongs.

Clev'is Tongs. A form of pipe tongs with a swinging jaw like a cant-hook.

Fig. 629.



Clews.

a. Heart clew.
b. Clew thimble.
c. Ear-ring clew
d. Clew-bow.
e. Clew-bar.
f. Spectacle clew.

Clew. (*Nautical.*) A loop and thimble at the corner or clew of a sail. The means of attachment of the hook of the clew-tackle to the sail; the hook engaging with the loop, and the lashing passing around the thimble and the sail rope.

Clew Thim'ble. A metallic guard or sheath, (shown at *b*, Fig. 629,) over the rope forming the eye of the sail, in order to prevent chafing. In the figure a guard is placed in the interior of the thimble to fit loosely over the body of the clew to prevent the rope from chafing against the upper portion of the eye to which it is attached.

Cli'ma-tom'e-ter. An instrument for indicating the fluctuations in the conditions of sensible temperature. See instrument of Mr. J. W. Osborne, called also *Esthermoscope*, Fig. 6368, p. 2550, "*Mech. Dict.*"

Professor Forbes's instrument, described in a paper, "*Observations relative to the Temperatures to which the Human Body is exposed*,"[1] is intended to determine the "sensible warmth of the air," by which is meant, not the physical temperature which would be measured by an ordinary thermometer, but what might be termed the physiological temperature or warmth of the skin, as it is estimated by nervous persons. The questions of humidity, evaporation, movement of the air enter intimately into the question.

The apparatus consists of a cylindrical can filled with hot water and covered with a non-conductor. In this a copper rod is plunged, its upper end expanding into a cup which incloses the bulb of a thermometer. The heat of the can being assumed as constant, the rod, the lower portion of which is plunged in the can, parts at the exposed portion with its heat, and this rate depends upon the length of rod exposed and the atmospheric conditions. The length of the rod is made variable by sliding in and out of the heated vessel. The length is adjusted to give a constant thermometrical reading, and the length required to give the constant is the measure of the sensible warmth of the air.

[1] [In a letter by Prof. George Forbes, dated May, 1879, and published in the "*Journal of the Scottish Meteorological Society*," vol. v., p. 278.]

Climb'ing Ap'pa-ra'tus. See CHIMNEY.

Fig. 630.

Clinical Thermometers.

Clin'i-cal Ther-mom'e-ter. A thermometer for ascertaining the temperature of the person. It is common to place the bulb in the axilla, and the bulb of the lower instrument, in Fig. 630, is curved for that purpose. The next instance above that is a straight thermometer, with a contraction in the stem at *A*, to prevent the index slipping down into the bulb. The pencil-case thermometer is peculiarly convenient. The bent stem thermometer, Fig. 631, has also an evident provision against loss of index. In the best form of thermometer the front surface of the tube is made in the form of a cylindrical lens, the focus of which is in the column of mercury, thus magnifying it, rendering it easily read off. — *Beck.*

Fig. 631.

Bent Stem Thermr.

Fig. 632.

Clinometer Level.

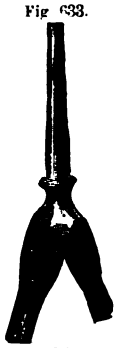
Cli-nom'e-ter Lev'el. An improved form of hand-level, having also an arc divided into angles of elevation and divisions for slopes.

Clip Chair. A form of chair used on some railways in England, to fasten the rail to the metallic sleeper.

The sleeper is an inverted trough, and through square holes punched in this trough a clip chair of rolled wrought iron or cast steel is slipped from the under side. The clip chair is of horse-shoe shape, one side forming a hook about

2½″ wide, and the other side is like one jaw of an ordinary railway chair for taking a wooden railway key. The wooden key fastens the rail tightly upon the sleeper, as well as holding the clip chair in its place.

Fig. 633.



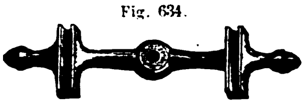
Clip King-bolt.

Clip King′-bolt. (*Vehicles.*) A clip which embraces the forward axle, and the upward extension of which forms a king-bolt.

Clip′ping Ma-chine′. A machine in which the clipping shears (Fig. 1330, p. 567, "*Mech. Dict.*") is driven by power; to clip horses. Similar apparatus are used to cut hair, and to shear sheep. Fig. 4942, p. 2139, *Ibid.*

Horse clipper, *Casey*, * "*Sc. Amer.*," xli. 210.

Fig. 634.

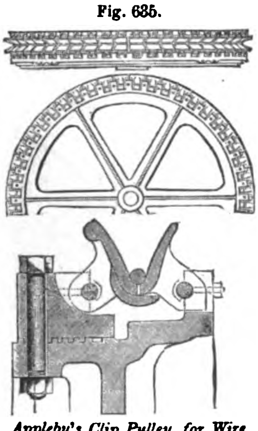


Spring Saddle Clip Plate.

Clip Plate. (*Carriage Hardware.*) A plate lying upon the spring of a carriage, and having channels above for the bows of the clip which attach it to the axle.

Clip Pul′ley. A pulley arranged for a wire rope. The perimeter of the pulley is made up of pivoted clips in pairs, and these close in upon the rope and grasp it, which prevents its slipping upon the wheel. The nipping action of the clips is upon at least half the diameter of the pulley, so that the wear of the rope is almost *nil*, the nipping action ceasing immediately and automatically the moment the rope begins to diverge from the circumference.

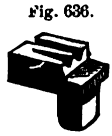
Fig. 635.



Appleby's Clip Pulley, for Wire Rope Transmission.

Clip Swage. (*Blacksmithing.*) A swage inserted in the hardy- hole of the anvil, used in finishing the clips on horse-shoes.

Fig. 636.



Clip Swage.

Clip Yoke. A small plate through which the ends of a stirrup-shaped clip pass, and against which the nuts are screwed.

Clock. See the following, which refer to instances of curious or otherwise remarkable clocks.

Century, *Hile*	* "*Sc. Amer. Sup.*," 688.
Curious, *Engle*	"*Iron Age*," xxi., Jan. 24, p. 3.
Lovelace, Br.	"*Iron Age*," xix., June 14, p. 3.
Guilmet	* "*Sc. Amer.*," xxxv. 371; xxxv. 401; xli. 132.
Remarkable	"*Sc. Amer*," xxxiv. 17.
Gas, Engl.	"*Sc. Amer.*," xxxix. 325.
Maker's hand-turning tool	* "*Sc. Amer. Sup.*," 1381.
Monster, *Dent*	"*Sc. Amer.*," xxxvi. 31.
Mysterious, on, *Lockert*	"*Technologiste*," xl. 79.
Rosset	* "*Sc. Amer.*," xli. 226.
Théodore	* "*Sc. Amer.*," xli. 297. "*Technologiste*," xl. 207.
Cadot, Fr.	* "*Sc. Amer.*," xxxvi. 214; xxxvii. 194. "*Technologiste*," xxxix. 318.
Secrets of mysterious	* "*Sc. Amer.*," xxxvi. 405.
Dials, luminous	"*Man. & Builder*," xi. 38.
Self-winding	"*Sc. Amer. Sup.*," 1711.
Three-wheeled	* "*Sc. Amer. Sup.*," 212.
Westminster	"*Sc. Amer.*," xxxiv. 138.
Washington Observatory	"*Iron Age*," xxi., March 14, p. 9.
Without hands, *Gillett & Bland*	* "*Sc. Amer. Sup.*," 440.
Wonderful, *Meier*	* "*Sc. Amer.*," xli. 191.

See also DIAL; ELECTRIC CLOCK.

Clock Reg′is-ter Ther-mom′e-ter. A means for enabling the meteorologist to ascertain the temperature of any given hour of either day or night at will by automatic registration.

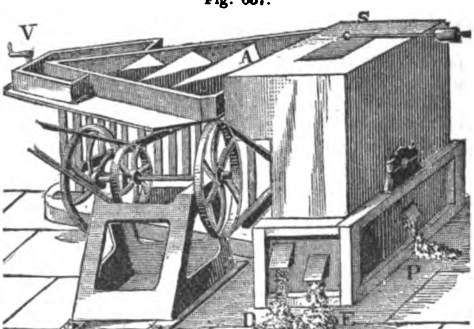
Negretti & Zambra provide for this need in a very ingenious way, which they term their "patent recording thermometer." The tube of the thermometer is bent at the middle so as to form two parallel vertical arms, and it is contracted at its union with the bulb, so that when it is turned over and upside down, all the mercury which is in the arm above the contraction runs round into the other branch of the tube, and there measures exactly the same length, and indicates the same number of degrees on the scale that it did in the first branch in the original position. The clock which carries the thermometer is set like an alarum. It turns the thermometer over, and so secures the register of the temperature at the hour at which its mechanism and hands are set.

"*Journal of the Society of Arts*"	1877.
"*Scientific American Supplement*"	935.

Clod Clear′er. A French machine to remove clods from grain.

The tray has a rocking motion on supporting bars, the crank making 115 turns per minute. The foul grain, etc., entering at *A* is divided to each side, bounced from side to side, and sorted according to gravity; the slope is toward the apex.

Fig. 637.



Aspirating and Vibrating Stone and Clod Clearer. (*Hignette, Paris.*)

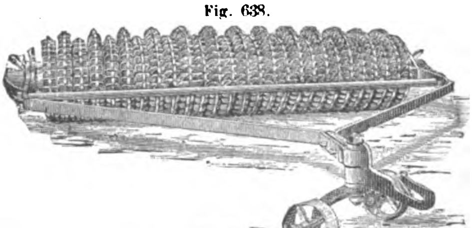
Stone and clods leave at the point *V*, the grain passes into the aspirator, where it is sorted by quality: *D* second quality, *E* heavy waste, *P* second waste; the good wheat has its discharge on the other side (not shown).

See Knight's Report Paris Exposition 1878 . . * v. 199.

Clod Crush′er. A rough-faced roller for breaking clods in the field.

Dr. Knight's report on Class 76 at the Paris Exposition of

Fig. 638.



Clod-crusher and Compressor. (*Demarly, Origny-Sainte-Benoite, France.*)

1878, contains views of the following (see "*Paris Exposition* (1878) *Reports*," vol. v., pp. 99-101): —

Clod-crusher, *Lowcock & Barr*, Engl.
"Excelsior" clod-crusher, *Picksley & Sims*, Engl.
Crosskill clod-crusher, *Puzenat*, Fr.
Clod crusher and compressor, *Demorly et Cie*, Fr.

Fig. 638 shows the Demarly implement. Besides the unequal sizes of the roller sections, in alternate order, they have an ability to slip transversely upon the axis. By this means, though of varying size, they may present themselves in straight line upon a level surface; either may lift in yielding to a large clod; and, as the surface rotation of each is equal, the rate of motion of the larger ones on the common axis is slower than that of the smaller rings, and, therefore, any clods getting between them are ground to powder, and the spaces between them are not choked.

Randell's clod crusher, Br. . * "*Engineering*," xxviii. 35.

Cloi-son-né. 1. (*Fine Art Metal Working.*) A pattern is raised on a metallic surface by means of wire or strips welded on to it, and enamel spread in the spaces, *cloisons*, between the raised metal.

A species of inlaying resembles it in this respect, that the lines are engraved, wires laid into them and the surface burnished down to hold the wire in position.

Champ-leve has lines engraved in the metal and filled with enamel.

Shushikuwan . . . . . . "*Technologiste*," xli. 519.

See lists Fine Art Metal Working; Art in Various Materials; Ceramics.

2. A coin on which a subsequent impression has been imposed on the previous one.

Clos'ing Ma-chine'. A sewing machine for boot-closing, stitching soles to welts, and for light harness work. The machine makes a lock-stitch with two threads, both sides alike.

Cloth-cut'ting Ma-chine'. Of the three power cloth-cutting machines shown at the Centennial Exhibition in 1876: —

Albin Warth's machine employs a reciprocating cutter blade in a turning head at the end of a pivoted arm guided on a track or rail at the side of the table on which the cloth rests. It operates better than a rotary knife on curved lines and corners.

Sanson's machine is a spring-arm band-saw machine, accurate and swift.

Fenno employs a rotary cutter at the end of a universally movable arm.

See the following references: —

Cutter band knife,
Powis Bale & Co., Br. . . * "*Engineer*," xlix. 235.
Cutting machine, *Sanson*, Br. * "*Engineer*," xli. 393.
Cutting machine, *Sanson*, Br. * "*Sc. American Sup.*," 4312.
Warth . . . . "*Thurston's Vienna Rept.*," iii. 320.
* "*Engineer*," xliii. 320.
Cloth finishing machine,
Pierron & Dehaitre, Fr . . * "*Sc. Amer. Sup.*," 4023.
Folding machine (Fr.) . . . * "*Sc. Amer.*," xxxiv. 178.
Inspector. Bolting cloth, *Deal*. * "*Sc. American*," xl. 326.
Press, *Boomer & Boschert* . . * "*Scientific Amer.*" xlii. 242.
Testing machine, *Riehl* . . . * "*Manf. & Builder*," xi. 178.
Hausner . . . . * "*Sc. Am. Sup.*," 1236.

Clothes Dry'er. An application of the centrifugal machine to the partial drying of clothes, preliminary to the *drying closet*, which see.

The *essoreuse* shown in Fig. 639 is made to go by hand or by power, being one of the smaller sizes.

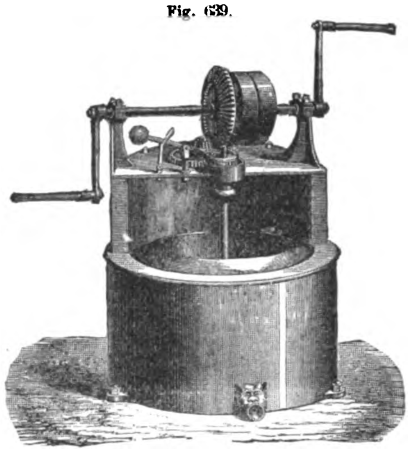
Brooks . . . . "*Scientific Am.*," xxxiv. 99.
Clothes wire-fastener, *Almont* * "*Scientific Am.*," xxxv. 166.
Clothes pins . . . . . . * "*Scientific Am.*," xxxvi. 227.

Clothes Pin. The machinery used in making clothes pins consists of

Bolting-up saw for working log into slabs.
Splitting-saw for working slabs into rods.
Cross-cutter or cutting-up machine.
Lathe for rounding.
Slotter.

Cloth In-spect'ing Ma-chine'. A machine in which the cloth is exposed in a smooth, inclined

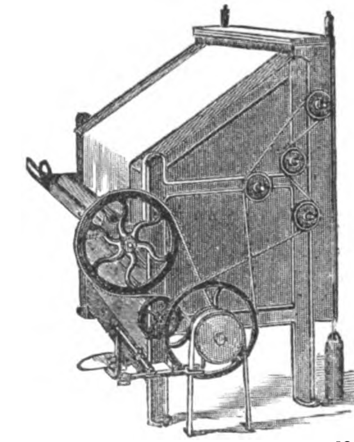
Fig. 639.



French Clothes Dryer. (*Beaume à Boulogne.*)

surface to the view. It may also be brushed, burled, or trimmed during momentary stoppage of the automatic motion.

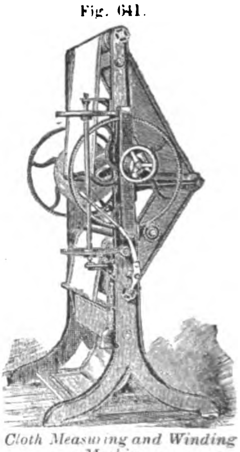
Fig. 640.



Cloth Brushing, Trimming, and Inspecting Machine.

Cloth Meas'ur-ing Ap'pa-ra'tus. A winding machine which takes the cloth from the bolt or pile, runs it over a measuring roller, then over stretching rollers at the back of the machine, and from thence to the winding jaws which hold the board on which it is wound. The measuring roller has a worm which operates the vertical shaft, on the top of which is a dial which indicates the length wound, and the pointer is set to zero for each operation.

Fig. 641.



Cloth Measuring and Winding Machine.

In the cloth-measuring machine of *White, Child, & Co.*, of London, the cloth runs upon a smooth and level table and underneath a wheel of known circumference, the revolutions of which are counted by worm gearing and dial. It is adapted for measuring and rolling cloth in salesrooms.

"*Scientific American*" . . . . . * xxxix. 54.

Cloth Press. A machine for pressing cloth *in transitu* or in bolt.

Nussey & Leachman, Leeds, England, make a powerful automatic machine, in which the woolen cloth is fed intermittingly between steam-heated platen and bed-piece. These are driven together with a force of 1 ton to the square inch, by a steam-pump acting as a hydraulic press. The whole surface is such that the aggregate pressure is 153 tons, and the pressure is maintained for 15″. The platen then retreats, the cloth is automatically advanced, bringing a fresh position between the pressure surfaces, which are again advanced, and so on. The cloth at the feed-end is fed over smoothing rollers. The machine was shown at the Centennial Exhibition.

In the continuous cloth press of *Harwood & Quincy*, of Boston, Mass., the cloth goes direct from the shearing machine to the press where it is brushed and pressed simultaneously.

The cloth to be pressed passes over bars and friction rollers, then over the upper part of a brush, and thence between a roller and concave bearing, and finally over another roller and the plaiter. The bearings are heated or not, as desired; the pressure may be brought up by the lever to 6 tons. When no pressure is required, the machine may be used as a brushing frame only. For the purpose of steaming the fabric it is necessary to heat the roller, and to cover it with a thick felt. — "*Textile Manufacturer.*"

The machine of *M. Hirst* is described in *Laboulaye's* "*Dictionnaire des Arts*," etc., article "*Laine*," * vol. ii., ed. 1877.

Boomer & Boschert . . "*Scientific American*," * xlii. 242.
"*Scientific Amer. Sup.*," * 2326.

Cloth-shear'ing Ma-chine'. A machine to cut the nap of undressed cloth. See pp. 575, 576, and Figs. 4922–4924, p. 2135, "*Mech. Dict.*"

For French woolen cloth-shearing machine, see Figs. 1339–1351, article "*Laines*," *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," tome ii., ed. 1877. Machines of
Lewis & Davis . . . . Figs. 1339–1343.
Davis . . . . Figs. 1344–1348.
Poupart . . . . Figs. 1349–1351.

Cloth Stretch'ing Ma-chine'. A machine for stretching and softening fabrics.

In the machine of *Devilder* (France) several cylinders and rollers are supported by a cast-iron frame, and operated by power transmitted by a belt and gearing. The necessary pressure on the goods is produced by a weight, pulleys, and levers. The goods, rolled on the lower cylinder in the rear part of the machine, are carried between a zinc cylinder and a wooden roller situated directly above the lower cylinder. The zinc cylinder runs in a trough filled with water. By this means the necessary degree of moisture is imparted to the goods. They are next taken up by a bar at the top of the machine, which may be regulated so as to increase or lessen the tension of the goods. From this bar the goods pass to the stretching cylinder, which is composed of sixteen copper plates revolving around, and alternately approaching to and receding from, a common axis. The approach takes up the first half of the revolution and the return the second half. The goods, by this means, are well stretched; they are afterwards rolled on a wooden cylinder below the stretcher. — * "*Revue Industrielle.*".

"*Scientific American*" . . . . * xl. 227.

Cloth Test'er. A machine for testing the strength of cloth by direct pull.

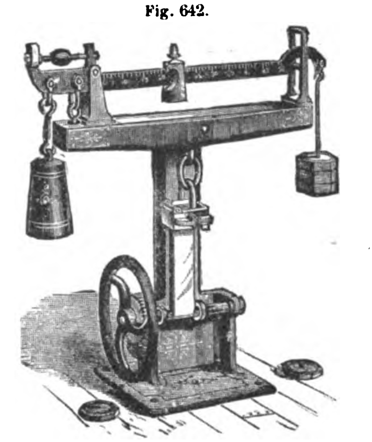
Riehlé Brothers' cloth-testing machine is shown in Fig. 642. One end of the sample of cloth, paper, or twine is inserted in a clamp attached to the weighing mechanism and the other end wrapped around a roller. The strain is put on by turning a hand-wheel, and the beam kept in equipoise by shifting the running weight. The strain is continued until the sample breaks, the result of the test being indicated on the scale in pounds. The scale levers are inclosed in the box in the upper part of the frame.

Yarn, fiber, and paper testers operate in a similar manner. See list under MEASURING, ETC., INSTRUMENTS.

"The official test of resistance of tissues and cordage shows the nature of the yarn and the quantity of matters contained therein by the following triple method: —

"*a*. The weight of the tissue per square yard is taken after the samples have been well dried in the stove or in the sun.

Fig. 642.



Riehlé Brothers' Cloth Tester.

"*b*. The number of threads in warp and weft is ascertained by the ordinary thread counter of a quarter-inch field.

"*c*. The resistance to traction of either tissues or cordage is measured by means of an apparatus which has two jaws, between which the tissue or cord is fixed, one jaw being stationary and the other connected with a lever, which is loaded until the sample breaks. In France the apparatus used is the dynamometer of Perreaux. For tissues the trials are made with bands 16″ long and 2″ wide, one cut lengthwise and another crosswise of the stuff

"The following are the conditions required by the navy and public offices for the following principal tissues: —

Kind of Tissue.	Threads per centimeter. In the Warp.	Threads per centimeter. In the Weft.	Weight per square meter.	Resistance of a band 5 cm. wide. Lengthwise.	Resistance of a band 5 cm. wide. Crosswise.
			k.	k.	k.
Hand loom cloth	-	-	435	220	230
Hand loom cloth	-	-	345	190	140
Tilt cloth	32, 33	10, 11	540–560	270	330
Double yarn hammock cloth .	-	18	350–370	200	290
Sail cloth, No. 1	22	7	550	275	410
Sail cloth, No. 6	24, 25	10	350	170	255
Sail cloth, No. 8, single yarn .	16–18	13, 14	270	135	200

"After experimenting on samples well dried at a temperature of about 80° C., the same should be repeated with others damped with water, which, of course, generally offer greater resistance than dried samples."

The cloth tester of MM. Chavin and Marin-Darbel, of Paris, is shown in "*Scientific American*," * xxxix. 211.

The cloth tester used by M. Giffard in testing the fabric of his captive balloon, Paris, 1878, is shown in "*Scientific American*," * xxxix. 194.

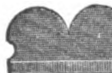
See also *Riehlé* . * "*Manufacturer and Builder*," xi. 178.
Hausner . * "*Scientific American Sup.*," 1236.

Cloth-Wind'ing Ma-chine'. See CLOTH MEASURING AND WINDING MACHINE; CARPET WINDER.

Clouds, Ap'pa-ra'tus for Meas'ur-ing heights of. John Harmer of Wick, near Arundel, Britain, has invented a method of estimating the height of clouds by photography and the stereoscope. Described in "*Nature*," Dec. 30, 1880, pp. 145, 195.

Clov'er Leaf Sight. A rear gun-sight having side lobes, which slightly resemble two foils of the clover leaf.

Fig. 643.



Clover Leaf Sight.

Club'-Foot Ap'pa-ra'tus. (*Surgical.*) Apparatus to bring a constant pressure upon the foot to bring it to symmetrical position. The talipes apparatus varies according to the nature of the deformity.

The figures following refer te *Tiemann's* "*Armamentarium Chirurgicum.*"

For talipes varus	Fig. 63, Part IV.
For talipes valgus	Figs. 64, 65, Part IV.
For talipes calcaneus	Figs. 67, 68, Part IV.
Artificial muscles	Fig. 76, Part IV.
Apparatus to evert the feet . . .	Fig. 77, Part IV
Apparatus for contracted tendo achillis, talipes equinus	Fig. 62, Part IV.
Shoe for partial paralysis of the foot .	Fig. 143 *a*, *b*, Part IV.
Club foot extension apparatus . . .	Fig. 28, supplement.
MacOwen's chisel for bow legs, etc. .	supplement.

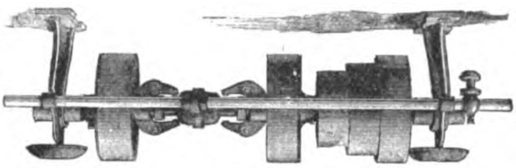
Clus'ter Spring. (*Railway.*) One formed of a number in a group. A *group spring.* See Fig. 1143, p. 483, "*Mech. Dict.*"

Clump. A thick outer sole attached by springs or cement to the ordinary boot sole.

Clutch. (*Nautical.*) The reëntering angle at the junction of the arm and shank of an anchor. The *throat.* See *d*, Fig. 191, p. 96, "*Mech. Dict.*"

Clutch Coup'ling. Fig. 644 shows a clutch

Fig. 644.



Clutch for Countershafts.

coupling as applied to countershafts. It has no shock in starting or reversing, nor any sudden tension of the belt. The shipper slide slips the cone against the clutch jaws, expanding them and bringing the surfaces in contact to produce motion. See also FRICTION CLUTCH.

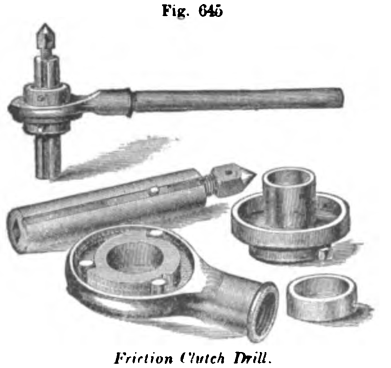
For rolling mills, *Beauregard*	* "*Min. & Sc. Press,*" xxxvii. 65.
Gear, *Burrell*, Br.	* "*Engineer,*" xlvi. 442.
Pulley, *Hunter*	* "*Scientific Amer.,*" xl. 275.

Clutch De-tach'er. A device for throwing off the clutch in a rolling mill train.

Lloyd . . . . * "*Iron Age,*" xxv, June 17, p. 11.

Clutch Drill. A drill the motion of which is obtained by a lever which binds upon the stock in the forward motion and runs free on the backward

Fig. 645



Friction Clutch Drill.

motion; pins on the lever head traveling inclines on the hub of the drill stock. The head can be moved from end to end of the stock, a feather traveling in a slot. The strain is divided on three points around the spindle.

Clys'ter Ap'pa-ra'tus. An enema syringe.

Coach. 1. (*Railway.*) A first class passenger car, as distinguished from a drawing room car, or second class.

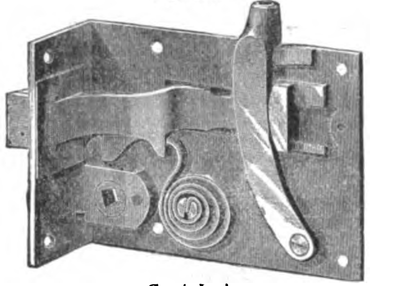
2. A passenger vehicle plying for hire.

Herdic . .	"*Scientific American Supplement,*" 3901.		
Murch.	Patents	147,421.	151,240.
		152,244.	149,779.
See also CAB.		154,572.	7,166. 7,445.

3. A private close carriage of size and pretensions.

Coach Bit. (*Manége.*) One having large scroll or straight checks made stationary on the mouth-piece, loops for the driving rein being placed at different distances from the mouth-piece, by which the leverage is increased or diminished.

Fig. 646.



Coach Lock.

Coach Lock. A spring latch operated either by the cross-bar handle on the exterior, or by a lever from within side the carriage.

Fig. 647.

Coach Screw

Coach Screw. A peculiar form of screw, with a V-thread and a square head like that of a machine bolt.

Coach Whip. (*Nautical.*) Another name for the pennant.

Coak. (*Nautical.*) The metallic strengthening piece in the middle of a block-sheave; pierced for the pin.

Coal Dust Burn'ing Grate. A grate peculiarly constructed to burn the anthracite slack, which has accumulated to such an enormous extent in the anthracite coal regions of Pennsylvania and Wales. The grate has usually a large surface and moderate intervals between bars, and the dust is distributed by a fan-like motion of the shovel. In some cases it is introduced in a gentle and constant shower by mechanical means. See WASTE-BURNING LOCOMOTIVE.

Coal-dust fuel	"*Scientific American,*" xxxv. 179; xxxviii. 33.
Loiseau	"*Scientific Amer.,*" xxxiv. 163; xxxviii. 116.
Furnace, *Stevenson*, Br.	* "*Engineer,*" xliii. 335.
	* "*Scientific American Sup.,*" 1295.
Locomotive, *Wootten* .	See WASTE-COAL LOCOMOTIVE.
Coal economizer . . .	See ECONOMIZER.

Coal El'e-va'tor. The projecting track *C* supports a carriage *B*, over which and through the running-block *A*, the hoisting rope runs, the end being fastened to the carriage *B*.

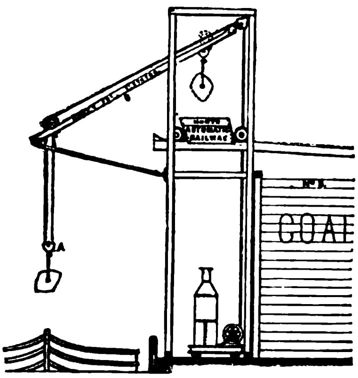
When the hoisting engine starts the rope in motion, the running-block *A*, with the loaded tub attached, rises vertically from the hold of the vessel until the block *A* strikes the carriage *B*. The engine continuing in motion, draws both the carriage and the bucket of coal up the inclined track *C*, until the bucket is over the bin or car, where it is dumped. The rope is then slackened and the carriage and empty bucket run back on the track to *B*, when the carriage is stopped by an adjustable chock and the bucket descends to the hold of the vessel to be refilled. The running block *A* is hooked to another tub already filled and ready to be hoisted.

When not in use, the whole track *C* swings on hinges back against the side of the building entirely out of the way.

The performance is usually 25 to 30 tons per hour.

In *Mariller's* hydraulic coal-hoist, used at Hull, England,

Fig. 648.



Coal Elevator.

the coal wagons are hauled by a *Brotherhood* capstan on to the rising platform, and are hoisted by a hydraulic ram to the required level, when they are run on to the middle platform over the hopper, and are discharged by opening the hopper doors and by tipping with special hydraulic apparatus for end-tip wagons. While the wagons are being discharged, the lifting platform is descending, and is lifted again with another wagon by the time the previous one is empty. The empty wagon passes on to the second moving platform, and, by means of its weight, controlled by a hydraulic brake, is lowered to the ground level, and passes out on to the empty siding. The brake ram, being connected to the hydraulic main, is of sufficient power to raise the lowering platform again to the top without the expenditure of any power beyond that obtained from the empty wagon in its descent. The tipping arrangements allow of the wagon being tipped in either direction, and the hoist is fitted with the usual appliances for adjusting the hoppers and coal chutes.

With properly hoppered wagons, constructed to discharge the coal freely, 300 tons of coal per hour can be shipped by the hoist.

Colliery hoist at Épinac, France * "*Engineering*," xxvii. 367.

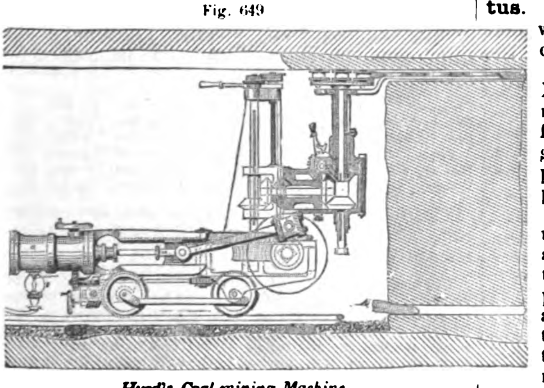
Coal Gas Test'er. See GAS-TESTING APPARATUS, *infra*. See also Fig. 651, next page.

Coal Min'ing Ma-chine'. The coal under-cutting machine of Lechner protrudes into the coal a horizontal shaft, armed with cutters and driven by chain-gearing. It advances straight into the breast of coal.

The Brown machine traverses along the breast and under-cuts to a depth of 4'. It uses cutters on an endless chain protruded into the coal.

The Gledhill machine (British) also advances along the breast. The endless chain of cutters passes over a jib which extends into the coal, and the jib has a capacity for a swinging motion in a horizontal plane so as to cut out at the end.

Fig. 649



Hurd's Coal-mining Machine.

The machine of Hurd & Co., of Wakeford, Britain, has also a jib which protrudes into the coal and around which the chain of cutters passes; but the machine is capable of cutting out all the four faces of the drift by revolving the head of the machine in a vertical plane so as to present the jib below, above, or on either side. The machine has two cylinders, 6'' diam., 12'' stroke, and works by compressed air. Motion is given to the cutters by bevel gearing, and the shaft driving the cutters is capable of being revolved in a vertical plane about the horizontal shaft.

The Payton & Holmes machine (London, England) has a species of saw jib having a number of teeth to which a peculiar pecking motion is given by means of short curves or eccentrics. The jib (or saw) has a swinging motion in cutting in or out and when sunken in the face to its full depth the machine is traversed on rails along the face of the breast.

See notices under the following references: —

Report on coal-mining machinery by A. Jottrand, "*Centennial Exhibition Reports*," Group I., vol. iii., p. 338 — including —

McDermott's coal-drilling machine	* p. 340.
Gledhill's coal-cutter	p. 341.
Holmes & Payton's coal cutter	* p. 342.
Brown's coal cutter	* p. 347.
Coal-breaker, *Hull*, Br.	* "*Engineering*," xxix. 135.
Chute for tenders	* "*Railroad Gazette*," xxi. 275.
Coaling	* "*Railroad Gazette*," xxii 193.
Cutting	"*Scientific American Sup.*," 1810.
" Monitor," *Brown*	* "*Eng. & Min. Jour.*," xxiv. 365.
	* "*Scientific Amer. Sup.*," 1702.
Lilienthal	* "*Scientific Amer. Sup.*," 2587.
	* "*Engineering*," xxvi. 498.
Lechner	* "*Engineering*," xxix. 78.
	* "*Eng. & Min. Jour.*," xxvi. 130.
	* "*Scientific American*," xlii. 81.
Payton & Holmes	* "*Eng. & Min. Jour.*," xxi. 288.
Discharging, *Beuvry*, Fr.	* "*Engineering*," xxvi. 98.
Getting, Scotland	* "*Scientific Amer. Sup.*," 3754.
Handling, Sugar Refinery	* "*Eng. & Min. J.*," Aug. 23, 1879.
Hoist, Nuneaton, Br.	* "*Engineer*," xliv. 184.
Hydraulic, Br.	"*Iron Age*," xx., Aug. 16, p. 7.
Hydraulic hoist	* "*Engineering*," lvii. 231.
Mining, Schuylkill, Pa.	* "*Eng. & Min. Jour.*," xxiii. 40, 56, 72, 88.
Screen, spiral, *Schmitt*	* "*Engineer*," xlvii. 416.
Shipping, *Smith*, Br.	* "*Engineering*," xxviii. 373.
Tipping, *Rigg*	* "*Scientific American*," xli. 290.
Truck, Penn. Railway	* "*Engineering*," xxv. 8.
Washing, *Robinson & Son*	"*Iron Age*," xix., June 7, p. 1.
	"*Am. Manuf.*," Feb 7, 1879, p. 11.
Stutz	* "*Iron Age*," xxi., June 13, p. 1.
Evard, Fr.	* "*Engineering*," xxix 42.
Molières, Fr.	* "*Engineering*," xxix. 84, 96.
Bessège, Fr.	* "*Engin'g*," xxix 122, 201, 260.
Washing, Osterpey, Ill.	* "*Eng. & Min. Jour.*," xxii. 88.

Coal Oil Fur'nace. See PETROLEUM FURNACE.

Coal Sledge. A peculiarly formed hammer of from 5 to 8 pounds weight, used in coal mining and breaking lumps.

Fig. 650

Coal Sledge.

Coal Test'ing Ap'pa-ra'tus. An apparatus by which the director of a gas-works may readily ascertain the quality of coal.

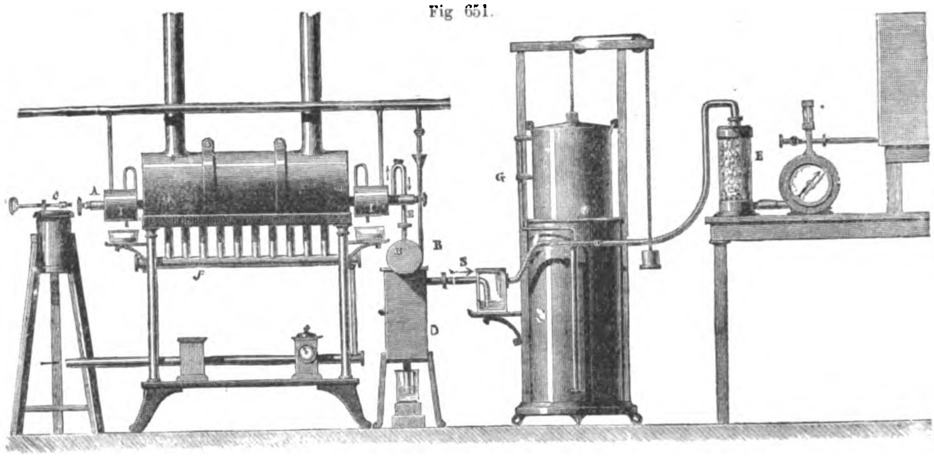
Fig. 651 shows an apparatus, designed by M. Andouin of Paris, by which can be determined, in less than an hour, the quality of coal from the point of view of the production of gas, the quantity of gas and coke, the lighting power of the gas produced, and whether the purification of the gas is easy or otherwise.

This apparatus serves not only to determine the value of different coals, but also to assist in judging of the conditions under which the gas-works is operated day by day, in comparing results under diverse treatment. It also enables the director to determine whether the difference in results is due to change in the nature of the coal or to changes in the mode of operation in the gas-works.

The mode of operating the apparatus is as follows: —

An average sample of the coal being selected, is crushed and charged into an iron crucible. The weight of a charge is 100 to 200 grams, or more, according to the size of the ap

Fig 651.



Andouin's Coal-testing Apparatus.

paratus. The iron tube which has the function of the retort is raised to the required temperature by means of the special means indicated in the figure.

The furnace is heated by gas, which allows the requisite degree of temperature, a bright red, to be maintained steadily by means of a gas regulator which determines the pressure, shown by a manometer communicating with the tube *f*, which brings the gas.

As soon as the required temperature of the furnace is attained (in about half an hour after lighting the gas), which is determined by a pyrometer, the tubular retort is introduced and the opening A closed. The gas, as it is disengaged, passes to the gas-holder G after parting with its tar and ammoniacal water; the holder has a capacity of about 60 liters and maintains a pressure at 0°. The distillation terminated, the gas, which is measured in the holder, is conveyed to the purifier and then to the photometer to be tested for quality.

The retort is withdrawn from the chamber and rapidly cooled, and the weight of the coke is readily ascertained.

The right-hand portion of the apparatus shown in Fig. 651 is ordinarily at some distance from the retorts, but they are shown close together for convenience of illustration. The break is visible near the arrow S. B is the washer; D the condenser; the cooled gas escapes by the pipe S to the gas-holder G, thence by the purifier E and the meter to the photometer. I I are the chambers in which cold water circulates around that part of the retort outside of the furnace. C is a screw to close the tube.

Coal-still, *Clements*, Engl.	* "*Scientific Amer.*," xxxix. 85.
Coal-tar still	"*Scientific Amer. Sup.*," 2895
	"*Scientific Amer.*," xxxiv. 213.
Scotland	* "*Scientific Amer. Sup.*," 2740.

Coal-tip'ping Ma-chine'. One for discharging the corves or mine cars down a grated incline into railway cars or boats. The screen removes grades of dust and small coal which fall into cars or receptacles beneath.

Riggs . . . . . * "*Scientific American*," xli. 290.

Coal-whip'ping Ma-chine'. A form of hoisting apparatus for quickly lifting the large loaded buckets out of a ship's hold. It was formerly done by a set of men called coal-whippers, who used the simple form of apparatus known as a whip. Described on page 2770, "*Mech. Dict.*"

In the coal-whippers' machine the cylinders act directly upon the barrel, and an up-and-down rope is used; the engine and boiler are made separate, and are as light as possible, so that they can be taken in a boat alongside a sailing ship, and readily hoisted on board by the ship's tackle.

In some cases the whole of the winches required to work the cargo in and out of the ship are driven from one engine placed amidships by means of a high-speed cord carried along the deck, and protected by wooden casings.

Co'ap-ta'tion Splint. (*Surgical.*) A stiff cradle bandage to hold the broken ends of bones in apposition. See SPLINT.

Co'balt Pla'ting. Cobalt electro-plating is done in a bath of a neutral solution of the double sulphate of cobalt and ammonium (*Gaiffe*), or the chloride of cobalt combined with the chloride of ammonium and magnesium, or the sulphate of cobalt with sulphate of ammonium or sulphate of magnesium (*Adams*). See also ELECTRO-PLATING.

"*Engineering and Mining Journal*"	xxvi. 136.
"*Scientific American Supplement*"	207.

Cob Stack'er. An attachment to a power corn sheller to raise the cobs from the machine and pile them at a distance. See CORN SHELLER.

Cock Al-loy'. The Society of Mechanical Engineers, of Vienna, have decided upon the following alloys as best suited for cocks and valves.

	No. 1.	No. 2	No. 3.
Copper	84.	83	80
Tin	22.9	17	18
Zinc	8.4	-	2
Lead	4.3	-	-
Iron	.4	-	-
Total	120	100	100

The freshly cast alloy to be cooled rapidly with water.

Cock valve, *Mayer*, Austria * "*Engineering*," xxx 259.

Cof'fee Clean'er. 1. A machine for rubbing the parchment envelope which incloses the associated seeds.

2. A machine for cleaning mold, dust, and trash from raw coffee.

Stafford's coffee cleaner (Br.) has a magnetic nail detector to remove nails. The inclined sieve removes dust.

Cleaning	"*Scientific American*," xl. 368.
Dryer, *Guardiola* . .	* "*Scientific American*," xxxvi. 83.
Pot, *Sherwood* . .	* "*Scientific American*," xxxvii. 182.
Place	* "*Scientific American*," xxxix. 168.
Huller, *Guardiola* . .	* "*Scientific American*," xxxvi. 83.
Washer, *Guardiola* . .	* "*Scientific American*," xxxvi. 82.

Cof'fee Cool'er. An apparatus for cooling coffee after being roasted or kiln-dried after treatment to clean it.

The machine consists of a large blower or exhaust, 26″ in diameter, and a large double-bottomed box, the false bottom being of heavy wire cloth. The box is supported on two wheels, so that it may very readily be moved to receive the material from the roaster or dryer; and so arranged that, when the open end is attached to the open side of the blower, the air is exhausted from between the bottoms, and so drawn down through the material, and cooled, without dust or smoke entering the room; the same being blown into any chimney or flue, or out at any convenient opening. — *Burns.*

Cof'fee Hul'ler. A machine for operating upon the coffee berry to remove the husk, or parchment envelope of the grains.

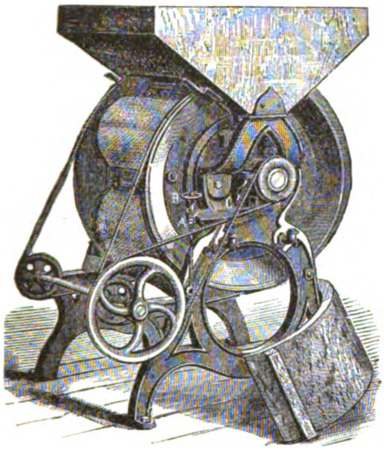
In Lombard's coffee huller the coffee is placed in a hopper that discharges on an endless chain apron which carries it in contact with a system of elastic pads. The pads treat each berry according to its size, retiring and returning readily as the grain of varying sizes pass under them.

The coffee, as it leaves the apron, is riddled by a screen below, being at the same time cleaned by a fan working in connection therewith, and falls into a well, from which it is elevated by buckets on an endless belt, and discharged on to a second endless chain apron that draws it under a stiff brush, by which the berries are polished.

The berries then fall on a second riddle that separates them according to size, and they are discharged at their separate spouts.

Cof'fee Mill. In the granulating coffee-mill,

Fig. 652.



Granulating Coffee Mill.

Fig. 652, the berries are cracked by a coarse roller, and the grains removed by the revolving sieve as soon as they attain a certain degree of fineness, the object being to obtain uniformity of size. The sieve revolves on flanged friction-wheels, the toothed roller and concave do not touch when the machine runs empty. The sieve is made up of 6 semi-circular divisions, which successively return their quotas of coarse stuff to the grinder.

Fig. 653 is a retailer's mill, the roller axis shifted, one cover removed, and the cutting disk exposed. The coffee from the hopper above passes between the attrition surfaces and falls into the tin vessel.

Fig. 653.

Coffee Mill.

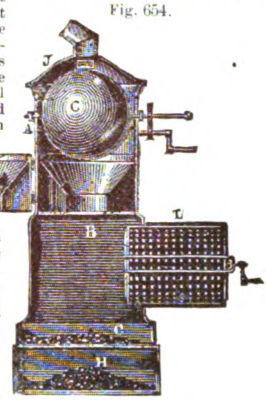
Cof'fee Roast'er. A multitude of small domestic and larger warehouse coffee roasters are in the market.

A French coffee roaster has a spherical chamber of glass, rotating over a special small furnace.

The coffee roaster of Hignette (Paris) has a globular vessel *C*, in which the coffee is roasted by the heat of a brazier, *D*, which is placed beneath it during the operation, but retired, as shown in the figure, and a funnel substituted when the coffee is to be discharged from the roaster into the cylindrical sifter, where the dust and pellicles are removed from it. The globular roaster receives the coffee from above when the opening is brought into temporary apposition with the flue hole in the cover, *J*, of the apparatus.

Fig. 655 shows Smith's portable coffee roaster, adapted to be placed over a stove or range. It is automatic, revolving by steam pressure.

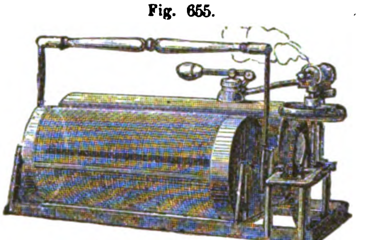
Fig. 654.



Coffee Roaster and Sifter. (*Hignette, Paris.*)

Cof'fer Dam. (*Hydraulic Engineering.*) An inclosure from which water is pumped, to expose the surface of the ground or bottom.

Fig. 655.



Portable Coffee Roaster.

The coffer dam at dam No. 4, Kanawha River improvements, is shown in "*Report of Chief of Engineers, U. S. Army,*" 1878, * ii. 467.

Conn. River, *Burrall* . * "*Van Nostrand's Mag.*," xiv. 366.
Harlem River . . . "*Iron Age*," xvii., May 11, p. 15.
Portable, "Centennial" * "*Iron Age*," xix., Feb. 22, p. 1.
Walsh, New York . . * "*Scientific American*," May 8, 1875.

Coil. (*Heating.*) 1. A convoluted pipe used as a heater, evaporator, condenser, as the case may be. The names of coils are derived from their construction, shape, purpose, and application. See the following: —

Bell.	Manifold.
Box coil.	Pipe stand.
Branch.	Radiator.
Circular tank coil.	Return bend.
Coil hanger.	Return bend coil.
Coil heater.	Ring plate.
Coil plate.	Sleeve.
Coil screen.	Soap coil.
Coil stand.	Spiral tank coil.
Condensing coil.	Square spiral tank coil.
Cone joint.	Square tank coil.
Double cone coil.	Taper screw joint.
Flat coil.	Tee.
Flat square coil.	Trunnion coil.
Heater coil.	Tuyere coil.
Helical tank coil.	Tymp coil.
Hour-glass coil.	Vertical tube coil.

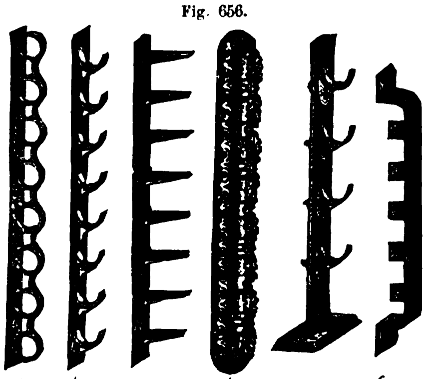
See also instances under CONDENSER, REFRIGERATOR, RADIATOR, FEED-WATER HEATER, etc., etc.

2. (*Electricity.*) *a*. The bundle of soft iron wires in the center of the helix. *b*. The wrapping of insulated wire around the core of an electro-magnet. Fig. 2672, "*Mech. Dict.*"

Coil'ing Ma-chine'. The ovens and machine for coiling bars, for making tubes for cannon, is shown in Plate II., Appendix I. *d*, "*Report of Chief of Ordnance, U. S. A.*," 1877, pp. 400, 412. See also Appendix L, Fig. 75, and p. 549, same report.

Coil Plate. A plate with hooks or rings to support the horizontal coils of a radiator; a steam or hot-water heater, evaporator, or condenser.

Fig. 656.



a b c d e f

Coil Plates.

a. Ring plate. *d.* Rosette plate.
b. Hook plate. *e.* Movable-hook plate.
c. Corner plate. *f.* Wall plate.

Coil Stand. A pair of coil-plates (which see), arranged to stand upon a floor and to support the various coils or convolutions.

Coil Screen. An ornamental open-work of wire concealing a coil, but allowing passage of radiated heat through the openings.

Coil Steam Boil'er. One in which the water in coiled iron pipe is exposed to the heat of the furnace.

See Fig. 5636, Plate LXI., p. 2317, "*Mech. Dict.*"; also, Fig. 2686, p. 1191, *Ibid.*
A double coil steam generator was shown in Paris, 1878, by M. N. Roser, St. Denis (*Seine*).

Coin Al-loy'. An alloy for coins, prepared by Johnson, Matthey, & Co., of London, is

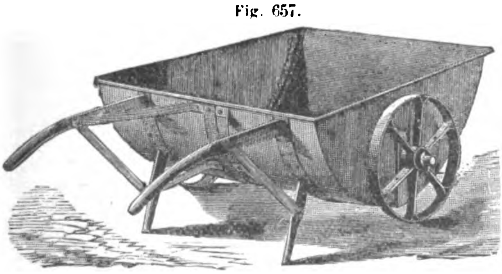
Aluminum	98
Nickel	2

It is light (Sp. gr. 2.75), does not tarnish; and is too light to be mistaken for silver. See also ALLOY, *supra*.

Detector, *Sutton* .	* "*Manufacturer and Builder*," ix. 118.
Silver dollars . .	"*Iron Age*," xxi., March 28, p. 7.
Tester, *Doherty* . .	* "*Scientific American*," xxxviii. 355.
Philadelphia mint .	"*Scientific American Sup.*," 2892.
Apparatus . . .	* *Laboulaye's "Dictionnaire desArts et Manufactures*," article "*Monnaie*," vol. ii., ed. 1877.

Coke Bar'row. A large, semi-cylindrical

Fig. 657.



Coke Barrow.

sheet-iron two-wheeled barrow used about coke ovens and furnaces.

French	"*Scientific American*," * xxxix. 322.

Coke-con-sum'ing Bat'te-ry. (*Electricity.*) The coke is imbedded in melted nitrate of potassium or sodium; the former being burned at the expense of the oxygen of the latter. The negative electrode is cast-iron. Invented by *Jablochkoff*.

Niaudet, American translation	240.
"*Scientific American Supplement*,"	1759.
"*English Mechanic*"	* xxvi. 109.

Coke Fork. A ten-tined fork for shoveling coke.

Coke Fur'nace. See the following references: —

Oven, *Aiken*	* "*Scientific Am. Sup.*," 1026.
Carvé, Bessèges, Fr. . .	* "*Engineering*," xxix. 399.
Stove, article, "*Chauffage*"	*Laboulaye's "Dict. des Arts*," etc., iv., Fig. 3458.
Self-coking, *Ferrie* . .	"*Iron Age*," xix., May 24, 16
System, *Carve*	"*Iron Age*," xxii., Oct. 17, 11.
From anthracite dust, *Wister*	"*Iron Age*," xxi., May 30, 9.
Crusher, *Thwaite & Carbutt*	* "*Engineer*," xliii. 159.
Furnaces, Br.	* "*Engineering*," xxiv. 227.
Self-coking, *Ferrie*, Ironton	* "*Iron Age*," xvii., Feb. 3, 1.
Manufacture	* "*Sc. American*," xxxiv. 34.
Ovens, *Bennington*	* "*Iron Age*," xxiii., June 26, 1
Oven, *Aitken*	* "*Iron Age*," xix., Jan. 11, 1.

See GAS AND COKE FURNACE, *infra*.

Cold Air Ma-chine'. See AIR REFRIGERATING MACHINE.

Also "*Scientific American Supplement*," 4011.

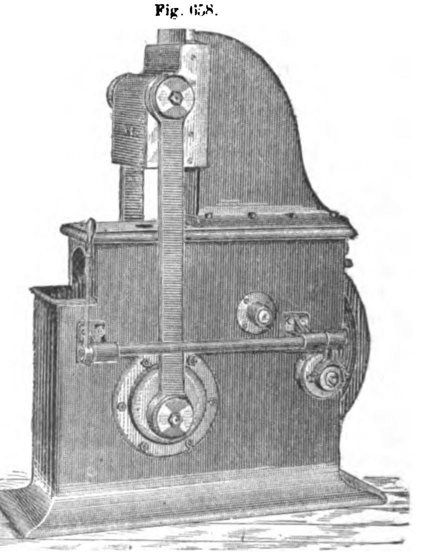
Cold'-i-ron Saw. A circular saw for removing the fag end of a rolled rail. It saws through a cold steel rail 5½″ deep in 18 minutes.

The cold saw used at the Landore Siemens Steel Co. is shown at Figs. 18, 19, p. 14, vol. xlii., "*Engineer*."
Also used for cutting bar iron into lengths for piling, reheating, and re-rolling.

Sellig, Sonnenthal & Co., Br.	* "*Engineer*," xlviii. 472.
For rails	* "*Engineering*," xxv. 382.

Cold-press'ing Ma-chine'. A machine for

Fig. 658.



Cold-pressing Machine.

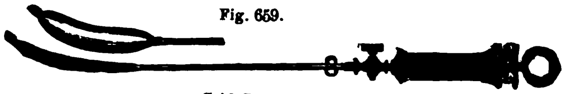
finishing by cold drawing, or for pressing forgings. It has a pressure of from 300,000 to 400,000 lbs.; stroke 1″ to 6″. It stops and starts instantly by means of Pratt's friction clutch.

Cold Shot. (*Foundry.*) Small globules of iron found in chilled portions of a casting.

Cold Shut. (*Add.*) 2. (*Founding.*) An imperfection in a casting owing to the cooling of the metal while flowing.

Cold Sound. (*Surgical.*) *Psychrophor.* Invention of Dr. Winternitz, of Vienna. An instrument for treating pollutions, spermatorrhea, and chronic gonorrhea.

Fig. 659.



Cold Sound

A double current catheter without eyes, the two canals communicating near the point of the instrument. It is introduced into the urethra until its point has passed the *pars prostatica*, and it is then attached by rubber tubing to a reservoir containing water of the desired temperature. On turning the stop-cock, the water flows into one canal and out through the other. In this way the *caput gallinaginis* and the entire mucous membrane are exposed to the mechanical action of pressure and the sedative action of cold.

See also Fig. 56, Sup., *Tiemann's* "*Armam. Chirurgicum.*"

Co-li-fi-ché. (*Ceramics.*) A little prism or tripod of refractory clay, used in a faïence or porcelain kiln to support the enameled or decorated ware in the second firing. They are known as *stilts* and *spurs* in England. See SEGGAR, Figs. 4815–4816, p. 2089, "*Mech. Dict.*" where rings, ridges, and studs are shown supporting the ware in the seggars.

Col-lap'si-ble Boat. One capable of folding for convenient transportation.

Crispin's . . . * "*Scientific American*," xxxviii. 348.
Berthon's, Br. . * "*Scientific American Supplement*," 1827.
* "*Engineer*," xlviii. 162.
* "*Van Nostrand's Mag.*," xix. 94.
Osgood . . . * "*Scientific American*," xl. 38.
"*Iron Age*," xx., July 19, p. 1.

See also BOAT: FOLDING BOAT.

Col'lar. (*Nautical.*) 1. A bite at the end of a shroud or stay, to go over the mast-head.

2. A rope formed into a wreath, with a dead-eye in the bight, to which the lower part of the stay is secured.

3. The neck of a bolt.

4. A circular enlargement on a rod.

Col'lar-laun'der. The pipe or gutter at the top of a lift of pumps by which water is conveyed to the cistern.

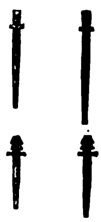
Col'lar Ma-chine'. Vapey's horse-collar blocking machine consists of a former, which can be varied in length, and a tightener rope to draw the leather close to the former or mold by means of lever and screw.

Collar stuffing machine, *Lichliter* * "*Sc. Amer.*," xxxvii. 38.

Col'lar Nail. A nail used in *blind-soling* boots and shoes. *Field & Sons.*

The nail being driven into the heel (or sole) as far as the collar, the outer lift (or sole) is driven on to the projecting pin, and thereby held, without the head of the nail appearing upon the outer surface.

Fig. 660.



Collar Nail.

Col'lar Swage. (*Blacksmithing.*) A swage set in the hardy hole of an anvil and used in swaging a collar on to a rod. The depression in the swage is equal to one half the size of the rod and collar; a top tool laid upon the iron completes the form, the piece being swaged between the two by the blows of a hammer. See also FULLER, SWAGE, etc. See Fig. 661.

Col-lo'dion. Gun-cotton dissolved in ether or chloroform.

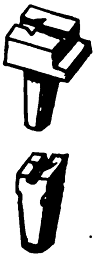
It is used for many purposes. See PYROXYLINE, p. 1831, "*Mech. Dict.*"; GUN COTTON, p. 1036, *Ibid.*

See also CELLULOID, *supra.*

Col'lo-type. (*Photography.*) A name given to the process in which the image is taken upon a sensitive colloid film.

The first attempts were made on metallic plates, and the adhesion of the film was effected by the oxydation of the metallic surface. Albert introduced the use of glass plates, Obernetter used very thin zinc plates. Description of his process in "*Photographisches Wochenblatt.*" Reproduced in "*Scientific American Supplement*," 2671.

Fig. 661.



Collar Swage.

Col'o-phene. A viscid colorless oil, obtained by distilling oil of turpentine with sulphuric acid. See Clarke's Patent, No. 6,001, June 2, 1849.

Col'or Com-par'a-tor. An apparatus by Dr. Leeds, of the Stevens Institute, for making comparisons of tints of color.

A rack holds ten comparison tubes of equal caliber and contents. An adjustable mirror reflects the light downward through these comparison tubes, and the light, after passing through slits (¾" long and ¼" wide), cut in a stage beneath, is reflected outward to the eye by a similar adjustable mirror placed below. In the original apparatus, the supports of the upper mirror are placed at the front corners, so as to make the axis of the mirror in front of the upper row of holes, and permit the tubes to be lowered into their places from the top. Later, it was found more convenient to slip the tubes in from below, which can be done without rising from one's seat, and in this case the axis of the mirror was put directly over the centers of the line of holes, and the mirror made somewhat narrower (3"). A black cloth, hung from the back upper corners, prevents any light reaching the eye except that reflected from the lower mirror.

The comparison is effected by a prism nearly filled with a suitable colored liquid. The prism is constructed by cementing within four straight walls of plate glass the inclined top and bottom sides of the prism It is 10" long, 1¼" wide, 2¾" at the base of the prism, narrowing to 3-16" at the apex. The prism is cut off in this manner at the apex, because, when filled with liquid of the most suitable intensity of color, the graduations beyond this point are too inconsiderable to be of value. The liquid is introduced through an orifice in the base, over which is afterward cemented a glass cover.

"*Scientific American Supplement*" . . . . * 2185.

Col'ored Glass. (*Glass.*) Glass colored in the pot; as distinguished from *enameled*, which has a surface of vitrifiable color baked on.

It consists commonly of two layers, white and colored melted into junction, or one laid upon the other: in some instances, white glass overlaid with three or four colors. There are, however, other modes. See list under GLASS, "*Mech. Dict.*," *et infra.*

The oxides of the different metals form the colors: —

For blues: oxide of cobalt or *safre*, oxide of iron, etc.

Shades of blue, such as *violet* or *celestial:* different proportions of cobalt.

Light blue, for spectacles: a mixture of cobalt and red oxide of iron.

London smoke: a mixture of oxides of copper, iron, and manganese.

Black: by increasing proportions of the last mentioned.

Purple: oxide of manganese. Potash glass with manganese gives a bluish purple; soda glass verges on the red. The color is made of a deeper blue by the addition of cobalt.

Brown purple: a mixture of oxides of manganese and iron.

Ancient purple: a mixture of oxide of manganese and red oxide of iron.

Yellow: a mixture of oxides of iron and manganese; charcoal is supplied in the shape of wood sawdust, an increase of which gives an orange, or in excess red.

A mixture of ochre and silver applied to the surface and baked in.

Green: a mixture of black oxide of copper and oxide of iron; or replace a part of these oxides by one third of their weight of bi-chromate of potassium.

Blue green: add oxide of cobalt to the above.

Yellow green: add yellow oxide of uranium to the recipe for green.

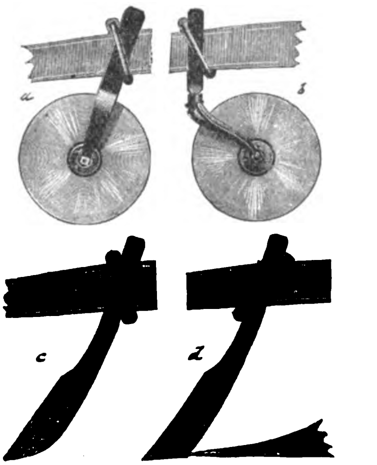
Red or *ruby:* brown oxide of copper, oxides of lead and tin, scales of iron, and borax, are added to the batch in the pot and melted. The glass is dipped out, broken or ground, and remelted, with additional quantities of the oxides and borax. The color is not developed until repeated heatings.

Opal: calcined bones are added to the batch of glass in the pot. Cryolite, 10; white sand, 20; oxide of zinc, 20; make an opal glass, called *Hot cast porcelain*. See also CRYOLITE.

Fluor spar added to the batch.

Laboulaye's "*Dictionnaire des Arts et Manufactures*," Article "*Verre*."
"*Scientific American*" . . . . xxxiv. 263.
"*Scientific American Supplement*" . . . 129.

Fig. 662.



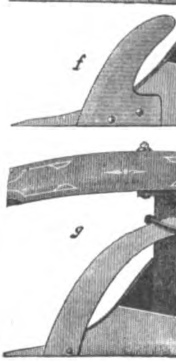
Colters.

a. Rolling colter
b. Caster colter.
c. Knife colter.
d. Standing colter.

Col-o-rim'e-ter. Dr. Scheibler's method consists in a number of parallel tubes in which solutions of sugar and syrups are examined for relative depths and qualities of color.

Nanquette, "*Technologiste*," xl. 362.
See also DIAPHONOMETER, *infra*.

Fig. 663.



Colters.

e. Quincy cutter.
f. Fin cutter.
g. Sword cutter.

Col'or-ing Met'als Prepare a solution of sulphide of lead by dissolving ½ oz. of hyposulphite of sodium in 1 lb. of water, and adding ½ oz. of acetate of lead dissolved in 8 oz. of water. Heat to 200° Fah., and the sulphide of lead is precipitated in brown flakes.

Metals exposed to the solution become colored —

Brass in the following order, according to the time of exposure, and consequent thickness of the coat: gold, copper-red, carmine, dark red, blue, blue-white, reddish white.

Iron becomes steel blue.

Zinc becomes brown.

Copper, the order of brass, except that the gold color does not appear.

If, instead of the acetate of lead, sulphuric acid be added to the hyposulphite of sodium, the brass becomes red, green, brown, with green and red iris glitter.

See also BRONZING, etc.

Col-peu-ryn'ter. (*Surgical.*) An inflatable bag introduced into the vagina to prevent prolapsus uteri.

Braun's, Fig. 420, p. 90, Part III., *Tiemann's* "*Armamentarium Chirurgicum*."

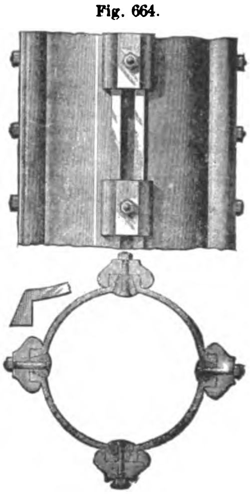
Col'ter. The sward cutter in advance of the plowshare and mold-board. See Figs. 662, 663.

Rotary colter grinder . * "*Scientific American*," xlii. 198

Co-lum'bin. (*Electricity.*) The non-conducting material placed between the parallel carbons of the ELECTRIC CANDLE, which see.

Col'umn. Built wrought iron columns, so much used in modern engineering, are made in segments, which are bolted together. The construction of two prominent forms is evident at a glance. Figs. 664, 665.

Fig. 664.



Built Iron Column.

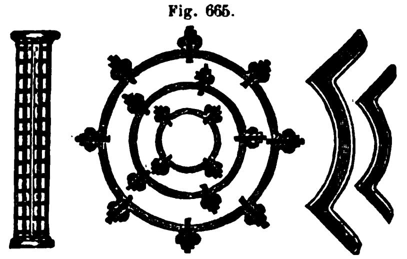
Col'umn Bat'te-ry. (*Electricity.*) One in which the elements are formed into a column. See VOLTAIC PILE.

Comb. (*Add.*) 8. (*Fire-arms.*) The top corner of the stock, where the cheek rests in firing.

Comb making, * "*Manufacturer and Builder*," x. 129.

Com'bi-na'tion Au'ger. An auger used in well or shaft boring. It has a long barrel, inclined throats at the lower end, and detachable horizontal cutters. Used in clay, sand, and other soft or friable strata.

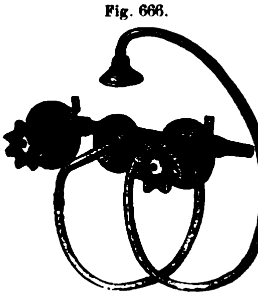
Fig. 665.



Phœnix Iron Co.'s Wrought-iron Column.

Com'bi-na'tion Ba'sin Cock. A shampooing arrangement in which the tube and sprinkler connect with hot and cold water faucets, so as to receive a mingled stream of the required warmth.

Fig. 666.



Combination Cock.

Com'bi-na'tion Lock. 1. A bank or safe lock, the mechanism of which is operated by two graduated dials, whereby one bolt, common to both, is controlled by either of the two independent dials, which latter may be set on two different combinations, thus giving the control to either of two persons.

2. A *permutation* lock: see Figs. 3646–3648, p. 1669, "*Mech. Dict.*"

Com'bi-na'tion Plane. A joiner's plane, capable, by adjustments and attachments, of assuming various capacities: such as plow, fillister, dado, rabbet-plane, matching-plane, etc.

Fig. 667.

Bailey's Combination Plane.

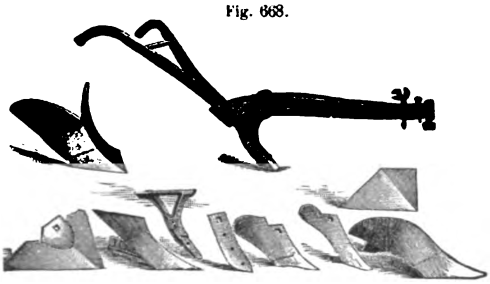
The main feature of the plane is that it has a fence or guide which is made to change to one side or the other, as the nature of the work requires, the fence being also vertically adjustable.

Com'bi-na'tion Plow. A plow having a number of optional shares, so as to be convertible to a number of different uses.

Combination plows are generally those of the smaller class, such as are used in tending crops, rather than those for breaking ground; many are found in the varieties adopted for special culture, such as beets, grapes and garden crops.

Hornsby's (English) plow has a number of mold boards; also potato diggers, hoe frames, etc., either of which can be attached to the beam.

Fig. 668.



Combination Plow.

Farquhar's convertible plow, Fig. 668, has double shovel, single shovel, subsoil, bull-tongue, ridging shares and bodies.

Com'bi-na'tion Open and Peep Sights. A species of gun-sight, Fig. 669, having several sights for different distances. When the leaf is down, a low slit-sight is exposed. When the leaf is lifted, the peep sight may be slipped up and down on the graduated stem, according to the distance of the object.

Fig. 669.

Combination Open Peep Sight.

Com'bi-na'tion Spring. One made by the multiplication of several similar parts.

In elliptic springs for railways see numerous examples in Fig. 1144, p. 483, "*Mech. Dict.*"

Instances of the spiral kind in Fig. 1148, same page.

Combinations of steel and caoutchouc: Figs. 1142–1144, pp. 482, 483, *Ibid.*

Com'bi-na'tion Scale. A scale with several beams.

a. A dairy scale beam which admits of weighing the milk brought by a number of farmers, at the same draft, keeping the weight of each on its own beam. See CREAMERY SCALE.

b. A postal-scale having separate beams and poises, the graduations in grams and ounces (and fractions) on each respectively.

c. A weighing scale with one beam for the cart, and another for the load; with the addition of a third beam for small weights, the second being for the thousands.

d. A furnace scale for charging the barrow with the respective quantities of ore, coke, and limestone, to be dumped into the hopper of the blast furnace. See FURNACE CHARGER.

"*Engineering and Mining Journal*" . . . * xxvi. 313.

Com-bined' Car. (*Railway.*) One with separate compartments for different purposes, as a *combined baggage and express car*, or a *combined mail and passenger car*, etc.

Or: one capable of being converted to distinct uses; as a *combined box and cattle car.*

Comb'ing Ma-chine'. The cotton combing machine of *Heilmann*, of Alsace, is a marvel of ingenuity in preparing cotton for fine counts of yarn. The machine has been somewhat simplified by Dobson & Barlow, of Bolton, England. The action is intermittent, by means of nippers and combs. In the Dobson & Barlow machine the nipper holds the cotton to be combed against the fluted feed rollers. The cotton is drawn up into the top comb by the detaching rollers, which draw it in a straight line from the grip of the two feed rollers.

Some of the following references concern flax, and other cotton: —

Laboulaye's "*Dictionnaire des Arts et Manufactures.*"

Girard, French	* ii., art. "*Lin*," Figs. 1424–1429.
Worstworth, Engl. . . .	* ii., Figs. 1430, 1431.
Fairbairn, Engl. . . .	* ii., Figs. 1432, 1433.
Westley & Lawson, Engl.	* ii., Figs. 1450–1452.
Heilmann	* iv., art. "*Peigneuse.*"
	* ii., art. "*Laines.*"

Linen, *Horner*	* "*Technologiste*," xxxvii. 24.
Ward	* "*Technologiste*," xxxvii. 27.
Stephen, Cotton & Co.	* "*Technologiste*," xxxvii. 30.
Combe & Barbour . .	* "*Technologiste*," xxxvii. 41.
Vanoutryve	"*Technologiste*," xxxvii. 215.
Heilmann, Lille	* "*Scientific Amer. Sup.*," 3896.
Pierrard	* "*Scientific Amer. Sup.*," 2581.

Com'fit Pan. For making comfits and all kinds of confections known as pan goods. The pan is heated by steam conveyed through an india-rubber tube. Another tube conveys away water of condensation. It does not revolve, but has a peculiar rocking motion. See CONFECTION PAN.

Com'mu-ta'tor. (*Electricity.*) An instrument or arrangement used to change the currents from primary to secondary, or the reverse; to change the polarity of a current; or to change from one to more cells in a constant battery.

Mercury, *Lartigue* . "*Telegraphic Journal*," vii. 153.

Com-par'a-tor. *a.* An instrument for comparing measures of length together. The objects to be compared are laid on an iron bed, and microscopes with micrometric eye-pieces placed vertically over the bed for observation and comparison.

In the comparator of *M. Tresca* but one microscope is used; the bars to be measured are placed side by side upon the bed, which is movable both laterally and longitudinally. One end of the standard is first brought under the microscope, and afterward, the corresponding end of the scale to be tested is by a lateral movement similarly brought into the field of view, and by the slow movement of the scale itself, if necessary, its terminal mark is brought into coincidence with the cross-wires of the microscope. The whole system is then moved longitudinally until the opposite ends of the bars come under observation, when without disturbing the microscope the mark on the standard rule is first brought into coincidence with its cross-lines, and subsequently that on the rule to be tested, the difference in length, if any, between the two being measured by the micrometer.

b. Saxton's comparator consists essentially of a mirror, which reflects a beam of light over double the angle through which the mirror is revolved, and this beam acts as an index by being caused to sweep over a graduated scale, having for its center the center of the axis of the mirror. It will be obvious how measurements may be made by this arrangement. It is applied by Prof. A. F. Mayer to the observation and measurement of the changes in the dimensions of iron and steel bars on their magnetization.

See "*Scientific American Supplement*," * 1519, * 1595, * 1637, * 1694.

c. Lissajous' comparator "consists of a diapason, to one limb of which is attached the object-glass of a compound microscope; the body of the microscope being detached and supported by an independent stand. If the diapason be thrown into vibration, the image of any small object seen through the microscope will appear to have a similar motion, which will be magnified by all the power of the instrument. Let the object be itself a point in a vibrating body, having its direction of vibration at right angles to that of the object-glass, and the combination of the two motions will produce figures, from the analysis of which the character of the vibration of the body observed may be deduced. When the vibrating body is a string, or other object without conspicuous points suited to be used in the comparison, it is necessary to mark it in some manner. Different observers have adopted different expedients for this purpose; but in order to avoid loading the body or altering its condition by adding coloring matters, Mr. Lissajous, in the case of strings, has employed a cylindrical lens to throw a sharp line of light across the object. This creates a brilliant point moving with the string without in any manner disturbing its mode of vibration." — *Dr. F. A. P. Barnard*, "*Paris Exposition Reports*," * iii. 508, 509.

See also ELECTRICAL DIAPASON.

Com'pass. See list under COMPASS, p. 599, "*Mech. Dict.*"

Alarm	"*Scientific American*," xli. 81.
Correction, *Thompson*	"*Scientific Amer. Sup.*," 760.
Differential, *Ile*	"*Scientific Amer. Sup.*," 255.
Japanese	"*Scientific American*," xxxv. 67.
Nickel needle, Fr.	"*Telegraphic Journal*," iv. 75.
Sir William Thompson	"*Scientific Amer. Sup.*," 568.

See also AZIMUTH, etc.

Com-pen'sa-tor. (*Gas.*) An aid to the governor of the gas-exhauster engine, in order to maintain equal pressure in the main when the exhauster may be working in excess of the production of gas. The object is to limit the vacuum, to prevent its reaching a dangerous degree. The raising of a bell in the compensator opens a valve in the bye-pass, and allows the gas to pass around the exhauster ineffectively. See GAS COMPENSATOR; GAS GOVERNOR.

Com-pos'ing Ma-chine'. *Flamm's* (French) and *Sweet's* (American) machines, acting by the consecutive impressions of types upon cliches, which form molds for stereotyping. Described in article "*Imprimerie*," *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," tome iv., ed. 1877.

Frazer's composing machine was shown in operation at the Paris Exposition, 1878.

See TYPE-SETTING MACHINE, p. 2675, "*Mech Dict.*"

Com'po-si'tions, Wa'ter-proof'ing, etc. See the following:—

Amber.
Amber, artificial.
Asbestos.
Asbestos felt.
Baleen.
Beeswax, artificial.
Black lead.
Bois durci.
Bolata gum.
Bonesilate.
Boulinikon.
Caoutchouc.
Caoutchouc, artificial.
Caoutchouc solvents.
Carbolic-acid paper.
Cartonpierre.
Celluloid.
Cellulose.
Ceresin.
Chrome leather.
Coral, artificial.
Cork board.
Cork leather.
Corundum.
Cosina.
Ebonite.
Ebony, artificial.
Eburine.
Eburite.
Felt.
Fire-proofing.
Fire-proofing cloth.
Fire-proofing fabrics.
Fire-proofing paper.
Fire-proofing wood.
Fly paper.
Gas and water-tight cloth.
Gas cloth.
Grafting wax.
Graphite.
Hemacite.
Heveenoid.
Incombustible wood.
India rubber.
Ivorine minerale.
Ivory, artificial.
Kerite.
Leather, artificial.
Leather, imitation.
Leatheroid.
Leather waste.
Lining felt.
Meerschaum.
Meerschaum, artificial.
Metaline.
Metallikon.
Mica.
Mineral wool.
Oil cloth.
Paper carpet.
Paper fabric.
Paper preservative.
Paper, fire-proofing.
Papier-maché.
Parakite.
Pastille.
Pâte de bois.
Plumbago.
Rubber solvent.
Shoemaker's wax.
Silicate board.
Silicate cotton.
Slag.
Slag cloth.
Slag wool.
Soluble glass.
Spence's metal.
Straw-wood.
Sulphurine.
Sulphur-sulphide.
Tar.
Thiate.
Tripoli.
Usudurian.
Vegetable leather.
Vegetable tallow.
Vegetaline.
Veneer, celluloid
Vulcanite.
Vulcanized fiber.
Water-proofing.
Water-proofing fabric.
Water-proofing paper.
Wax.
Whalebone.
Wooden wall-covering.

Com-pos'ite Por'trait. One obtained by combining a number of portraits into a single resultant figure.

See paper read by Francis Galton, F. R. S., before the Anthropological Institute, London.

Partly reproduced in "*Scientific American*," xxxviii. 389.

Com-pos'i-to. (*Ship-building.*) A *composito* vessel is one built partly of iron and partly of wood: *e. g.*, some of the U. S. Coast Survey vessels which have hulls, the frames and beams of which are of iron and the planking of wood.

See *Wilson's* "*Ship-building*," Wiley & Sons, New York.

Com'pound Ar'mor. An iron plate with steel facing. See ARMOR COMPOUND; also ARMOR PLATING, "*Mech. Dict.*"

Com'pound Cot'ton Press. One in which a hydraulic ram of relatively small area and rapid movement is used to compress the cotton up to a certain point, and then a relatively larger and more powerful, slow-moving ram is used to complete the pressure.

Watson . . . . "*Engineer*," * xlv. 38, 46.

Com'pound Beam En'gine. A beam engine, with compound cylinders, in which the steam is used successively at a higher and then lower pressure.

See in list of references under COMPOUND STEAM ENGINE.

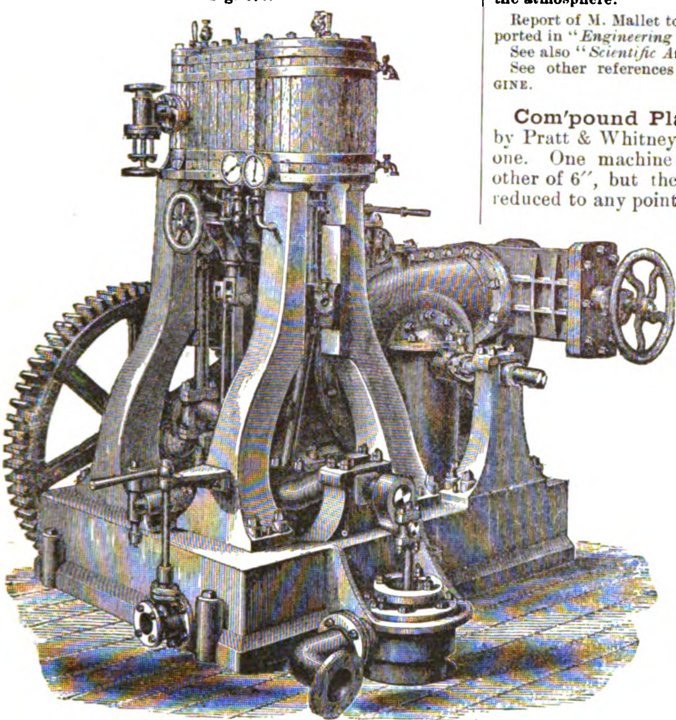
Com'pound En'gine. See COMPOUND STEAM ENGINE.

Com'pound En'gine Pump. Appleby's compound engine applied to the centrifugal pump is shown in Fig. 670, and is used in Egypt, where it forms a remarkable contrast to the norias, shadûfs, etc.

The whole arrangement is self contained, all the various parts being attached to one deep massive cast-iron bed-plate, which carries the crankshaft pedestals and the pedestals for the pump spindle. The engines are of the vertical type, compound and condensing. The high pressure cylinder is 7″ diameter, and the low pressure cylinder 14″ diameter, so that the areas are in the proportion of 1 to 4, and each has a piston stroke of 14″. The valve boxes are between the cylinders, a cover being provided at the top for examination, etc., and the cylinders and valve boxes are felted, and lagged with mahogany. The valve of the low pressure cylinder is the ordinary D valve, but the high pressure engine is fitted with a Mayer's expansion gear, whereby the expenditure of steam can be regulated in accordance with the height to which the water has to be pumped. Each of the cylinders is mounted on, and cast with a pair of strong iron standards, which also form the guides for the cross-head, a portion of them being bored for this purpose.

The jet system of condensation is used, the condensing chamber being formed in the bed-plate. The cock for regulating the supply of injection water and the air pump are in the foreground of the engraving, the latter of the ram and bucket principle, is driven by a crank arm and pin on the end of the crankshaft, the valves being india-rubber disks working on gun-metal gratings. A spur fly-wheel is keyed on to the end of the crankshaft, this drives a pinion on the pump spindle, so that the pump disk makes three revolutions for each double stroke of the engines; this enables the engines to maintain a very moderate speed, and obviates the necessity of the constant repairs, which frequently are a

Fig. 670.



Compound Engine and Centrifugal Pump.

source of inconvenience in very high speeded engines. The pump has 12″ suction and delivery pipes, the suction pipe having a foot valve on it, and the delivery being provided with a sluice valve. The pump disk makes about 600 revolutions per minute, and delivers 2,500 gallons per minute to a height of 20′. Small covers are provided on each side of the pump casing, so that the disk may be examined without taking the pump to pieces.

See also references under Compound Steam Engine.

Com′pound Lathe. The *tour composé* of the French. The term may be held to include the geometric, rose engine, oval, and engine-turning lathes. Which see.

See elaborate article, *cap.* "*Tours Composés*," *Laboulaye's* "*Dictionnaire*," etc., iv., ed. 1877.

Com′pound Lo′co-mo′tive. One using the steam in two successive cylinders.

The compound locomotive has but two cylinders; they are placed on the outside, and act at right angles to each other, as in ordinary locomotives with outside cylinders, the only difference being that the cylinders have different diameters, and that the smaller one alone, in the regular working of the engine, receives the boiler steam directly, discharging it after a first expansion into the larger one, which in turn discharges it into the chimney.

When the engine is to be started, the boiler steam, by means of a special apparatus, which constitutes the sole addition to the ordinary locomotive, and which from its design and purpose is called the *undoing* valve, is delivered directly into both the large and small cylinders, and the latter, instead of discharging it into the former, discharges it into the chimney, the engine in this case acting like an ordinary locomotive. This independent action of the steam in the two cylinders can also be employed when the engine has to overcome a momentarily greater resistance, like a short steep ascent, for instance.

The system just described has been for the first time applied by M. A. Mallet to three locomotives, constructed at Creuzot, for the branch railroad from Bayonne to Biarritz. They weigh in service from 19 to 20 tons each, and have cylinders of 9 7-16ths and 15¾″ diameter, with pistons of 17¾″ stroke. They have four coupled wheels of 47¼″ diameter. The boiler has 484.4 square feet of heating surface, and is worked with a pressure of 142 pounds per square inch above the atmosphere.

Report of M. Mallet to "*French Academy of Sciences*," reported in "*Engineering and Mining Journal*."

See also "*Scientific American*," xxxvii. 260.

See other references under list in Compound Steam Engine.

Com′pound Pla′ner. A machine tool made by Pratt & Whitney. It combines two planers in one. One machine has a stroke of 10″, and the other of 6″, but the length of the stroke may be reduced to any point below these limits. The tool-slide has a quick return stroke, and the cross-feed is automatic and adjustable.

Com′pound Plate Bat′te-ry. One, the negative plate of which, instead of being of one material, is constructed of several different metals soldered together.

Byrne's "*Engineering*," * xxv. 421.

Com′pound Spec′ta-cles. 1. *a.* One in which supplementary frames of colored glass are hinged to the ordinary spectacles, for use upon occasion.

b. The same adaptation of additional lenses to increase the power.

2. The Franklin spectacles of two half glasses of different character in each bow.

Chevalier in "*Sc. Am. Sup.*," * 2264.

Com′pound Spring. A spring in which several different types of springs are united to produce a simple effect.

Specifically: a steel spring surrounding or confining a cylinder or block of caoutchouc.

See instances in Figs. 1142, 1143, 1144, pp. 482, 483, "*Mech. Dict.*"

A *combination* spring may be defined as one in which several similar parts are multiplied to increase the resisting power.

Com′pound Steam Boil′er. One consisting of several separated but communicating chambers, usually having some different functions; for instance, boiler and superheater, or sectional portion with elevated chamber, etc.

German forms: —

Steinmüller	. . . . .	"*Engineer*," June 11 1880.
Pregardien	. . . . .	"*Engineer*," 1. 228.
Piedbœuf	. . . . .	"*Engineer*," 1. 228.

See several examples, Plate LXI., p. 2327, "*Mech. Dict.*"

Com′pound Steam En′gine. An engine using the same steam successively in two cylinders at diminishing pressures.

The *Hornblower* engine, mentioned on page 601, "*Mech. Dict.*," dates from 1781. The *Heslop* engine, patented by him in England in 1790, has lately attracted a good deal of attention. Nine of these engines were built, and one remains, being preserved in the South Kensington Museum, London.

"The Heslop engine has two open-topped cylinders, called respectively the hot and cold cylinder, one on each side of the main center of the beam; both are single acting, their pistons acting in the same direction. The steam, on being admitted into the first or hot cylinder, helps to raise the piston by its pressure underneath; the return stroke is then made by the weight of the pump-rods, etc., in the pit, suspended by a chain working over an arched beam-head. During the down-stroke of the pump-rods, the reduction valve being opened, the steam passes from the hot cylinder to the second or cold cylinder by means of a connecting pipe constantly immersed in cold water, which produces sufficient condensation to *kill* or reduce it to atmospheric pressure as it enters and fills the cold cylinder. The cold piston having arrived at the top of its stroke and its cylinder being thus filled with steam, the injection valve is opened, admitting a jet of water beneath the piston, thus bringing a vacuum into play. In the case of rotative engines, the return stroke is made by the weight of the connecting-rod, crank, and a heavy pair of links attaching the hot piston to the beam, assisted by the momentum of the fly-wheel. The two pistons are heavily weighted in equilibrium, probably to keep the chains taut, and the action of the steam in the hot cylinder simply takes off the weight of the hot piston, and allows that of the cold piston to come into play."

See the following notices by adaptors or of adaptations of the compound principle: —

Borsig, Ger. . . . . * "*Iron Age*," xxv., Feb. 26, p. 1.
Burgh, Br. . . . . * "*Engineering*," xxiv. 471.
Demenje, Fr. . . . . * "*Technologiste*," xli. 267.
* "*Sc. American*," xl. 66.
Donkin, Br. . . . . "*Engineering*," xxi. 212.
Goodfellow (wire rope gear), Br. * "*Eng'ing*," xxiii. 381.
* "*Sc. Am. Sup.*," 1268.
Locoge, Fr. . . . . * "*Technologiste*," xli. 628.
Pearson & Spurr, Br. . . . . * "*Sc. Am. Sup.*," 2032.
S. S. "City of Rome," Inman . * "*Sc. Amer. Sup.*," 3946.
S. S. "Nelson," Br. Navy . . . * "*Sc. Amer. Sup.*," 3767.
Trials of, 19 Figs., Br . . . . * "*Engineering*," xxx. 311.
Urquhart, Hor. . . . . . . * "*Sc. Amer. Sup.*," 1920.
U. S. Navy, Trials . . . . . "*Engineering*," xxiii. 381.
Watt . . . . * "*Sc. Am. Sup.*," 2844.
Westphal, Ger. . . . . . . * "*Technologiste*," xli. 320.
Yacht "Isa," Br. . . . . . . * "*Sc. American*," xl. 238.

Also — arranged by character of engine: —

Beam . . . . * "*Sc. Amer.*," xxxiv. 7.
Corliss . . . . * "*Engineer*," xliii. 62
Powell, Fr. . . . . * "*Engineer*," xlvi. 1.
Blowing, *Klein*, Ger. . . . . * "*Engineering*," xxx. 372.
Wetter-on-the-Ruhr . . . * "*Engineering*," xxix. 170, 175.
Condensing, *Claparede*, Fr. . . * "*Engineer*," xlvii. 120, 135.
Day & Co., dir. act., Br. . * "*Engineer*," xlv. 465.
Galloway, expanding, Br. . * "*Engineer*," xlvi. 226, 240.
Gutehofnung Schutte . . . * "*Engineering*," xxx. 88.
S. S. "Limerick," incl., Br. * "*Engineer*," xliv. 43, 61.
S. S. "Nipsic," U. S. Navy . "*Sc. Amer. Sup.*," 656.
Sulzer, exp., Switz. . . . * "*Engineer*," xlvi. 147.
See also Horizontal Condensing.
Corliss, Douglas & Grant, Br. . * "*Sc. Amer. Sup.*," 1023.
beam . . . . * "*Engineer*," xliii. 62.
horizontal, Br. . . . . . * "*Eng'ing*," xxviii. 487.
Pawtucket . . . . * "*Engineering*," xxviii 154, 189.
Direct acting, *Henderson* . . . "*U. S. Patent*," Dec. 24, 1869.
Disconnecting, Br. . . . . . * "*Sc. Amer. Sup.*," 3799.
Factory, *Bates & Co.*, Br. . . . * "*Engineer*," xlviii. 379.
Ferryboat, "Loftus Perkins," Br. * "*Engineer*," xlix. 3.
Horizontal, *Alsaciennes Soc.*, Fr. * "*Engineering*," xxv. 4.
Avonside Engine Co., Br. . * "*Engineer*," xliv. 242.
* "*Sc. Amer.*," xxxvii. 370.
Brearley, Br. . . . . . . * "*Engineer*," xlv. 238, 258.
Herman-Lachapelle, cond. . * "*Technologiste*," xli. 89.
Holborow, Br. . . . . . . * "*Engineering*," xxv. 386.
Stribo mines, cond., Bohem. * "*Engineering*," xxx. 169.
Sulzer, condensing, Switz. . "*Engineering*," xxvi. 133.
Turnbull, condensing, Br. . * "*Engineer*," l. 214.
* "*Engineering*," xxv. 202.
Urquhart . . . . * "*Sc. Amer. Sup.*," 1920
Launch, exp., *Kingdon*, Br. . . * "*Sc. Amer. Sup.*," 3848.
Tipping, Br. . . . . . . * "*Engineering*," xxx. 229.
Tipping, Br. . . . . . . * "*Engineer*," l. 140, 156.
Wilson, exp., Br. . . . . * "*Engineer*," xliii. 24
Locomotive, 21 Figs. . . . . * "*Engineer*," xlviii. 85.
Fr. . . . . "*Van Nostrand's Mag.*," xv. 379.
Mallet, Fr. . . . . "*Technologiste*," xxxvii. 114.
Mallet, Fr. . . . . * "*Eng'ing*," xxviii. 17, 58.
Mallet, Fr. . . . . "*Iron Age*," xxiv., Aug. 7, p. 15.
Mallet, Fr. . . . . "*Van Nostrand's Mag.*," xxii. 6; xxiii. 418.
"*Sc. Amer.*," xxxvii. 260.
Marine, *Claparède*, Fr. . . . . * "*Engineer*," xlvi. 385, 388.
Cramp . . . . * "*Engineering*," xxii. 298.
Escher, Wyss & Co., Switz. . * "*Engineering*," xxx. 345.
Marine, *Sells*, Br. . . . . . * "*Engineer*," xlii. 272.
Sells, Br. . . . . * "*Sc. Amer.*," xxxvi. 166
Vile, Br. . . . . * "*Engineer*," xlviii. 162
S. S. "Arizona," Br. . . . * "*Engineering*," xxx. 28, 89, 182.
"Britannic," . . . . . * "*Sc. Amer. Sup.*," 806.
"City of New York," Br. * "*Engineer*," xliv. 458.
"City of New York," Br. * "*Engineer*," xlv. 4, 26.
"City of Rome," Br. . . * "*Engineer*," xlv. 127.
* "*Sc. Amer. Sup.*," 3946
"Dante," Br. . . . . * "*Eng'ing*," xxviii. 380
"Grangemouth," Br. . . * "*Engineer*," xlv. 129, 132
"Grangemouth," Br. . . * "*Sc. Amer.*," xxxviii. 259.
"Grecian," Br. . . . . * "*Engineering*," xxix. 400, 435, 475, 496.
"Isa," Yacht, Br. . . . * "*Sc. American*," xl. 238.
"Iris," Br. . . . . . * "*Engineer*," xlv. 98.
"Limerick," Br. . . . * "*Engineer*," xliv. 43, 61.
"London Castle," Br. . * "*Engineer*," xliii. 341.
"Lord of the Isles," Br. . * "*Engineer*," xlvii. 28, 46, 82, 98, 170.
"Mytho" . . . . . . * "*Engineer*," xlviii. 288.
"Nelson," Br. Navy . . * "*Engineering*," xxix. 279.
* "*Sc. Amer. Sup.*," 3767.
"Nipsic," U. S. Navy . . "*Sc. Amer. Sup.*," 656.
"Ohio," "Penn.," *Cramp*. * "*Engineering*," xxii. 68.
"Orient" . . . . . . * "*Engineer*," xlviii. 247.
"Rover," Br. . . . . . * "*Engineer*," xli. 324.
* "*Engineering*," xxi. 228.
"Ville d'Oran," Fr. . . * "*Engineer*," l. 101, 214.
"Wanderer," Yacht . . * "*Engineer*," i. 440, 444.
steeple, "Lady Tyler," Br. . * "*Engineer*," l. 386, 424.
paddle, "Hirondelle," Fr. . * "*Engineer*," xli. 317–320.
inclined, *Soc. John Cockerill*, direct acting, Belg. * "*Engineering*," xxx. 320.
(See also Screw.)
Portable, Br. . . . . "*Iron Age*," xxiv., July 31, 13.
Fowler, Br. . . . . . . * "*Technologiste*," xli. 498.
Garrett, Br. . . . . . . * "*Engineer*," l. 40, 44, 397.
* "*Engineering*," xxx. 44.
Marshall, Br. . . . . . . * "*Engineering*," xxx. 538.
Pumping, Chichester, Br. . . . * "*Engineer*," xlvi. 336.
Comstock . . . . * "*Engineer*," xli. 187, 194.
differential, Croydon, Br. . * "*Engineer*," xliv. 338.
Dubuc, Fr. . . . . . . * "*Engineer*," xlv. 424.
Goodhope Co., Br. . . . . * "*Engineer*," xlv. 58.
Lawrence, beam . . . . . * "*Engineering*," xxix. 18.
Nijni-Novgorod, Rus. . . . * "*Engineering*," xxx. 341.
San Francisco . . . . . * "*Engineer*," xlv. 198, 202.
Selden . . . . * "*Man. & Builder*," ix. 80.
Staveley, horizontal, Br. . * "*Engineer*," l. 232, 262.
Sydney, Australia . . . . * "*Engineering*," xxiv. 10.
Tangye, Br. . . . . . . * "*Engineer*," xlii. 128.
Vienna, Austria . . . . * "*Eng'ing*," xxviii. 432.
Rolling-mill, Br. . . . . . . * "*Engineer*," xlvii. 204.
Reversing, Br. . . . . . * "*Engineering*," xxvii. 274, 277.
Phœnix Iron Co. . . . . . * "*Engineering*," xxix. 105.
Screw, disconnecting Twin, *Lawrence*, Br. . . . . . . * "*Engineer*," xlvii. 405.
S. S. "Lord Jeffrey," Br. . * "*Engineering*," xxx 517.
S. S. "Otter." . . . . . * "*Sc. Am. Sup.*," 1345.
Discon. *Rankin & Blackmore* * "*Engineering*," xxiv. 9.
Ross & Duncan, Br. . . . * "*Engineering*," xxix. 337.
Soc. John Cockerill, Belg. . * "*Engineering*," xxx. 402.
U. S. Navy . . . . . . * "*Engineering*," xxii. 150, 206, 276, 439; * xxiii. 110, 129.
Semi-portable, *Fowler*, Br. . . * "*Engineer*," xlvii. 452.
Single cylinder, *Westphal.*, Ger. * "*Engineering*," xxvi. 510.
Street-car, *Black, Hawthorn & Co.* * "*Eng'ing*," xxviii. 363.
Three cylinder . . . . . . * "*Engineering*," xxi. 191.
Brotherhood . . . . . . * "*Iron Age*," xxii., Aug. 8, p. 1.
* "*Sc. Am. Sup.*," 2194.
* "*Engineering*," xxvi. 9.
Yacht "Isa," . . . . . * "*Eng'ing*," xxvii. 194.
S. S. "Mytho," . . . . . * "*Engineer*," xlviii. 288.
"Orient," . . . . . * "*Engineer*," xlviii. 247.
"Rover," Br. . . . . * "*Engineering*," xxi. 228.
French Navy . . . . . . * *Laboulaye's* "*Dict.*," art. "*Bateau a Vapeur*," vol. iv., Figs. 3417, *bis et ter.*
Torpedo boat, *Normand*, Fr. . . * "*Engineering*," xxx. 423.
Tug boat, discon. "Mt. Etna" . * "*Engineering*," xxix. 412.
Rankin, Br. . . . . . . * "*Engineering*," xxii. 255.
Twin-cylin. direct act., *Bernay's* * "*Engineer*," xlvii. 102.
Variable cut-off, Bolton, Br. . . * "*Engineering*," xxi. 314.
Vertical, *Fowler & Co.*, Engl. . * "*Sc. Amer.*," xxxvii. 191.
Fowler, Br. . . . . . . * "*Engineering*," xxiv. 126.
Perkins, Br. . . . . . . * "*Engineer*," xliii. 390.
Watts, Br. . . . . . . * "*Engineer*," xlvii. 60.
Willam, Br. . . . . . . * "*Eng'ing*," xxvii. 577.
Yacht "Wanderer," Br. . . . * "*Engineer*," l. 440, 444.

See also the following references: —

Galloway, Gt. Britain. Engine exhibited at Vienna 1873.
See * *Thurston's* "*Rept. Vienna Exposition*" . . ii. 30.
Schneider & Co.'s, Creusot, France, * *Ibid.* . . . . ii. 31.
Ehrhardt's, Zweibrücken, *Ibid.* . . . . ii. 31.
Burmeister & Warri, Copenhagen, * *Ibid.* . . . . ii. 51.
Motala Works, Sweden, for twin-screw gunboats, *Ibid.* ii. 59.

Galloway compound condensing engine drove the British machinery at the Paris exposition of 1878.

Compound three cylinder marine engine of the French Navy. *Laboulaye's* "*Dict. des Arts et Manufac.*," vol. iv., ed. 1877, article "*Bateau à Vapeur*," Figs. 3417 *bis et ter.*

See: *Mallet's* "*Compound Engine.*"

Turnbull's "*Treatise on the Compound Engine.*"

Com'press. (*Surgical.*) The pledget compress has been referred to, p. 602, "*Mech. Dict.*"

Arterial compressors are of the nature of tourniquets.

Erichson's, Buck's, and Skey's, Figs. 108-110, Part I. of *Tiemann's* "*Armamentarium Chirurgicum*," Part I.
Briddon's artery compressor, *Ibid.*, Fig. 112.
Gross's, *Ibid.*, Fig. 156.
Langenbeck's bandage clamp for the *Esmarch* bloodless method of amputation, *Ibid.*, Fig. 111 *b.*
Esmarch bandage clamp, *Ibid.*, Fig. 111.
Tourniquets, *Ibid.*, Figs. 104-107, 113, 114.
Seminal cord compress, *Ibid.*, Fig. 206, Part IV.
Trusses, *Ibid.*, p. 9, Part IV.

Com-pressed' Air Brake. That form of railway-car brake in which air compressed by some form of pump on the locomotive is conveyed by pipes and flexible hose beneath the cars to cylinders and pistons under each car, by which the pressure is transmitted to the brake levers and thence to the brake-shoes.

The *Westinghouse* and *Loughridge* are notable examples. The other class are known as *vacuum* air-brakes.
See also *Colladon's* (Fr.) brake, "*Sc. Amer. Sup.*," * 2814.

Com-pressed' Air En'gines and Ma-chin'e-ry. The following references may be examined: —

Lamm's patents are: . .	No. 105,581.	
	No. 121,527.	December 5, 1871.
	No. 124,495.	March 12, 1872.
Tellier	No. 121,909.	December 12, 1871.

See also Air and Gas Engines for propelling cars.

Bompas' English patent . No. 5,644, 1828, compressed air.
Stewart & Kershaw, Eng. pat. No. 1,092, 1863, compressed air.
S. Carson, U. S. patent . . December 9, 1856.
N. H. Barbour, U. S. patent March 14, 1865, carb. acid gas.

Stewart & Kershaw, cited above, compress air by water-power at stations along the road. The engine has small reservoirs disposed along the center of its frame. Air is first used in high-pressure cylinder, then in low pressure.

Harrison's Air Engine, 3,034, is a turbine, driven by compressed air. See also reaction wheel worked by compressed air, 1,451 of 1866.

See also Air Engine and Compressed Air Engine, "*Mech. Dict.*"

Beaumont, Woolwich, Engl. . .	"*Sc. Amer. Sup.*," 1041, * 3943.
	"*Brit. Trade J.*," June 1, 1880.
Mekarski, Paris	* "*Scientific Amer.*," xl. 51.
	* "*Paris Expo.* 1878 *Rept.*," vol. iv., p. 462-464.
	* "*Sc. Am. Sup.*," 276.
Polytechnic college, Phila. . .	"*Polytechnic Rev.*," Dec. 23, 1876.
Schneider, St. Gothard tunnel .	* "*Sc. Am. Sup.*," xvi. 20.
Bushnell, New York	"*Sc. Amer.*," xxxix. 129.
Haupt's Report on the use of street cars	compressed-air motors for "*Sc. Am. Sup.*," 2795, 2813, 2891.
Lamm & Francq, Paris tramways	* "*Paris Exposition* (1878) *Repts.*," iv. 465.

Zahner's "*Transmission of Power by Compressed Air.*"

See also Air Car	"*Sc. Am. Sup.*," 789.
Air compressor, *Burleigh* . . .	"*Technologiste*," xxxviii. 389.
Air engine, *Beaumont*	"*Sc. Am. Sup.*," xxxvii. 84.
Air locomotive, *Beaumont*, Engl.	"*Sc. Am. Sup.*," 966.
"*Engineer*"	"*Van Nostrand's Mag.*," xxiii. 225.
Air machines	"*Sc. Am. Sup.*," 2448.
Air in mines, *Johnson*, Engl. .	"*Sc. Am. Sup.*," 2223.
Air motor, *Fallart*, Brussels . .	"*Mining and Sc. Press*," xxxvii. 307.
Lecauchet	"*Technologiste*," xxxvii. 116.
Air-pump and condenser. *Tangye*, Br.	* "*Engineer*," xlii. 40.
Air pump, "Hartford" . . .	* "*Engineer*," xlii. 298.
Air receptacles, *Siemens* . . .	"*Sc. Am. Sup.*," 1906.
Air (etc.) reservoirs, *Siemens* .	* "*Engineer*," xlv. 287.
Air street car, *Mékarski* . . .	* "*Engineering*," xxii. 142.
Air, Transmission of power by. *Zahner*	"*Van Nostrand's Mag.*," xix. 446, 481.

Com-pressed' Fuel. Fuel made of materials artificially compounded and pressed into blocks. See Briquette; Fuel, Artificial.

In the works of the "Crown Preserved Coal Co.," at Cardiff, Wales, the fine coal from the colliers is tipped from the wagons, pulverized, mixed with pitch automatically, passes to the heating furnaces to be made plastic, and is thus delivered to the molds, each of which receives 60 tons pressure, forming the block and stamping the name on it. An endless band carries the blocks to the stacking ground. The blocks are regular in shape, weigh 26 lbs. each, and are made at the rate of 40 per minute.

Com-pressed' Glass. A process by Siemens, of Dresden, Saxony.

The glass is tempered by being cast or pressed in chilled molds. It is claimed to be stronger than the glass tempered in oil by the De la Bastie process (see Tempered Glass) in the proportion of 5 to 3.

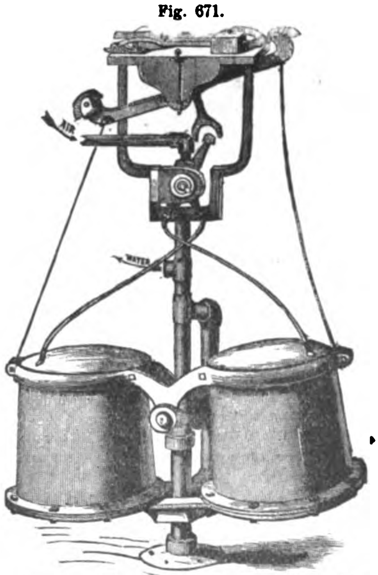
The fracture is fibrous; the glass may be bored and wheel polished; is fractured by the diamond.

Siemens . . . . "*Technologiste*," xxix. 342.

Com-pressed' Air Pump. A windmill works an air compressing pump, and the air is conducted by a pipe to the submerged apparatus shown in Fig. 671.

Two merged chambers rest upon a frame, pivoted to allow them a certain amount of rocking motion in a vertical plane.

Fig. 671.



Compressed Air Pump. (Hartford Pump Co.)

Each cylinder has a valved inlet at bottom, and a discharge pipe at bottom on the inner side, the respective pipes passing to a common upright main. An air valve above determines the access of compressed air to the chambers alternately. This valve is operated by the rise and fall of the chests: the compressed air being always directed to the lower chest. As soon as a chamber is emptied it becomes relatively lighter than the other, ascends, works the lever and valve, and directs the air into the other.

Com-pressed' Gas Gov'er-nor. See Gas Governor.

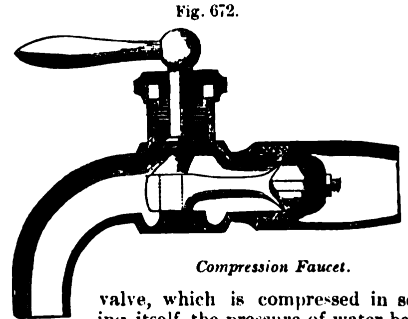
Com-pressed' Steel. (*Metallurgy.*) Steel condensed by hydraulic pressure, while yet fluid, to give it density, tenacity, and freedom from blow holes. See Whitworth Steel.

The principle of compressing metals while fluid, which has been applied with such effect to steel by Sir Joseph Whitworth, has long been in use in copper works. The mold is placed on the table by a hydraulic press, the melted copper poured in from ladles, and a strong cover adjusted to the mouth of the mold by screws. The hydraulic ram is then set to work, and a pressure of about three tons to the square inch applied. The effect is very beneficial to copper, but on brass the result is just the contrary.

Whitworth . . "*Iron Age*," xxiv., Dec. 4, p. 15.
"*Van Nostrand's Mag.*," xv. 536; xvi. 184.
Steel-press, Fig. 5747, p. 2369, "*Mech. Dict.*,"

Com-pres'sion Cock. One with an elastic

Fig. 672.

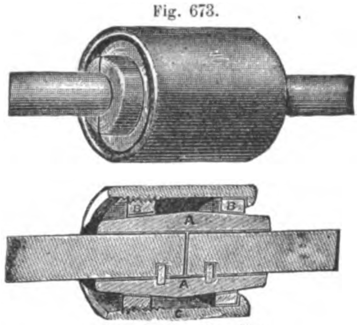


Compression Faucet.

valve, which is compressed in seating itself, the pressure of water being also toward the seat.

Com-pres'sion Coup'ling. A means of uniting adjacent ends of shafts. The compression rings, *B*, are forced up the inclines of the sleeve from

Fig. 673.



Compression Coupling.

each end by a flange at one end and a screw thread at the other end of the cover, *C*, which is rotated by a spanner.

See also Clamp Coupling.

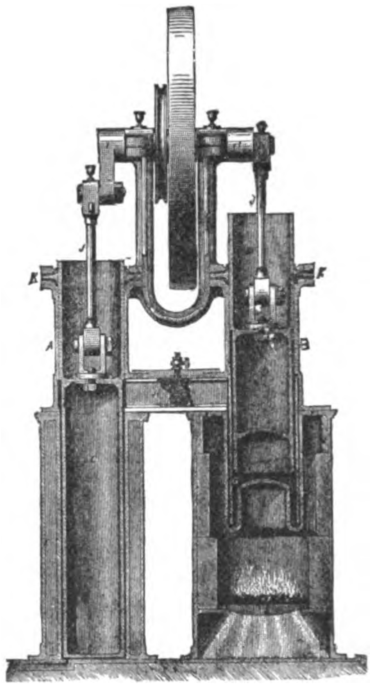
Com-pres'sion Hot'-air En'gine. The terms *hot-air engine*, *air engine*, *caloric engine*, are somewhat arbitrarily given.

The *Rider* engine, Fig. 674, is shown as a pumping engine. Cold air admitted to cylinder *A* is compressed to one third its normal volume by the descent of compression piston *C*, the air being transferred through the regenerator *H* into the heater *F* without appreciable change of volume. Heated by the passage through the regenerator and then by the fire, the expansion of the air raises the power-piston *D*, in turn depressing the compression piston *C*, and so on.

"*Scientific American*," . . . * xxxiv. 66; * xxxviii. 131.
"*Railroad Gazette*" . . . . * xxiv. 189.

See also Air Engine; Caloric Engine; Hot-air Engine.

Fig. 674.



Rider's Compression Engine.

Com-press'or. 1. A device on the stage of a microscope by which an object is compressed between glass plates.

2. (*Surgical.*) An instrument for grasping a uterine tumor and severing the pedicle. An *Ecraseur.*

Com-pres-so'ri-um. A compressor for microscopic objects.

Microscope, *Holman* . . . "*Manuf. & Builder*," xii. 205.

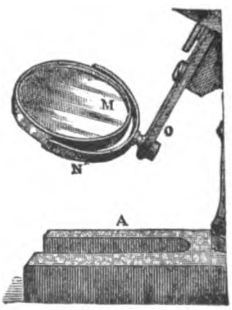
Com'pro-mise Wheel. (*Railway.*) One adapted by an extra breadth of tread to run upon tracks of gages varying say 1½″ in width.

A broad-tread wheel.

Con'cas-seur. A French coarse-grinding mill for grain or feed. A *corn cracker.*

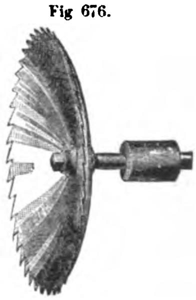
Con'cave Mir'ror. A mirror, *M*, attached to a microscope to throw oblique rays upon the object. It is adjustable in any direction, as, besides swinging in a rotating semicircle, *N*, it is attached to a bar, *O*, with a joint at each end, allowing a lateral movement.

Fig. 675.



Concave Mirror.

Fig 676.



Concave Saw.

Con'cave Saw. A dish-shaped saw for sawing out bowls or curved stuff. See Fig. 676.

Con-cen'tra-ting Ap'pa-ra'tus. An apparatus for eliminating extraneous, refuse, or diluting matter. The term has many applications. See p. 604, "*Mech. Dict.*," and list under METALLURGY, p. 1424, *Ibid.*, for the names of those machines concerned in mining.

Ore, *Richards* . . .	* "*Mining & Sc. Press*," xxxv. 161.
Tolles	* "*Mining & Sc. Press*," xxxiv. 17; * xxxiv. 237.
Beet sugar process, Fr.	"*Dept. Agri. Sp. Report*," 128, Pl. XXVI.
For syrups	*Laboulaye's* "*Dict.*," "*Sucre*," iii.

See also CONDENSER. "*Mech. Dict.*"

Con'cer-ti'na. (*Music.*) An instrument of the accordeon family. It is a small elastic box, held horizontally between both hands It is played by knobs pressed by the points of the fingers, and which, raising a valve, cause to pass over the reeds of brass the column of air supplied by the bellows between the two sides of the box. The sides hold the knobs on the outside, and, on the inside, the vibrating plates. The bellows has no valves, but fills and empties by means of the reed valves, which inspire and expire, each in turn, the air necessary for the vibration of the reeds. The *bass concertina* has the compass of the *violoncello;* the *alto* that of the *viola;* the *soprano* that of the violin.

Con'crete. A mixture of mortar with gravel or spawls.

Architectural treatment	"*Scientific American Sup.*," 683.
Blocks	* "*Manuf. & Builder*," ix. 112.
Woodhouse, Eng. . .	"*Iron Age*," xix., Feb. 1, p 24.
Building	"*Scientific American Sup.*," 408, 534, 1524.
Bell, Engi	"*Scientific American Sup.*," 899
Block lowering, Jersey.	* "*Engineering*," xxiii. 282.
Concrete and iron, *Hyatt*	"*Scientific American Sup.*," 1939.
Dwelling house	* "*Scientific American Sup.*," 1895.
House building	"*Scientific American Sup.*," 1767.
Fire-proof	"*Scientific American Sup.*," 921.
Foundation, *Matthews*	* "*Scientific American Sup.*," 245.
Mill	* "*Mining & Sc. Press*," xxxv. 273.
Mixer, *Messent*, Eng. .	* "*Scientific American*," xxxvii. 97.
Day & Lampard, Br. .	* "*Engineer*," xlv. 354.
Tank	"*Scientific American Sup.*," 3742.

See also BÉTON, CEMENT, etc.

2. (*Sugar.*) Sugar boiled down to a solid mass; to be worked up subsequently in factories provided with superior machinery. See CONCRETOR.

Con-cre'tor. An apparatus for evaporating sugar, bringing the whole juice of the cane to a solid mass, to be subsequently treated with superior machinery. *Fryer's process.*

The apparatus consists of three parts: 1st, a rectangular pan of cast-iron, made in sections, and in all 25′ or 30′ long by 6′ wide and 6″ deep, with a number of partitions running across, extending alternately from each side nearly to the other, and set with a slight inclination, so that the juice runs in at one end, and in a stratum of not more than ½″ in depth, by a long, zigzag course, escapes at the other. The pan is heated by direct fire from below, and in passing through it about two-thirds of the water is evaporated. The juice, now of syrupy consistence, goes thence to the interior of a hollow cylinder of sheet-copper, heated on the outside by the flue gases from the fire under the pan (or by the vapor from the juice therein), while through the inside a current of air is driven, heated by the exhaust steam of the small engine, which furnishes power. This cylinder is 20′ long by 3′ 6″ in diameter, open at the ends, with the exception of a little rim to retain the syrup, set with a slight inclination from the horizontal, and made to revolve slowly — about 6 or 8 times per minute — on its axis. Thence the syrup, now of thick consistence, passes to the exterior surface of a copper-faced iron cylinder of 4′ in diameter by 4′ long, over which it is evenly distributed in a thin layer. This cylinder is heated from within by exhaust steam, revolves upon its axis twice per minute, and receives on the outside a steady blast of heated air, by which the evaporation is rapidly completed and the syrup brought to the consistence of a soft solid, which is removed by a scraper, and can be molded while warm, but on cooling sets into perfectly hard slabs, ready for storage or shipment. The time required for the passage of any given portion of sugar from end to end of the whole apparatus is only about 15 minutes, and with the above dimensions of parts the product is about half a ton of *concrete* per hour. Of course the arrangement may be used to produce crystallized sugar, but it is specially adapted to its intended use of rapidly putting the crude juice into a condition in which it may be kept free from alteration and in small bulk for shipment, to go in due time into the hands of the refiner.

Mallet's report on Group III., in vol. iv., "*Centennial Exhibition Reports*," 1876.

Con-cus'sion Ta'ble. *a.* An ore-sorting table to which concussion is imparted in order to separate the broken ore by gravity. A *percussion* table.

Rittinger's double concussion table, * "*Mining and Scientific Press*," xxxiv. 217.

b. A species of grain cleaner. See CLOD CLEARER, *supra.*

Con-den'ser. A word with several applications, referring to the concentration of volume of an object, as of a solution, a syrup, a gas, an ore, or slime mixed with gangue or impurities.

Pelouze & Andoin's condenser for the mechanical separation of vapor held in suspension by gases. *Smedberg's* improvement. "*Mining & Scientific Press*," * xxxvi. 393.

Dahlgren's fume condenser. "*Sc. American Sup.*," * 629.

McCarter's steam-engine condenser without air pump. "*Scientific American Sup.*," * 643.

Rice's condenser for pharmaceutical stills. "*Scientific American Sup.*," * 1511.

Deane's independent condensing apparatus is a circulatory pump attached to any non-condensing engine, and made at Holyoke, Mass.

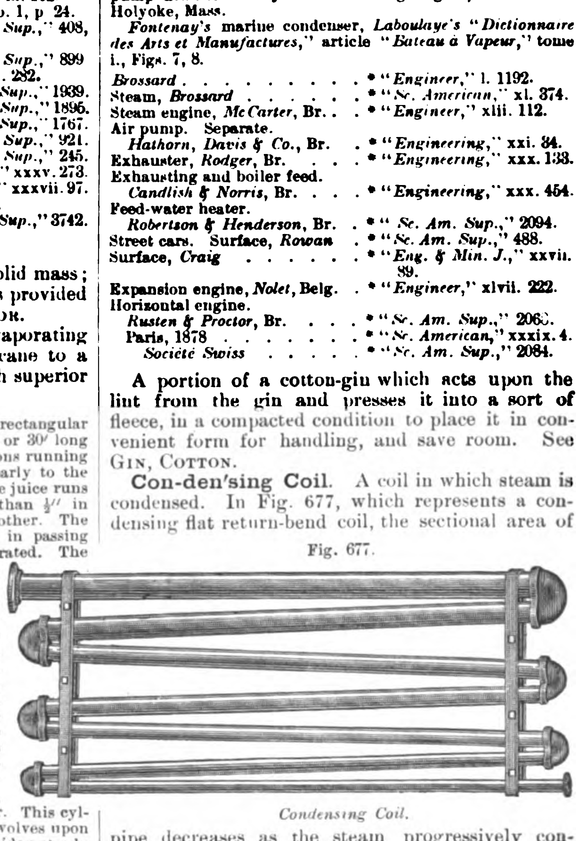
Fontenay's marine condenser, *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," article "*Bateau à Vapeur*," tome i., Figs. 7, 8.

Brossard	* "*Engineer*," l. 1192.
Steam, *Brossard*	* "*Sc. American*," xl. 374.
Steam engine, *McCarter*, Br. .	* "*Engineer*," xlii. 112.
Air pump. Separate.	
Hathorn, Davis & Co., Br.	* "*Engineering*," xxi. 84.
Exhauster, *Rodger*, Br. . .	* "*Engineering*," xxx. 133.
Exhausting and boiler feed.	
Candlish & Norris, Br. . .	* "*Engineering*," xxx. 454.
Feed-water heater.	
Robertson & Henderson, Br.	* "*Sc. Am. Sup.*," 2094.
Street cars. Surface, *Rowan*	* "*Sc. Am. Sup.*," 488.
Surface, *Craig*	* "*Eng. & Min. J.*," xxvii. 89.
Expansion engine, *Nolet*, Belg.	* "*Engineer*," xlvii. 222.
Horizontal engine.	
Rusten & Proctor, Br. . . .	* "*Sc. Am. Sup.*," 2066.
Paris, 1878	* "*Sc. American*," xxxix. 4.
Société Swiss	* "*Sc. Am. Sup.*," 2084.

A portion of a cotton-gin which acts upon the lint from the gin and presses it into a sort of fleece, in a compacted condition to place it in convenient form for handling, and save room. See GIN, COTTON.

Con-den'sing Coil. A coil in which steam is condensed. In Fig. 677, which represents a condensing flat return-bend coil, the sectional area of pipe decreases as the steam progressively condenses.

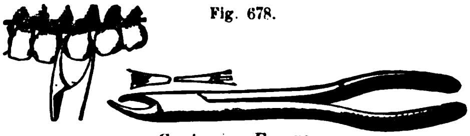
Fig. 677.



Condensing Coil.

Con-den'sing For'ceps. Dental forceps for

Fig. 678.



Condensing Forceps.

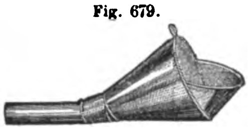
condensing plugs situated between the teeth, near their necks or their lingual or palatine edges.

Con'duc-tiv'i-ty. (*Electric.*) The conveying power of an object. Opposed to *resistance.*

Con'duc-tom'e-ter. An instrument for illustrating the comparative power of different objects for conducting heat, electricity, etc.

Con-duc'tor Head. A funnel spout and leading pipe, to conduct a liquid into a reservoir horizontally or nearly so.

Fig. 679.



Conductor Head.

Used in creameries in pouring the milk from the cans of the collecting wagons into the can on the scale inside the receiving-house.

Con-duc'tors' Valve. (*Railway.*) A valve connecting with the Westinghouse automatic brake, and placed at some convenient point in a car, and operated by a cord extending through the car within reach of the conductor.

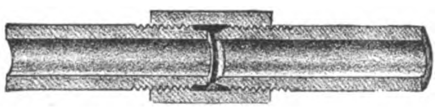
Cone. (*Spinning.*) One of the taper drums in the headstock of a mule, and known as the *backing-off* and *drawing-up* cones respectively.

Cone Gear. (*Add.*) Conical gearing for varying motion was described in *Bramah's* planing machine. English Patent, 1802.

Cone and Cra'dle Mill. A mill which has a conical muller or grinder, reciprocating in a semi-cylindrical concave.

Cone Joint. A pipe joint. The abutting ends of the pipes are conical, and are drawn by a screw-sleeve against a leaden gasket, and thus make a tight joint.

Fig. 680.



Cone Joint for Hydraulic Pipes.

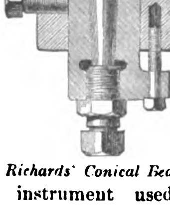
Con-fec'tion-er'y Stove. A sheet metal stove with holes to fit a variety of sizes of confection pans, one at a time.

Steam confection pan, *Brown* . . * "*Engineer*," xli. 226.
French confectionery . . . . . "*Sc. Am. Sup.*," 194.
See also Fig. 1428, p. 611, "*Mech. Dict.*"

Fig. 681.

Confectionery Stove.

Fig. 682.



Richards' Conical Bearing.

Con-form'a-tor. An instrument used in taking the shape of the head at the hat band. Used in shaping hats to fit the head.

Hat conformator and shapes of heads of many distinguished persons, "*Scientific American*," * xxxviii. 143, 146.

Con'ic-al Bear'ing. A compensating bearing for the spindles of shafts in wood machines. The bearing passes through the shell, and the end abuts against the end of an adjustable screw of hard brass having a core diameter equal to that of the spindle. Surrounding the bearing between the end-thrust screw and the spindle is an annular cavity for oil and fibrous packing. Fig. 682.

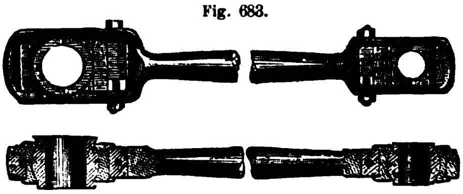
Con-junc'ti-va In'stru-ments. (*Surgical*) Instruments for operating upon the mucous membrane of the eye and lid.

Scissors curved on the flat . . . . . . Fig. 96, Part II.
Pterigium scissors (for removing excrescences from the internal canthus of the eye) . . . . Fig. 97, Part II.
Caustic holder . . . . Fig. 97 *b*, Part II.
Brush . . . . Fig. 97 *c*. Part II.
Of *Tiemann's* "*Armamentarium Chirurgicum.*"

Con-nect'ing Rod. A rod intervening between the piston rod or cross-head and the wrist of a crank or driving wheel.

Fig. 682 shows a connecting rod forged in a single piece and mortised for the reception of the brass boxes, which are curved on their backs and fit the cheek-pieces between which

Fig. 683.



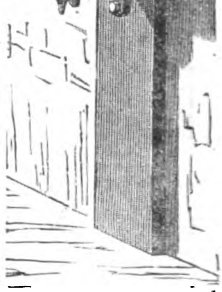
Connecting Rod.

they can turn to adjust themselves to the pins, in the plane of the axis of the rod. The adjustment for wear is by wedge-blocks and set screws.

Connecting rod with solid ends on Brown engine at the Centennial, "*Scientific American*," * xxxvi. 20.

Con'ning Tow'er. The pilot house of an iron clad, usually forward of the funnel in the British practice, and having no sight holes. A reflecting mirror may be exposed above its open top.

Fig. 684.



Console.

Con'sole. A bracket on a wall; in the present case for supporting a hydraulic motor or other object.

Con-sol'i-da'tion. (*Locomotive.*) A type of freight locomotive, the name of the engine, the first in its class, built in 1866, at the Baldwin locomotive works, on the plans of Mr. Alexander Mitchell, to operate a grade of 1 in 40 on the Lehigh Valley Railway, and specially for the Mahony plane, which rises 133′ to the mile.

It had cylinders 20″ + 24″ four pairs of 48″ diameter (pony) driving wheels, connected; and a two-wheel swing truck in front equalized with the front driving wheels. The weight of the engine at work was 90,000 pounds, of which all but 10,000 was on the driving wheels.

Con-sol'i-da'tor. (*Ceramics.*) A system of strainers in which slip is filtered through a series of bags. The consolidator of Needham and Kite is used in England.

Con'stant Bat'te-ry. (*Galvanic Battery.*) One in which the energy is kept constant by prevention of the polarization of the negative element. That is to say: the polarization of the negative plate is prevented by surrounding the same with a liquid which unites with the hydrogen which is given off from the positive plate.

The Daniell's battery, for instance, has an inner vessel of porous clay in which is a rod of zinc with a solution of sodium chloride, or dilute sulphuric acid; the outer cell has a solution of copper sulphate maintained at saturation by crystals on a shelf.

The action is as follows: when the circuit is closed decomposition of the dilute acid takes place in the inner cell; the oxygen of the acid combines with the zinc to form oxide, which is dissolved by the acid to form zinc sulphate. The hydrogen, set free by the decomposition, is liberated on the surface of the copper element, but instead of remaining meets the copper sulphate solution which is also being decomposed into (1) oxygen, with which it combines to form water; (2) copper, which is deposited upon the plate of the same metal; and (3) sulphuric acid, which permeates the porous cell, replacing that with which the zinc was dissolved, and so automatically refreshing the inner cell.

The depolarizing liquid is usually separated from the exciting liquid by a porous diaphragm or cup, but in the gravity battery the separation is effected by the differing specific gravities of the liquids themselves.

Becquerel's oxygen gas battery was the first constant battery. It was the first to employ two liquids or a porous cell. See Becquerel Battery.

See also Constant Battery, depolarizing by secondary current, "*Scientific American Supplement*," 764.

The following batteries come within the definition of *Constant*:—

Bunsen battery.	Leclanché battery.
Daniell battery.	Ponci battery.
Gravity battery.	Smee battery.
Grove battery.	Some of which are synonyms.

The following diagram will explain the reactions that take place in a Daniell's cell when the circuit is closed:—

Negative cell	Zinc	Zn	$ZnSO_4$	Zinc sulphate in inner cell.
	Sulphuric acid	H_2	H_2SO_4	Sulphuric acid, ready to dissolve more zinc.
		SO_4		
Positive cell	Copper Sulphate	Cu		
		SO_4		
	Copper	Cu	Cu.	Copper; deposited in outer cell.

In this diagram the water is not considered, as the reactions are explainable without including it in the statement. See also list under Galvanic Battery.

Con-su'mers' Test Me'ter. (*Gas.*) An apparatus for testing the accuracy of the indications of gas meters *in situ*.

It is usually a 5-light diaphragm meter with a circular dial, the outer circle showing 1′ divided into 10ths, the second circle 10′, and the third 100′ per revolution. The pointers are all adjustable. Unions and gum hose connect the meter with a pedestal and burners. The test-meter is verified by the Meter Prover; which see.

Con'tact Break'er. An arrangement or device to interrupt a circuit. The feature of making and breaking circuit is the essence of numberless telegraphic inventions.

One invented by *Herr F. Niemoller* is thus described:—

"To the middle of a wire stretched horizontally is attached a platinum point which touches the surface of mercury held by a small vessel. The current passes through the wire, and over that part of the wire through which the current passes when all the apparatus in its normal state is a small magnet. This magnet, acting on the current, causes vibrations in the wire, and so breaks and makes contact. The number of vibrations can be readily modified by changing the length of the wire, and as high a number as 1,000 breaks per second can be obtained. By passing an intermittent current over the wire, it can be set in vibration without the intervention of mechanical means. This happens when the fundamental note of the string is in unison with the pitch of the breaker."

Con'tact-vein. (*Mining.*) A vein along the contact plane of, or between two dissimilar rock masses.

Con-tin'u-ous Brake. (*Railway.*) One which is attached to each car of a train, and by connection of the several cars can be operated upon all simultaneously, and from points on the engine and each car.

The systems are various:—

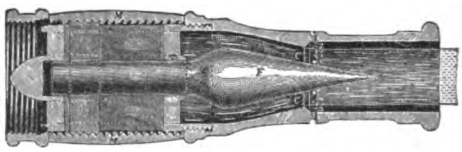
Air compression.	Hydraulic.
Vacuum.	Mechanical.
Steam.	Electric.

Con-trol'ling Valve. A supplementary steam valve adjustable to the maximum amount of steam which the foreman thinks proper to carry, while another valve is used to reduce this quantity, more or less, at the discretion of the workman.

Nash's . . . . "*Scientific American*," xlii. 166.

Con-trol'ling Noz'zle. A means of controlling the size of a stream issuing from a nozzle, by means of a cone valve *F*, which, by rotation of the sleeve *M*, is projected forward or retracted so as to partially (or entirely) close the opening, or leave the water full scope. By this means the pipeman is able to control the size of the stream according to the abundance and pressure of the water.

Fig. 685.



Controlling Nozzle.

Con-trol' Watch. A time-piece used as a watchman's time detector. See Figs. 7083, 7084, p. 2734, "*Mech. Dict.*"

Con-ver'sion. Changing the bore or fitting of a gun, as—

1. The conversion of a smooth-bore to a rifle.
2. A muzzle-loader to a breech-loader.

A report on the fabrication of wrought-iron tubes at the West Point foundry for conversion of Rodman 10″ smooth-bore guns into 8″ rifles, is contained in the "*Report of Chief of Ordnance, U. S. A.*," 1877, iii., pp. 400–412, and Plates I.-VII. accompanying.

Small arms, French system, *Tabatière*, *Ibid.*, App. L, Fig. 91.

Small arms, English system, *Snider*, *Ibid.*, App. L, Fig. 92.

10″ smooth-bores into 8″ and 9″ rifles, *Ibid.*, 1876, App. H, p. 55.

15″ smooth-bores into 11″ muzzle loading rifle, *Ibid.*, 1879, Appendix H, p. 61.

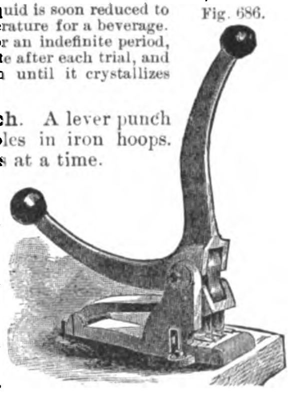
Con-vert'or. The vessel used in the Bessemer process. See p. 613, "*Mech. Dict.*"

Furnace, *Ponsard*, ... * "*Engineering*," xxv. 450.
Furnace, Crescent Steel Works, Pittsburg . . . . * "*Engineering*," xxiv 394
Appr. for working . . . . . * "*Engineering*," xxv. 99.
Ladle, *Caspersson* . . . . . "*Am. Manuf.*," Dec. 31, 1880, p. 12.

Cool'ing Cup. An invention of Toselli.

It is described in "*Les Mondes*," and consists of a cylindrical cup for holding any liquid into which may be plunged an inner goblet shaped like an inverted truncated cone, and having a lid which rests on the outer cup. Putting 150 grams of nitrate of ammonia in the inner goblet, filling it with cold water, and stirring it so as to hasten the solution, the temperature of the outer liquid is soon reduced to a sufficiently low temperature for a beverage. The salt may be used for an indefinite period, by spreading it on a plate after each trial, and exposing it to the sun until it crystallizes anew.

Fig. 686.



Cooper's Punch.

Coop'er's Punch. A lever punch for making rivet holes in iron hoops. It punches two holes at a time.

Coop'er-age Ma-chine'. See list under BARREL MACHINERY.

Cop'per. See the following references: —

Ore working . . . "*Sc. Amer.*," xxxix. 209.
Process, *Roessler*, Ger. . . . "*Eng. & Min. J.*," xxx. 369.
Hunt & Douglas . . . . * "*Engineering*," xxii. 419, 431.
Smelting process, Altenare . . "*Painter's Rept.*, *Vienna Exp.*," iv. 106.
Bukowina proc., 176, Lower Harz. *Ibid.*, iv. 129.
Hungarian proc., 195, *Mansfield* . *Ibid.*, iv. 133.
Tyrolese . . . . *Ibid.*, iv. 165.
Smelting furn., Swed., Norw., Ger. *Ibid.*, iv. 21.

Cop'per Bolt. A copper bit; a soldering tool.

Cop'per Cast'ing. Copper highly heated and cast under water, acquires a very beautiful and persistent rose color. A Japanese art. — *Dr. Percy.*

Cop'per-plate Print'ing.

Cylindrical system by roller and scraper, *Godchaux* (Fr.).
Flat plate system, *Robert Neale* (Patented in England, January, 1853).
Hydraulic pressure, *Silbermann*.
Described in article "*Imprimerie*," *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," tome iv., ed. 1877.

Cop'y-graph. Writing done on paper with a peculiar ink, preferably aniline, is allowed to dry, and then laid upon a slab of gelatine and glycerine which absorbs the ink and parts with it to paper laid upon it. It yields a large number of copies, if promptly taken.

The following is the recipe for making the slab: Best gelatine or glue, 1 part, soaked over night in cold water and the excess of water poured off; the glue is then warmed in a water bath with from 10 to 12 parts of glycerine, to which is added 4 to 6 parts of freshly precipitated sulphate of baryta and 1 part of dextrine, well mixed with constant stirring. During the summer less glycerine should be added than in winter, as the glycerine softens the mixture, while the glue and dextrine harden it. While soft it is poured into a zinc box and cooled. For ink, the aniline ink called Violet de Paris, is best.

The lithogram, chromograph, copygram, hectograph, and numerous other processes are substantially the same. It is the invention of *Stein*, of Vienna.

Cop'y-ing Lathe. A lathe which reproduces a pattern. This may either be a templet, in which case the slide-rest works against the templet, which thus governs the distance of the tool from the axis of rotation of the stuff. The result is symmetrical. The work may consist of table-legs, billiard-cues, etc.

Another form has a capacity for irregular shapes, the pattern revolving and governing the position of the revolving cutter.

See SPOKE-LATHE, Figs. 5451, 5452, p. 2283, "*Mech. Dict.*"
See LAST LATHE, Fig. 2825, p. 1259, "*Mech. Dict.*"
See LATHE . . Figs. 2336, 2837, p. 1264, "*Mech. Dict.*"

Arbey's (Fr.) copying lathe for lasts, etc., * "*Engineer*," xlvii. 262.

Cop'y-ing Pen'cil. Composed of graphite, kaolin, and blue violet aniline. Gum arabic may be substituted for the kaolin.

See also Ink . . . . "*Sc. Amer.*," xxxvi. 386; xxxvii. 327.
Pad . . . . "*Sc. Amer.*," xli. 325.
Paper . . . . "*Sc. Amer. Sup.*," 2438.
Pencil . . . . "*Sc. Amer.*," xxxix. 344.
Process, *Adler*, Gelatine . . . "*Sc. Amer.*," xlii. 1.
Alisoff, Polygraphic paper . "*Sc. Amer.*," xlii. 339.
Blue . . . . "*Engineer*," xlv. 279.
Gelatine . . . . "*Sc. Amer.*," xli. 284.
Hannot . . . . "*Sc. Amer.*," xxxvii. 259.
Holtzman . . . . "*Patent*," May 8, 1880, No. 227,629.
Ridout . . . . "*Sc. Amer.*," xlii. 100.
Sars, Lithographic . . . . "*Sc. Amer.*," xxxvii 326.

See BLUE PROCESS; GELATINE COPYING PROCESS; HECTOGRAPH, etc.

Cop'y-ing Tel'e-graph. See —

Chemical. *D'Arlincourt* . *Lines* "*Rept. Vienna Exp.*," 1873.
Writing . . . . *Laboulaye's* "*Dictionnaire*," ii. art. "*Ecritures*."

See also AUTOGRAPHIC TELEGRAPH; FAC-SIMILE TELEGRAPH.

Cor'al, Ar'ti-fi'cial. Yellow rosin, 4; vermilion, 0.2; melt and mix carefully.

Cord Car'ri-er. (*Surgical.*) A means of carrying a ligating cord to a deep-seated part.

Obstetric cases . . . . . . Fig. 496 *b*, Part III.
Knot-tyer . . . . Fig. 92, Part I.
Ligature Needle . . . . . Figs. 94–96, Part I.
Compress for seminal cords . Fig. 206. Part. IV.

All in *Tiemann's* "*Armamentarium Chirurgicum*."

Cord-mak'ing Ma-chine'. Binns' cord-making machine (Bradford, Eng.), automatic machine for making silk cord, trimmings, fringes, etc.

"*Manufacturer & Builder*" . . . . xi. 208.

Core. (*Add.*) It is often made of green sand, but usually of core sand, molded in a core box, or of loam struck up upon a spindle or core plate; it is dried and black washed. It must be sufficiently strong to bear the flow of metal around it, and sufficiently porous to allow free vent for the gases. There are many varieties: —

Dry sand.	Molasses water.
Flour.	Glue water.
Steam flour.	Sour beer.
Loam and sand.	Brickbat.
Rosin.	Charcoal.

(*Electricity.*) A bundle of wires in the center of the helix, made of soft iron, so that it may magnetize and demagnetize as rapidly as possible.

Core Lift'er. A collar or thimble lowered into a bore, made by an annular rock drill, in order to bring up the core left by the drill. The collar is of the size of the bit, and has on its interior periphery a catch which, on the retraction of the collar, engages the core and lifts it to the surface.

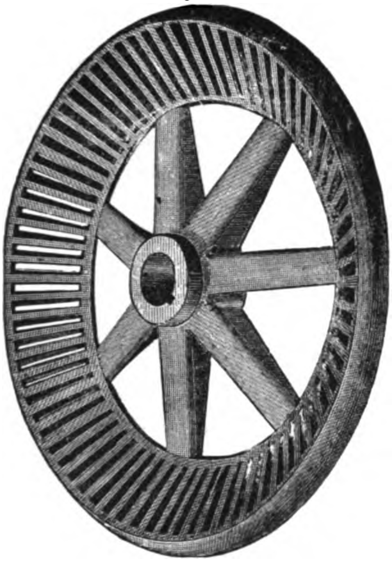
Core Wheel. A wheel with recesses which answer as the interspaces of cogs, or into which wooden cogs may be driven. Fig. 687. Such a wheel is made with cores, which are placed in the mold to form the openings in the wheel.

Cork Arm'-board. (*Leather.*) A graining-board, made of the outer or dead bark of the cork-oak. It has no grooves.

Cork Board. Ground cork incorporated with paper pulp in mixing machines and with powerful presses. The material is springy, light, a poor conductor of heat and sound. A French invention.

Cork'ing Ma-chine'. The form of corking machine used at Bordeaux is shown in Fig. 688 The bottle is placed on its stand, a pan being placed around it to catch the wine in case any bottle should break. The cork is in the sleeve immediately about the mouth, and is forced into the bottle by the piston operated by the lever. It is simple and efficient.

Fig. 687.

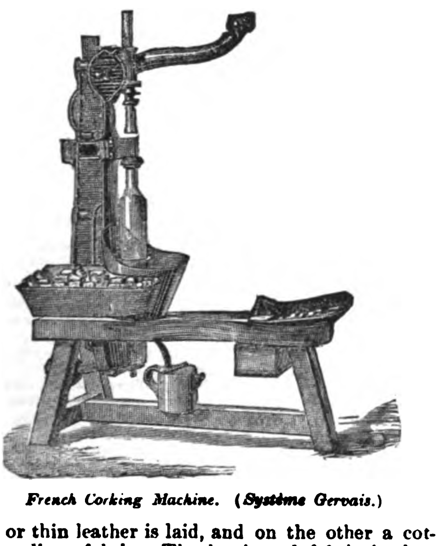


Core Wheel.

Cork Leath'er. Fine slices of cork placed between and attached to layers of leather. *De Beerski & Co.*, Fr.

Slices of cork coated on each side with India-rubber solution; on one side a sheet of cloth can-

Fig. 688.



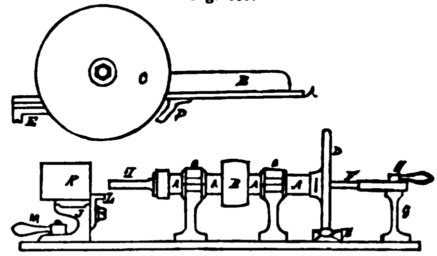
French Corking Machine. (*Système Gervais.*)

vas or thin leather is laid, and on the other a cotton or linen fabric. The laminated fabric is then pressed between rollers. To be used for trunks, driving belts, etc. Veneered with wood for panels. *Block*, Engl.

Cork Ma-chine'. Armstrong's machine for making corks is shown in Fig. 689. The upper figure is the machine for cutting the slab of cork into strips. The cork-slab is laid on the iron table *A*, which is secured by lugs *D E* to a wooden table. *C* is the revolving knife and *B* the gage.

In the lower figure, *A* is a hollow spindle driven by the pulley *B*, and capable of slipping back and forth in its bearings in the standards *C C*. On the right-hand end of the spindle *A* is the flange *D*, the edge of which runs in a groove in the lever *E*, the latter giving the spindle its end motion. On the other end of the spindle *A* is the tubular cutter *I*, which has parallel sides, and an edge produced by beveling

Fig. 689.



Cork Machine.

off the outside. *F* is a long, stationary rod, which runs from the set screw *H* through the spindle *A*, and nearly through the cutter *I*. A piece of cork being placed against the block of hard wood *R*, resting on the gage *L*, the lever *F* is moved, bringing the spindle *A* to the left, and forcing the cutter through the cork. Being retired, the central rod *F* forces the cork out of the cutter. *M* is the mode of adjustment for the abutment *J*.

The cork is tapered by presentation to a steel disk, while itself is slowly rotated

Armstrong . . . . . * "*Scientific American Sup.*," 528.
Procuring cork . . . * "*Scientific American Sup.*," 2649.

Cork'screw. Fig. 690 shows the lever for lifting the corkscrew and the cork out of the bottle without jarring it or disturbing the contents. A collar on one arm rests on the flanged lip of the bottle, and the other arm has its bearing under a collar on the cork-screw stem.

Fig. 690.

Lever Cork-screw.

Cork'screw Ma-chine'. A machine for twisting steel wire into corkscrews. Clough & Williamson.

Cor'liss En'gine. A form of engine described under CUT-OFF, which see.

See also references as follows: —

At Centennial . . . . . . * "*Engineering*," xxii. 12.
"*Iron Age*," xvii., April 13, p. 11.
* "*Harper's Weekly*," May 27, 1876.
"*Scientific Am. Sup.*," 402
And boilers . . . . * "*Scientific Am. Sup.*," 294
Horizontal, compound, Bombay * "*Polytechnic Rev.*," ii. 1.
Harris-Corliss . . . . . . * "*Sc. Amer.*," xxxv. 95.

Corn Clean'er. A machine with a combined rolling screen and suction fan, for the separating of cobs from shelled corn, and the cleaning of the corn for shipment.

Corn Crack'er. A farm or plantation mill having an outer iron shell with a corrugated inner surface, and a core or cone with sharp projections which, rotating within the shell, coarsely grinds the corn for stock feed. Used for grinding on the cob.

The British corn-mill is for grain of any kind for feed; *corn* being generic there, not *maize*.

Ransome's, Br. . . . . * "*Engineering*," xxvii. 319.

A pair of conical rollers on a horizontal axis rotating and revolving in a flat pan.

Guardiola . . . . . * "*Scientific American*," xxxvi. 83.
Grater, *Wood* . . . . * "*Scientific American*," xlii. 324

Corn Cul'ti-va'tor. See CULTIVATOR.

Corn Cut'ter. A large form of straw-cutter, adapted by size and power for cutting maize stalks. Corn fodder is thus prepared by some, and with great advantage, but the principal use of the machine is for cutting the green corn stalks for ensilage. See ENSILAGE CUTTER.

Corn-cutting machine (barn).

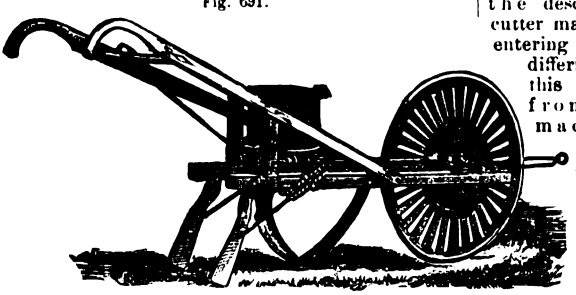
Dick	* "*Mining & Sc. Press*," xxxv. 225.
	* "*Scientific American*," xxxvii. 115.
Silver & Deming .	* "*Iron Age*," xix., Jan. 4, p. 5.

Corn Drill. A machine for planting corn in drills. The machine for planting it in hills is called a CORN PLANTER, which see.

Drills and planters are made for either one or two horses, and also to be worked by hand.

In the *Campbell* corn-drill a slotted solid wheel acts as a roller in breaking clods, and helps to prepare the seed-bed for the corn. It also is the drive-wheel which through its pitman rod and geared connections automatically operates the force-feed of the seed from the hopper, which, dropping down through the hollow share that has just provided its bed, is followed by the adjustable covering shares that complete the work. A fender in front curving back to the point of the seed-share clears the track.

Fig. 691.



Corn Drill.

There are three circles of cogs on the drive-wheel which give three different rates of feed, dropping a grain of corn at greater or lesser intervals, say from 12″ to 20″.

Cor'ne-al In'stru-ments (*Surgical.*) This includes *paracentesis*, and *cataract* instruments.

The former are needles and trocars.

The latter are enumerated under CATARACT INSTRUMENTS, which see.

See also IRIS INSTRUMENTS.

Fig. 692.

Round-corner Cutter.

Cor'ner Cut'ter. 1. A machine for cutting the corners off cards or books. Pass-books have the corners removed in order to avoid dogs-ears. The machine makes a round corner. Some cards are also rounded on the corners to suit the fancy or prevent bending too readily at the corners. Some playing cards are thus trimmed. The machine works by a treadle, or by power; in the former manner in Fig. 692. The spring clamp descends upon the object and holds it while the cutter descends, and cuts through the book to the wooden block beneath it.

2. A machine for cutting out notches from blanks of card-board, intended to be bent up to form boxes. The making of a corner notch, and the scoring partially through at the bending places, prepares the blank for being bent into shape.

Fig. 693.

Box-maker's Corner Cutter.

Fig. 693 shows a treadle motion corner cutter. The blank is laid on the table and the descending cutter makes an entering angle, differing in this respect from the machine, Fig. 692, which merely rounds the salient angle of the book or card. See PAPER-BOX MACHINE, page 1616, "*Mech. Dict.*," where various methods and forms of cutting are represented.

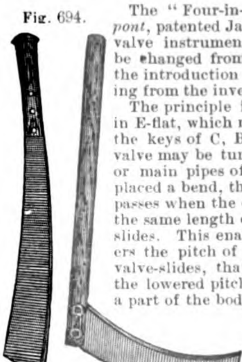
Cor'ner-ing Ma-chine'. A machine for rounding off the corners of stuff; especially used in implement and carriage work. See CHAMFERING MACHINE.

Cor'ner Valve. A valve at a corner, or bend in a pipe. See ANGLE VALVE.

Cor'net. (*Music.*) The cornet with three pistons and with cylinders has a compass of two octaves and two or three notes. Its mechanism allows of its giving all the chromatic degrees within its range.

Cornets are of many varieties as to key, and some have lengthening pieces by which the tone is lowered, but the facility of modulating by the pistons renders this mode of variation less needful.

Fig. 694.



Corn Knife. *Corn Hook.*

The "Four-in-one" cornet of *Conn & Dupont*, patented January 22, 1878, is a sliding valve instrument, so constructed that it may be changed from a higher to a lower key by the introduction of additional piping. Quoting from the inventors: —

The principle is this: First build a cornet in E-flat, which may be lowered in pitch to the keys of C, B-flat, and A. Now, that the valve may be tuned to correspond with open or main pipes of the horn, on each valve is placed a bend, through which the air-current passes when the open tone is used. Precisely the same length of pipe is added to the valve-slides. This enables the player when he lowers the pitch of the cornet, to draw out the valve-slides, that they may be in tune with the lowered pitch. This bend on the valves is a part of the body of the instrument when the open tone is used, but is cut off and its equivalent transferred to the valve-slides when the valve tones are produced."

See also cornets and horns, Fig. 2564, page 1122, and pages 1500-1501, "*Mech. Dict.*," where musical instruments are listed and classed in order of their nature and also alphabetically. See also Fig. 3263, page 1498, *Ibid*, for table of the compass of instruments and voices, showing the place which each occupies on the scale.

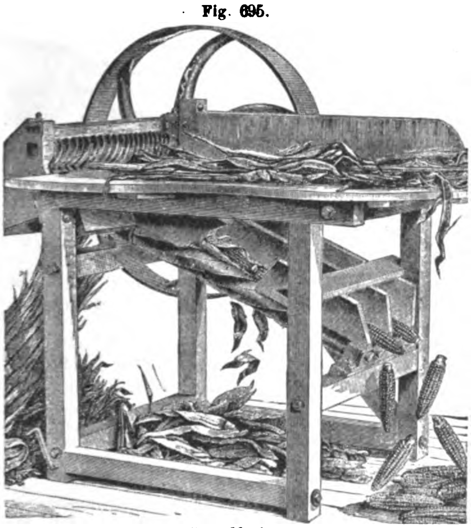
Corn Hook. A hand implement for cutting corn on the stalk. It is used by a draw motion, pulling upward. Fig. 694 shows the corn knife and corn hook. See also CANE KNIFE; MACHETE, *infra*.

Corn Husk'er. A machine for husking ears on the stalk.

Across the end of the frame near the top are placed two picking rolls provided with spiral grooves between which the stalks are fed, so that passing through the rolls they are divested of the ears both large and small. The stalks then drop upon an elevator and are taken away.

The ears, as they are severed from the stalks, drop upon the husking rolls that are placed lower down in the frame, at right angles to the picking rolls, and in an inclined position. Upon the surface of these rolls are spiral grooves for the purpose of allowing spikes to be put on the surface of the opposite roll, and also to allow the ear to settle down between the rolls, so that the hold upon the husk may be more certain. These depressions and spikes being arranged spirally upon the rolls, holding the husks at one end of the ear, and continuing the grasp to the opposite end, make the process of stripping the husk very similar to husking by hand.

Fig. 695.



Corn Husker.

As the ears slide down over the rolls, the husks, being torn off by the steel spikes, are dropped upon the elevator, while the ears pass on to the end of the rolls, and are there received into a basket, thus delivering the stalks and husks in front, and the corn in the rear of the machine at the rate of from 25 to 50 bushels per hour according to the condition of the corn, etc.

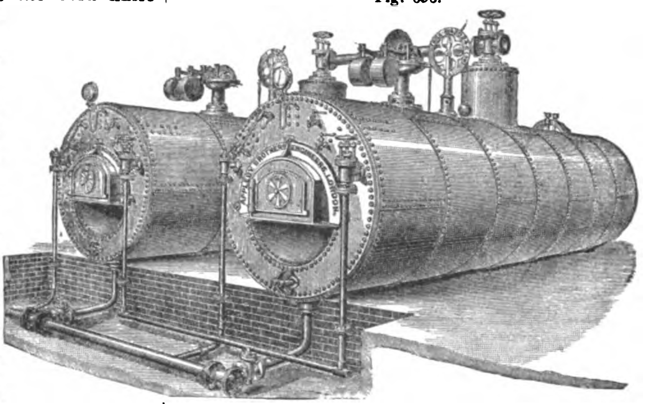
Cor'nice Ma-chine'. 1. A machine for shaping sheet metal into sham cornices for buildings.

2. A machine for planing wood into shapes for interior wall cornices.

Hayes . . . . . * "*Manufacturer and Builder*," xi. 217
* "*Iron Age*," xxii., May 15, p. 7: May 22, * p. 3: * xxiv., Oct. 2, p. 7.
Sheet metal . . . * "*Iron Age*," xviii., Sept. 7, p. 17; Oct. 26, * p. 1.

Cor'nish Boil'er. A boiler formerly made wagon-shaped (*A*, Plate LXI., opp. p. 2326, "*Mech. Dict.*") but now of a stronger form, cylindrical, higher pressure being required than in the atmospheric engine, where steam was only used to fill the space below the piston, in order that by its condensation a partial vacuum might be produced, and the pressure of the air, acting upon the top of the piston, should depress the latter and with it one end of

Fig. 696.



Appleby's Cornish Boiler.

the walking-beam, lifting by consequence the pump-rod at the other end of the beam.

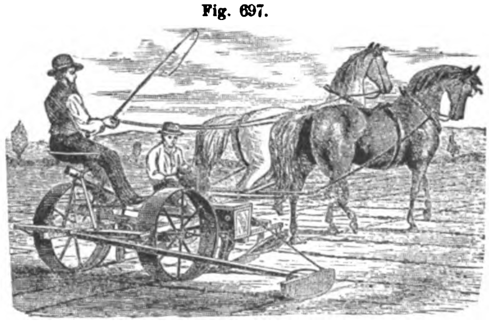
Fig. 696 shows two of a battery of Cornish boilers of the form built by Appleby Brothers, of London, for the locomotive shops of the East Indian state railways. The fittings consist of a furnace front with ventilator, grate bars, bearers, dead-plate, and damper, man-hole and mud-hole, with mud-hole cover and bridge, stop-valve, safety-valve, feed-valve, gage-cocks, glass water-gage, Bourdon's steam-pressure gage, blow-off cock, fusible plug in the crown of each tube, and high and low-water indicator.

Cor'ni di Bas-set'to. (*Music.*) A reed instrument like a clarinet in F (low), excepting that it has a brass bell-mouth, which elongates its lower extremity and descends to a lower note.

Cor'no In'glese. (*Music.*) A double reed instrument, the alto of the oboe, with a compass of 2½ octaves. It is written on the G clef.

Corn Plant'er. Walking, riding, and hand corn planters are shown on pp. 626, 627, "*Mech. Dict.*" Fig. 697 shows a complete machine, with

Fig. 697.



Corn Planter and Marker.

the driver, dropper, and marker. The weights of the operators practically balance each other. The shape of the runner makes a distinct channel in the ground for the reception of the seed. The depth of the channel is regulated by shoes over the faces of the runners. By projections on the wheels conforming to the width of the channels the earth is pushed over the corn, and the furrows are rolled by the broad-faced wheels which support the machine. The planter can be thrown out of the ground when turning at the end of the row and held in position by a catch, until the point of starting on a new bout is reached, when, by a movement of the foot of the driver, the machine is again placed in working position.

The machine is used principally for planting in check-rows by placing a boy on the machine to move the lever when crossing the check-marks, or is made to act automatically as a drill or hill-planter when check-rows are not desired. The marker shown as projecting from the off-side is to mark the ground as a guide for the next bout; when returning, the marker will be shifted to the near side, and so on alternately as the machine goes to and fro across the field.

In the bottom of each hopper is a round dropping-plate with a circle of pockets: into these the grain falls, and the rotation of the plate brings the hole over the tube and the corn passes by the tube to the open furrow at the heel of the runner. The motion of the dropping-plates is derived from the wheels, and different dropping-plates are used for different quantities of seed, 1, 2, 3, or 4 kernels; optional pinions used for dropping in drill-rows are of sizes for dropping at 19'', 15'', 10'', 7'', distance respectively.

The single row planter has the appearance of the walking cultivator, Fig. 1468, p. 627, "*Mech. Dict.*," or of the machine shown at CORN DRILL, *supra*.

Check row planter, *Gruetzel*, * "*Scientific Amer.*," xlii. 243.
Corn planter, *Du Souchet* . * "*Scientific Amer.*," xl. 99.
Hand planter, *Noel* . . . * "*Scientific Amer.*," xxxiv. 86.

Corn Plow. The principal corn plow is a cultivator, and is considered under that caption.

There are, however, special plows made for corn and for cotton cultivation, some of them adapted for either. Those with shifting shares, for operating upon the growing plant at different stages of its growth, are considered under *combination plow*.

Single and double plows and several other forms, mentioned in the list under AGRICULTURAL IMPLEMENTS, belong to this order.

Corn plow and marker, *Burns*, * "*Sc. American*," xxxix. 99.

See also CULTIVATOR.

Corn Shel'ler. A machine for removing corn from the cob. See "*Mech. Dict.*," p. 628.

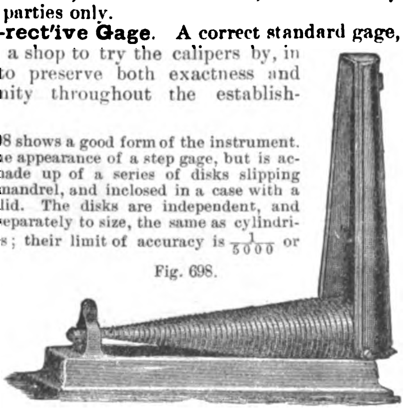
Goddard . . . . . * "*Scientific American*," xxxvi. 134.
Hutchison . . . . . * "*American Miller*," v. 6.
Livingston & Co. . . * "*American Miller*," v. 15.

Cor'po-ra'tion Stop. A stop cock in a gas or water main, outside of a house, to be used by official parties only.

Cor-rect'ive Gage. A correct standard gage, kept in a shop to try the calipers by, in order to preserve both exactness and uniformity throughout the establishment.

Fig. 698 shows a good form of the instrument. It has the appearance of a step gage, but is actually made up of a series of disks slipping upon a mandrel, and inclosed in a case with a hinged lid. The disks are independent, and ground separately to size, the same as cylindrical gages; their limit of accuracy is $\frac{1}{5000}$ or

Fig. 698.



Corrective Gage.

$\frac{1}{10000}$, according to the precision required, and the limit of expense. The sizes are from $\frac{1}{4}$'' to $2\frac{3}{8}$'' by 16ths; from $2\frac{1}{2}$'' to $4\frac{1}{8}$'' by 8ths, making 49 sizes.

Cor-ru-ga'ted Boil'er. A form of house-heating or greenhouse boiler, which occupies a position inside a furnace, and the shape of which exposes a large surface to the fire.

Cor'si-can Fur'nace. Another name for the Catalan furnace. See CATALAN FORGE.

Co-run'dum. A crystalline alumina used as an abradant.

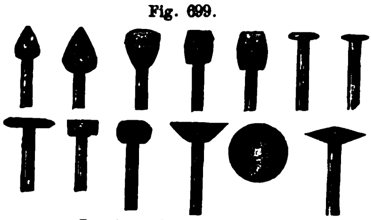
As a cutting agent, *Jenks* . . . . "*Sc. Am. Sup.*," 972.
Occurrence and distribution . . . "*Sc. Am.*," xxxix. 193.
"*Sc. Am. Sup.*," 672.
Wheels, paper on, by *Bateman*, Engl. "*Sc. Am. Sup.*," 1989

See Report of *J. M. Safford*, "*Centennial Exhibition Report*, Group 1., vol. iii., p. 189: Localities, Varieties, Mode of preparing.

See also EMERY; EMERY WHEEL.

Co-run'dum Points. (*Dental.*) A grinding and abrading tool used on the end of the spindle of

Fig. 699.



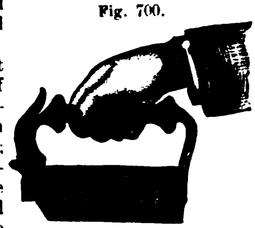
Dentists' Corundum Points.

a dental drill; either in mechanical or operative dental operations.

The set consists of wheels, olives, points, cherries, cones, etc.

Co-run'dum Tool. A grinding tool made of a block compounded with emery, or faced with the same.

Fig. 700.



Millstone Facing Tool.

The term is somewhat generic, a multitude of tools deriving their virtue and usefulness from degraded corundum; but the specific application of the term, in the present case, is to a tool for dressing the surface of millstones, restoring the natural grit; the flat for trueing the face, and the angles for the furrows. See MILLSTONE DRESSER.

Co-si'na. A dye produced by Dr. Carr of Stuttgart, Germany. Its solutions in alcohol are of a delicate rose color in transmitted, and a pure yellow in reflected light.

Prepared from fluorescin, by treatment with bromine in combination with potash.

"*Scientific American*" . . . . xxxiv. 130.

Cos'mo-graph. An instrument resembling an armillary sphere for popularizing astronomical knowledge, erected as a public monument.

Fig. 701.

Rivière's Cosmograph

The long rod indicates the earth's axis, and points to the polar star; the vertical circle is the meridian; the circle at right angles thereto the equator; a vertical point shows the zenith; others mark the tropics and polar circles.

See also ARMILLARY SPHERE, Fig. 336, p. 149, "*Mech. Dict.*," and TELLURIUM, * p. 2525, *Ibid.*

Cos'mo-scope. An instrument to demonstrate the positions, relations, and movements of the sun, earth, and moon. A form of orrery. *Lexcellent*, "*Technologiste*," * xl. 125.

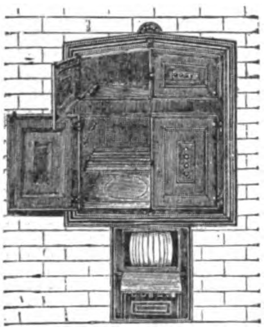
Cos'mo-ra'ma Lens. (*Optics.*) A large-sized double or plano-convex lens.

Cos'to-tome. (*Surgical.*) Rib-cutter. A post-mortem chisel or shears for opening the thoracic cavity.

Chisel costotome, Fig. 322; shears costotome, Fig. 68; Part I., *Tiemann's "Armamentarium Chirurgicum."*

Cot'tage Range. An elevated oven range with dividing horizontal flue, making a direct draft around the lower and upper ovens.

Fig. 702.



Cottage Range.

Cot'ton Cul'ti-va'tor. A three-share, expansible-frame, wheelless cultivator.

Cot'ton Cyl'in-der. A roller used in drawing fibers or slivers in cotton machinery. See DRAWING, DRAWING-FRAME, "*Mech. Dict.*" Osgood's substitute for the ordinary cylinder, covered with cloth and leather, is gelatine treated with bichromate of potassium.

"*Scientific American Supplement*" . . . . . 223.

Cot'ton Gin. See GIN.

Cot'ton Hold'er. (*Surgical.*) A staff to hold a pledget of cotton or lint for application to a wound or cavity.

Cot'ton Ma-chin'er-y. The following list gives the series of machines shown by the Willimantic Linen Co. in their complete exhibit of machines, from the bale of cotton to the spool thread; working upon sea-island cotton. Atlanta Exhibition, 1881.

Cotton gin.	Bobbin spooler.
Cotton picker.	Two-ply doubler.
Three Foss & Pevey cotton cards.	First twisting frame.
Railway head.	Spooler.
Comber doubler.	Three-ply doubler.
Comber.	Second twisting frame.
First drawing frame.	Reel.
Second drawing frame.	Skein spooling machine.
Slubbing frame.	Winding machine.
Intermediate frame.	Ticketing machine.
Roving frame.	Automatic spool turning machine.
Ring spinning frame.	Color card winding machine.

New cotton machinery * "*Engineering*," xxx. 484, 512.
* "*Engineer*," 1 383, 437.
Dobson & Barlow . . * "*Scientific American Sup.*," 2756.
Copping apparatus . . * "*Engineering*," xxx. 484.

Cot'ton Op'en-er. A machine in which bale cotton is picked to pieces, opened, shaken, and blown, to make it separate and light, and remove dirt. It is delivered in a fleecy condition in a sort of lap.

Cotton cleaner . Figs. 1485, 1486, pp. 633-634, "*Mech. Dict.*"
Buckley . . . "*Scientific American Sup.*," 1749.

Cot'ton Parch'ment. A material made in sheets by the following process. Cotton fiber, cleaned, digested in a solution of sulphuric acid, glycerine, and water. Rolled into sheets.

Sylvestre . . . . "*Technologiste*," xliii. 170.

Cot'ton Pick'er. A machine for picking cotton from the boll, in the field. Fig. 1488, p. 635, "*Mech. Dict.*" See also: —

Powell . . . . * "*Scientific American*," xxxviii. 86; xxxvi. 84.

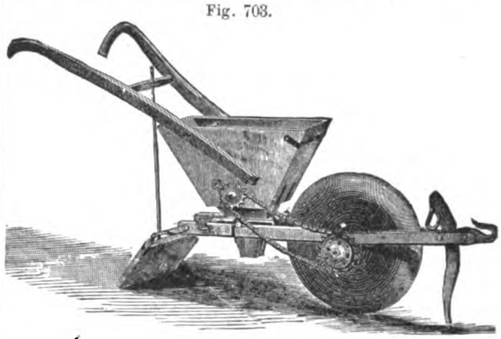
Lynch . . . . * "*Scientific American Supplement*," 240.
Smith . . . . U. S. Patent, April 10, 1877.

Cot'ton Plant'er. A machine which opens a furrow, drops the cotton seed, and then covers it.

There are many machines for the purpose. A force feed is useful on account of the fibrous clinging quality of the seed.

Conner's cotton planter, Fig. 703, has a tooth in front, followed by the disk wheel, which makes the seed-bed. The drive wheel, through an endless chain, operates the force feed in the hopper that furnishes the seed, and is followed by a coverer that is pivoted to the frame of the planter, and adjusted and held in position by a rod to the handle frame above.

Fig. 703.



Cotton Planter.

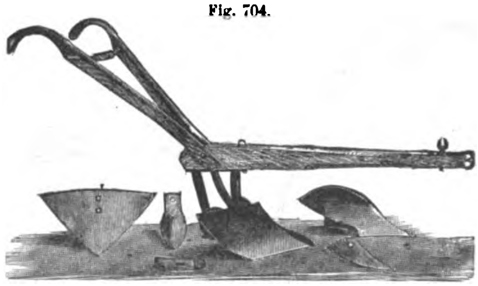
The "Globe" cotton planter gave the best satisfaction at the Atlanta Exposition. It has a barrel which rolls over the ground, being supported by end wheels. Around the equator of the barrel are round holes for the seed to issue. A hoop closes them or opens them to any extent. A spiked shaft in the middle remains stationary while the roller and contents revolve. This keeps the seed stirred. It has the opening share and covering board respectively in advance and rear of the seed cylinder.

Seymour . . . . . * "*Scientific American*," xxxiv. 54.

Cot'ton Plow. A form of cultivating plow differing but little from that employed in tending other crops which are planted in rows and plowed during growth.

Avery's combination cotton plow has adaptations for various duties in cotton tending, as turning plow, scraper sweep, shovel-plow and bull-tongue; five

Fig. 704.



Combination Cotton Plow.

implements with one stock. The half-shovel and scooter may be added if desired.

The rudder wheel acts as a guide, and as a fulcrum in turning or regulating depth, and preventing the implement from dodging and shooting into the line of plants.

See also COMBINATION PLOW.

Cot'ton Pow'der. See TONITE.

Cot'ton Press. See BALING PRESS, "*Mech. Dict.*," *et supra.* Also: —

Compress, *Burr* . * "*Scientific American*," xxxvii. 159.
Hydraulic, *Taylor* * "*Engineering*," xxv. 190.
* "*Scientific American*," xxviii. 15.

Watson, Br. . . . * "*Engineer*," xlv. 38.
* "*Scientific American Sup.*," 1808.
Wilson . . . . * "*Engineer*," xliv. 329.
* "*Scientific American Supplement*," 39.

See list under PRESSES; and REPRESSING PRESS, Fig. 4624, p. 1919, "*Mech. Dict.*"

Cot'ton Scra'per. A cotton cultivator for scraping the earth to or from the plants, as may be required at different periods of the cultivation. The scraper share is shown attached to the stock in COTTON PLOW, which see.

Cot'ton Spin'ning. The Clement process for spinning cotton direct from the seed cotton is mentioned in many of the journals of the day.

"*Engineering and Mining Journal*" . . . . xxviii. 423.
Louisville "*Evening Post and Press*" . . . . Dec., 1879.

The machine is a combined gin and card, making slivers from seed cotton.

It consists of a 36″ top-flat self-stripping card; the attachment (which is a diminutive gin 18 × 18 × 36″), is substituted for the licker-in and feed rollers of the card; its saws are 7″ in diameter, with fourteen teeth to the inch, and revolve from 100 to 200 times per minute. The brush connected with the saws is a cylinder covered with bristles; its periphery revolves a little faster than the saws, and has also a traverse or horizontal motion. The periphery of the card travels a little faster than the brush; a feed table is placed above the card and connected with the attachment by a chute, and gives a regular supply of seed cotton to the attachment. A stop-motion is used to save waste in case of accident. These, with a small drawing roller between the doffer and calender rollers, to reduce the sliver to the ordinary working size, and a cam motion to receive said sliver, are all the changes and additions made to the card.

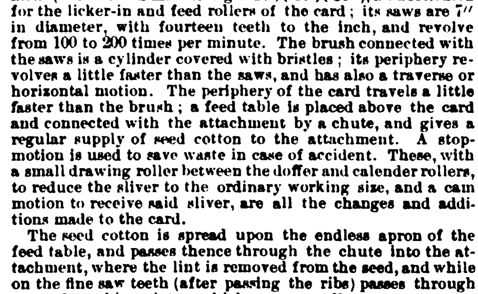
The seed cotton is spread upon the endless apron of the feed table, and passes thence through the chute into the attachment, where the lint is removed from the seed, and while on the fine saw teeth (after passing the ribs) passes through a set of combing plates, which removes all extraneous matter, and delivers the filaments to the brush, which delivers them to the card, and thence through the doffer, small drawing and calender rollers; being delivered as perfect sliver into a revolving can.

Cot'ton Stalk Pul'ler. A machine for pulling out of the ground the old cotton stalks preparatory to chopping or making into windrows and burning.

Brown . * "*Scientific American*," xxxiv. 358; * xxxvii. 230.

Cot'ton Sweep. (*Agric.*) A form of plow used in cultivating the balk between cotton rows: also used in corn cultivation.

Fig. 705.



Cotton Sweep.

Cot'ton-tie Fast'en-er. An apparatus to draw together the ends of cotton-bale ties, in order that they may be riveted or buckled: generally the latter, though the buckle is really but a square loop, around which the ends are bent. See BALE TIE, Fig. 540, p. 218, "*Mech. Dict.*," where 30 kinds are illustrated.

Fig. 706.

Cotton-tie Fastener.

The *Greenleaf* cotton-tie fastener is a clamp, the two members holding each a tie and approached by means of a crank pinion and rack.

Cot'ton Truck. A two-wheeled truck, the sides ending in flat points instead of the usual loop.

Cot'ton Worm De-stroy'er. Apparatus for destroying the cotton worm. There are numerous forms: some adapted for rose, potato, vine, and melon bugs.

Comstock's "*Report upon the Cotton Worm*," U. S. Agric. Depart., 1879, gives varied information on this subject and shows the following apparatus: —

Whitman, fountain pump sprinkler . . . . * p. 239.
Daughtry, spraying machine . . . . . . * p. 242.
Willis, atomizer . . . . * p. 243.
Johnson, sprayer . . . . * p. 245.
Young, sifter . . . . * p. 246.
Allen, duster . . . . * p. 247.
Willis, sifter . . . . * p. 248.
Davis, sifter . . . . * p. 249.
Levy, sifter . . . . * p. 250.
Eldridge, sifter . . . . * p. 251.
Robinson, sprinkler and duster . . . . . * p. 252.
Helm, brush and collector . . . . * p. 253.
Ewing, brush and collector . . . . * p. 255.
Heard, moth trap . . . . * p. 262.
McQueen, trap-lantern . . . . * p. 265.
Garrett, trap-lantern . . . . * p. 266.
Duke, trap-lantern . . . . * p. 267.
Stephens, trap-lantern . . . . * p. 267.
Pitman, trap-lantern . . . . * p. 268.
Dudley, trap-lantern . . . . * p. 269.
Cranston, trap-lantern . . . . * p. 270.
Pugh, trap-lantern . . . . * p. 271.
Byrne & Strunk, trap-lantern . . . . . . * p. 272.
Rigel, trap-lantern . . . . * p. 273.
Stith, trap-lantern . . . . * p. 274.

Couch'ing Nee'dle. (*Surgical.*) An instrument for depressing the opaque lens in cataract.

See Needles, Spuds, Spatulas, Curettes, etc., p. 27, Part II., *Tiemann's* "*Armamentarium Chirurgicum.*"

Cou-lomb'. (*Electricity.*) A term for a unit in electricity. It was suggested at the Electrical Congress in Paris, 1881, that the name *coulomb* shall be given to the quantity of electricity defined by the condition that an *ampère* gives one *coulomb* per second. At latest advices the matter of nomenclature of units is yet unsettled.

Coun'ter-bal'ance Crane. One having a load on its frame opposite to the jib to partially counterbalance the object lifted and remove strain from the pintle, or prevent oversetting in the case of movable cranes; *j*, Fig. 1507, p. 643, "*Mech. Dict.*," is an instance. See also LOCOMOTIVE CRANE. See also BALANCE CRANE, Fig. 176, p. 66, *supra*.

Coun'ter-bore. A cylindrical counter-sink, usually made with a pin-drill.

Coun'ter Brace. A member in a frame which transmits strains in an opposite direction to a main-brace.

Coun'ter Cock. A faucet upon a counter for drawing beverages. See Fig. 707.

Coun'ter Gear. Driving gear, for lathes, for instance, attached to a ceiling or post, and connecting by band with the machine or machine-tool to be driven.

"*Engineer*" . . . . * xlii. 258.
"*Scientific American*" . . . . . . * xxxv. 342.

Coun'ter Pump. A pump beneath a counter for drawing liquids from barrels in a cellar beneath. See Fig. 708.

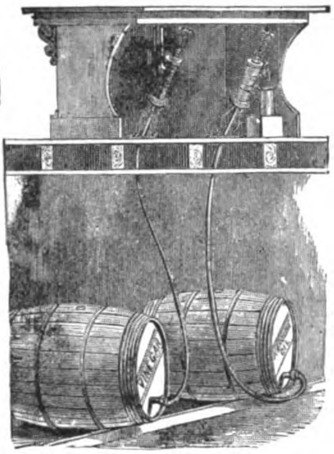
Coun'ter-sink. 1. (*Fire-arms.*) The recess in the rear of the chamber in which the rim of the cartridge fits.

2. (*Blacksmithing.*) A tool with a conical point to punch a tapering enlargement to a hole to receive the head of a screw.

Fig. 707.

Counter Cock.

Fig. 708.



Counter Pump.

3. (*Metal Working.*) A tool for chamfering the edge of a hole in metal. Fig. 709.

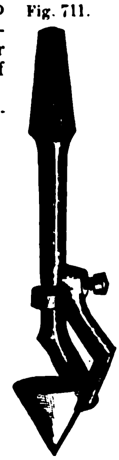
Fig. 709.

4. (*Wood Working.*) Barber's countersink, Fig. 710, is a gun-metal block which is screwed fast to the shank of the bit and carries an oblique steel cutter which chamfers the edge of the hole.

Fig. 711 is another countersink, with adjustable gage.

Fig. 710.

Fig. 711.

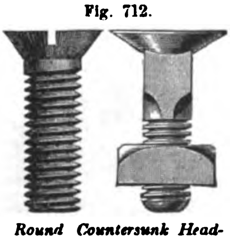


Countersink for Metal. *Countersink for Wood.* *Countersink and Gage for Wood.*

Welles . . . . . . * "*Scientific American*," xxxiv. 119.

A countersunk head-bolt is one the head of which is buried in a depression in the object so as to be flush with its surface and not project.

Fig. 712.



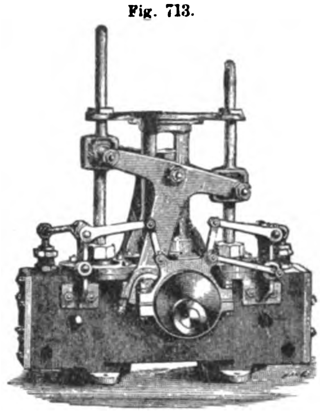
Round Countersunk Head-screw.
Square shank Countersunk Head-bolt.

Coup'led Steam En'gine. An arrangement in which two steam engines act in concert upon a single object; the term is more particularly applied, perhaps, to twin engines. The term *coupled* is perhaps a little astray in characterizing a grouping of a larger number, but the three-cylinder engine of Brotherhood, or the six-cylinder engine of West are *coupled*, in one permissible application of the word, *i. e.*, connected. This obtains in the *organ coupler*, which connects *two or more* of the ranks of keys.

The instance adduced, however, refers to a *pair* only in the twin cylinder engine of Bernays, of London, in which the crank is rotated by the intervention of a triangular connecting rod, made practicable by an ingenious arrangement of eccentric and valve-gear.

The two upright double-acting cylinders are placed with sufficient space between them to receive the crank-shaft. The pistons are connected to one crank by means of a triangular connecting-rod, which causes them to move as if connected to two cranks at right angles to each other. The steam distribution in the two cylinders is governed by one ordinary eccentric and its connections, in a manner analagous to that by which the main crank governs the motions of the two pistons. Two eyes are provided on the eccentric-ring, carrying rods or levers, through which the valves are acted upon. The position of, and distance between, these eyes bear the same relation to the throw of the eccentric as the measurements of the main connecting-rod bear to the throw of the crank, reproducing on a smaller scale the triangular connection between the crank and the two piston-rods in the eccentric and valve-rods, and the steam is correctly distributed. The eccentric is loose on the shaft and is thrown to the right or left for the purpose of reversing the engine. The position of the crank-shaft in relation to the cylinders may be varied in height to suit any required purpose.

Fig. 713.



Coupled Steam Engine.

In this engine there is no dead point, for the reason that the two pistons can never be at the ends of their respective strokes at the same time, since they reach their limit of movement when the crank-pin passes a point in line closest to the pin of the triangle to which either engine-piston attaches.

"*Iron Age*" . . . . . . * xxiv., July 10, p. 1.

Sweeney's Report, "*Paris Exposition* (1878) *Reports*," * iv. 882.

Coup'let. Two united, acting together, as of two elliptic springs, side by side, acting as a single spring. Coupled springs are shown on p. 483, "*Mech. Dict.*"

Triplet, *quadruplet*, etc., express still multiplied combinations of the same order.

Coup'ling. See under various heads, COMPRESSION COUPLING; CAR COUPLING; CLUTCH, etc. See list on pp. 638, 639, "*Mech. Dict.*"

Locomotive coupling rods, *Rose*, * "*Sc. Am. Sup.*," 490.
Safety coupling chain . . . * *R. R. Gaz.*," xxiv. 428.

Coup'ling Valve. (*Railway.*) A valve contained in the case of the hose-coupling of an air-brake arrangement. See BRAKE-HOSE COUPLING VALVE.

Cou'pon Tick'et Ma-chine'. Hoe's modification of the cylinder press for this purpose prints railway coupon tickets at the rate of 1,200 per hour. The paper, laid by the operator sheet by sheet upon the feed table, is delivered automatically to the cylinder, printed, numbered, perforated, brought back and laid down printed side up upon the rack under the eye of the attendant. The form and numbering wheels are on the same bed, and receive their ink from the same rollers. The impression cylinder gears into the bed, turning forward and backward with it, and, instead of fingers, has cords that run around in the spaces between the coupons. A numbering plate is arranged for each different spacing of coupons, so that no time is lost in adjusting the wheels.

Cou'pon Num'ber-ing Ma-chine'.

The French machine, for numbering coupons, checks, lottery tickets, stock-books, etc., is made by Pierron et Dehaitre, of Paris. It is worked by a pedal, and advances the sheet of paper at each stroke of the pedal a regulatable distance.

Cou-ronne' de Tasses. (*Electricity.*) The first cell battery. Invented by Volta, the author of the first pile, which the *Couronne* is said to have preceded. (*Niaudet.*) It consists of a series of glass cups placed in a circle, and each containing a zinc and a copper element, connected to the adjoining one of opposite polarity in the next cup.

Court Plas'ter.

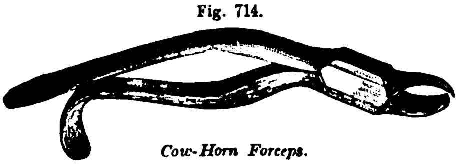
Soak isinglass in a little warm water for 74 hours; evaporate nearly all the water by gentle heat, dissolve the residue in a little proof spirits of wine, and strain the whole through a piece of open linen. The strained mass should be a stiff jelly when cool. Stretch a piece of silk or sarsnet on a wooden frame, and fix it tight with tacks or packthread. Melt the jelly, and apply it to the silk thinly and evenly, with a badger-hair brush. A second coating must be applied when the first has dried. When both are dry, apply over the whole surface two or three coatings of balsam of Peru.

"*Scientific American*" . . . . . xl. 182; xlii. 105.

Cov'ered Sight. (*Fire-arms.*) One having the sight inclosed in a ring or tube. See BAR AND BEAD SIGHT; BEACH COMBINATION SIGHT; GLOBE SIGHT, etc.

Cove Plane. A molding plane, making a quarter round or scotia. See *j*, Fig. 3194, p. 1465, "*Mech. Dict.*"

Fig. 714.

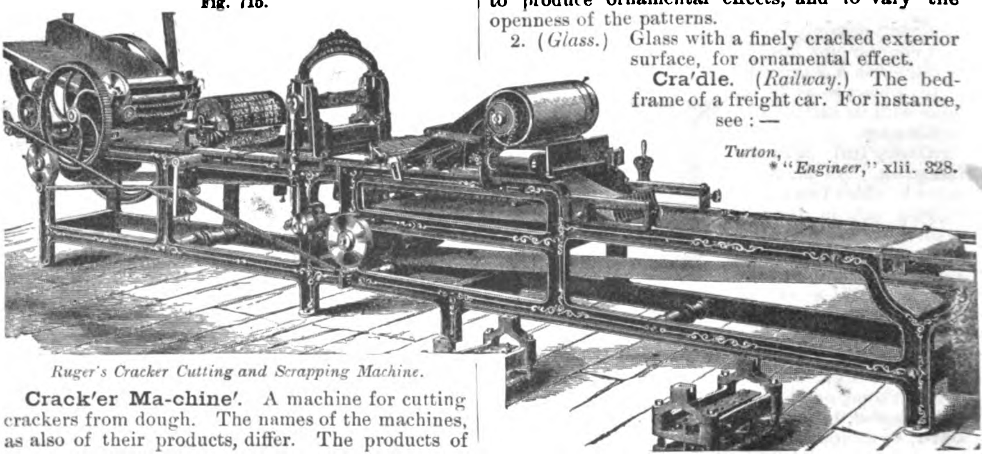


Cow-Horn Forceps.

Cow'-Horn For'ceps. (*Dentistry.*) Forceps for the extraction of molar roots when the crowns are decayed below the process.

They are made in pairs, right and left, for upper and for lower jaw.

Fig. 715.



Ruger's Cracker Cutting and Scrapping Machine.

Crack'er Ma-chine'. A machine for cutting crackers from dough. The names of the machines, as also of their products, differ. The products of the machines are usually known as crackers in this country, while they are called biscuit (*bis cuit*) in Europe. Lately, in this country, products called by the names oyster, butter, soda, milk, are known as crackers; while sweet goods, such as lemon, sugar, cream, tea, albert, etc., are called biscuits.

The machines, besides the generic names of biscuit or cracker machines, are known as *cutting machines* when they simply cut out the crackers from the blanket of dough, and *cutting and scrapping machines* when they automatically remove the scraps of dough from between the crackers. A *short cutting machine* is one with a short apron beyond the cutter, and may be a *two-peel machine* as holding on that portion of its apron, the *peel-end* of the machine, but two-peel lengths of crackers. A *three-peel machine* has an apron of one half greater length beyond the cutter.

The complete cracker machine rolls and dusts the dough, cuts into crackers, biscuits, cakes, and snaps, separates the cracker from the scraps, and places the work on pans.

The process of cracker-making by machinery is as follows: In the first place, the flour is run through a sifter, then put into troughs, where all the ingredients are mixed in by hand and left to stand until the chemical process is completed. The material is then run through the dough mixer, and from thence several times through the dough brake. It is piled up on a table, covered with cloth, and left to stand until it is properly proved, or gets light, then run again through the brake several times, being doubled over each time, and finally rolled out in a long strip the proper width for the machine. It is then placed on the hopper board of the machine, and goes through the rollers, where it is reduced to the proper thickness, falls on the apron or carrier, passes under a revolving brush, then to the cutter, which is changed to cut different shapes. After the crackers or biscuits are cut, the sheet of cut dough passes to the fingers and scrap apron, where the scrap is run over the upper apron, and the crackers pass below and drop into pans placed on the lower or third apron, and the pans are then placed in the oven and baked, which requires from 7 to 15 minutes, according to the kind of goods being baked. The largest set of machinery and oven will bake from 50 to 70 barrels of flour into crackers in ten hours.

See also Prof. *Horsford's* "*Report on Vienna Bread*," "*Vienna Exposition Reports*," vol. ii., § B.

Crack'ing Ma-chine'. (*Milling.*) A machine for fine-lining the surface of a millstone. The scores increase the grinding efficiency. See MILLSTONE DRESSING MACHINE.

Crack'le Ware. 1. (*Ceramics.*) Fr. *craquelle.* Ware, the enamel of which has a multitude of fine cracks, making a sort of reticulated surface. The art is Chinese; but as an actual effect, though not designedly so, many wares overbaked have a cracked glaze. The Chinese had the art of giving the crackle to definite portions of the surface, so as to produce ornamental effects, and to vary the openness of the patterns.

2. (*Glass.*) Glass with a finely cracked exterior surface, for ornamental effect.

Cra'dle. (*Railway.*) The bed-frame of a freight car. For instance, see: —

Turton, * "*Engineer*," xlii. 328.

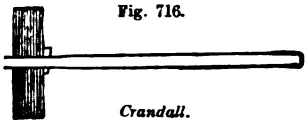
2. The infant's rocking crib.

Automatic, *Vandevort* . * "*Scientific American*," xxxiv. 99.
Attachment for bedsteads.
Robertson . . . . . * "*Scientific American*," xxxvi. 230.

3. (*Mining.*) A suspended scaffolding used in shafts.

Cran'dall. (*Stone Working.*) A hammer made up of a gang of pointed steel bars occupying a slot 3″ × ⅜″ in the head of the bar. There are 10 bars in the gang, pointed at each end, ¼″ square, and held by a key. Used for putting a certain kind of dressing on ashlar. See list of tools under Stone Working.

Fig. 716.



Crandall.

Cran'daled Stone Work. (*Stone Cutting.*) An ashlar dressed by dotting its surface with rows of points, made with a *crandall.* When other rows at right angles to the first are introduced the stone is said to be *cross crandaled.*

Crane. A lifting apparatus with a neck or jib from a planted post. The points which distinguish the crane, derrick, winch, sheers, whin, gin, etc., respectively, are given on p. 63 and elsewhere, and a list occurs on pp. 1110, 1111, "*Mech. Dict.*"

The cranes for handling the steel ingots at the Krupp works are shown in Fig. 41, Appendix L, "*Ordnance Report,*" 1877.

Austrian hydraulic cranes for handling heavy guns. *Ibid.*, Fig. 35.

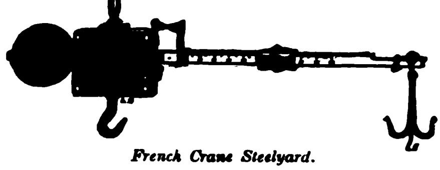
The new crane of Woolwich, England, which has occupied four years in construction, exceeds 1800 tons in weight, and is capable of lifting 1200 tons.

See also Railway Crane; Balance Crane.

See Automatic, *Watson*, Br. . . * "*Engineer*," xlv. 53.
Crab bucket, *Wilson*, Br. . . . * "*Engineer*," l. 279.
Locomotive, *Dubs & Co.*, Br.. . * "*Engineering*," xxiii. 510.
Black, Hawthorne & Co., Br. * "*Engineering*," xxii. 312.
Appleby . . . . * "*Sc. Amer.*," xxxiv. 147.
Coaling locomotives, *Wendt*, Ger. * "*Engineer*," xlix. 120.
Portable, *Wilson*, Br. . . . . * "*Engineer*," l. 279.
70-ton, *Taylor*, Dundee, Br. . . * "*Sc. Am.*," Nov. 6, 1875.
100-ton, } Creusot, Fr. . . . . * "*Engineer*," xlv. 335.
160-ton, } Creusot, Fr. . . . . * "*Sc. Amer. Sup.*," 2051.
Traveling (Belgium). . . . . * "*Sc. Amer. Sup.*," 744.
Traveling . . . . * "*Sc. Amer. Sup.*," 658.
Steam, Paris Exposition . . . * "*Exposition de Paris*," No. 54, Mar., 1878.

Crane Steel'yard. One suspended from the jib of a crane to weigh objects in transitu. *Romaine en l'air.*

Fig. 717.



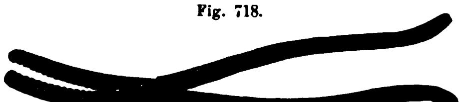
French Crane Steelyard.

Cra'ni-o-clast (*Surgical.*) A forceps for crushing the fetal skull.

Simpson's, Fig. 532, Part III., *Tiemann's* "*Armamentarium Chirurgicum.*"

Cra'ni-ot'o-my For'ceps. (*Surgical.*) An alligator forceps for crushing the fetal skull in cases of obstructed labor.

Fig. 718.



Dr. Meigs' Craniotomy Forceps.

Crank. See the following references: —

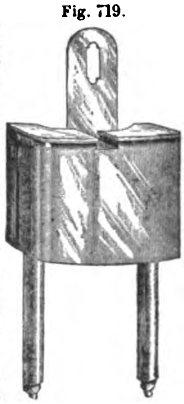
Axles, modes of forging, *McLean* * "*Iron Age*," xxiv., Sept. 25, p. 1.
Bending appa. hyd., *Clarke*, Br. * "*Engineer*," xlv. 438.
Pin driver, *Shaffer* . . . . . * "*Am. Manuf.*," May 23, 1879, p. 13.
Pin turner, *Webb*, Br. . . . . * "*Eng'ing*," xxviii. 260.
Shaft, "Trenton," . . . . . . * "*Sc. Amer. Sup.*," 415.
Shaft repair, "Colima" . . . * "*Sc. Amer. Sup.*," 491.

Crank and Fly'wheel Steam Pump. A form of steam pump, as distinct from the *direct acting.*

A crank shaft and rods is interposed between the steam cylinder and pump cylinder.

Crank'-pin Cup. A lubricator for the crank of an engine. The instance in Fig. 719 is one for a propeller. The great and constant strain renders special provision necessary; as it was aforetime with the paddle-wheel shafts, which lifted at each revolution a quantity of oil and poured it on the journal.

Fig. 719.



Crank-pin Cup for Propeller Engine.

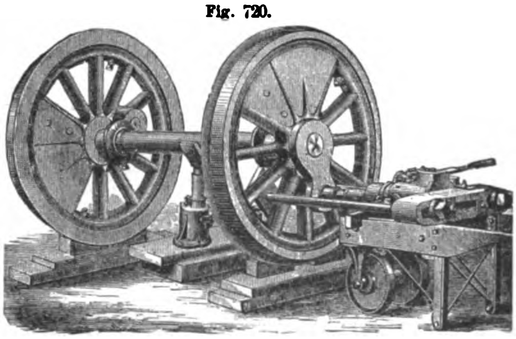
Crank'-pin Jack. An application of the hydraulic press to the pressing on or off of the crank pins of locomotives. The press is supported on a barrow, and is shown as supported by tie bars from the wheel in the act of pressing in a crank-pin. "*Railroad Gazette*" . . * xxi. 550.

Crank'-pin Turn'er. A machine for turning crank-pins in position, and while the wheels are under the engine.

It is fastened by means of scroll and self-centering jaws at one end, to the collar of the crank pin, upon which there is no wear. It is then clamped in position by bolts passing through the spokes of the driver. The tail-stock center is then run up, and if the pin is not bent will fit in the old center, and the machine is ready to operate. The cutter is driven and fed either way by the crank and intermediate gearing which gives motion to the screw. The cutter is bent and fastened by a set screw in the extreme end of the cutter bar.

"*Iron Age*," . . . . * xx., Nov. 29, p. 1.
"*Mining & Scientific Press*" . . . . * xxxvi. 278.

Fig. 720.



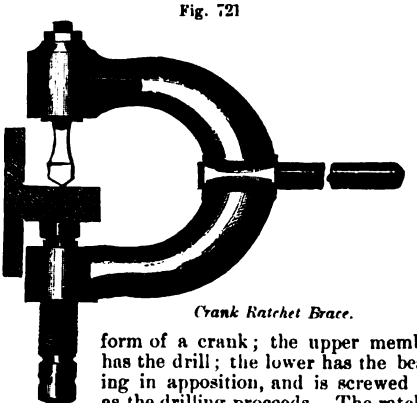
Dudgeon's Crank-pin Jack.

Crank Pla'ner. A metal-planing machine, in which the tool stock is moved on ways above the bed by pitman attachment to a wrist on a crank wheel.

A special machine, for planing cranks, having a short and rapid or variable stroke, is made by Hull & Belden. It has the usual horizontal bed on track; 12″ at full stroke, and Whitworth quick return motion. Cross and angular, or cross and down feed, as desired. The screw runs the length of the bed, enabling the operator to change position of stroke.

Crank Ratch'et Brace. A ratchet brace in

Fig. 721



Crank Ratchet Brace.

form of a crank; the upper member has the drill; the lower has the bearing in apposition, and is screwed up as the drilling proceeds. The ratchet is in the upper head, so that the drill moves only during the effective stroke. See RATCHET BRACE.

Crate Hasp. Hinged hasp and staple for securing the lids of boxes and crates.

Fig. 722.

Crate Hinge.

Cray'on Cut'ter. For pointing crayons: two circular rasps on a lathe arbor set obliquely so that their interval gives the required chamfer to the crayon point. The *chamfering machine* for wood, though on a very much larger scale, may give an idea of the apposition of the rasps.

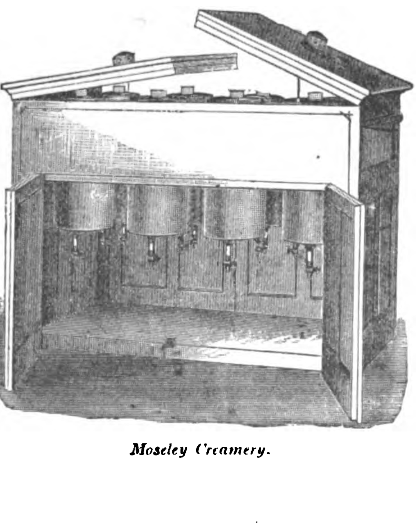
Cray'on Mold. A hinged mold in two parts, each containing a series of semi-circular depressions, the corresponding parts of each, when the mold is closed, form cylinders, in which the crayon material is molded.

Cream'e-ry. An apparatus or closet, with facilities for cooling or heating, in which to place milk jars under favorable conditions for cream-raising.

The *Ferguson* bureau creamery is a large press with shelves for cream, inclosing doors, and with a cupboard above for ice, and one below for the heater which is used in winter. U. S. Patent, August 22, 1876.

The *Moseley* creamery has deep cans suspended in a closet, and with means for drawing off the milk beneath, in lieu of skimming the cream.

Fig. 723.



Moseley Creamery.

The *Scoville* creamery has a wooden box designed to be set in the ground, and has pipes for entry and discharge of spring water. The deep tin pails have cream gages in inches at the sides.

Fig. 724.

Scoville Creamery.

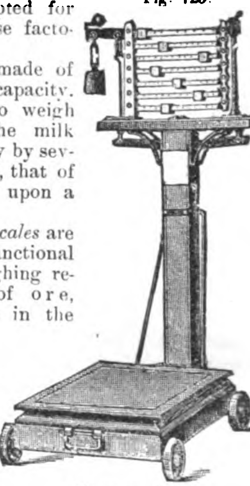
Scovill Creamery	* "*American Inventor*," iv. 173
Cream raiser, *Plumb* . . .	* "*Sc. American*," xli. 7.
Weldon	* "*Sc. American*," xl. 184.

Cream Ware. (*Ceramics.*) *a.* A name given by Wedgwood to a fine, light, yellow paste, invented by him in 1762. He also called it *queensware*,—a compliment to Queen Charlotte.

b. The ordinary *queensware* of the present is *stone ware.*

Cream'e-ry Scale. A scale with several beams, each having a sliding poise, specially adapted for creameries and cheese factories.

Fig. 725.



Creamery Scale.

Such scales are made of from 600 to 1,000 lbs. capacity, and are intended to weigh at a single draft the milk brought to the factory by several different persons, that of each being weighed upon a separate beam.

Furnace charging scales are made with the same functional arrangement for weighing respective quantities of ore, coke, and limestone in the same charge.

Creep'er. A spiral inside a revolving cylindrical grain screen to pass the grain towards the discharge end. A conveyor or a spiral on the inner surface.

Cre-ma'ting Car. One for burning bodies *in transitu* to the Columbaria, disposing of the corpse *en route. Decrescit eundo.* *Kuborn & Jacques.*

Furnace	"*Sc. Amer. Sup.*," 247.
Temple	* "*Sc. Amer.*," xxxvi. 49.
Turner, Temple at Woking, Br.	* "*Technologiste*," xli. 367.
In Japan	* "*Technologiste*," xli. 108.
Lissagaray, superheating . . .	* "*Technologiste*," xli. 496.
Moist system	* "*Technologiste*," xli. 508.

Cre-mom'e-ter. A specific gravity instrument of the hydrometer form, invented by Chevalier. The scale shows percentages in mixtures of water and pure milk.

Cre'o-so-ting Ap'pa-ra'tus. Apparatus for saturating timber with a solution, to prevent decay.

Bethel's English Patent, 1838.

The works of E. R. Andrews, South Boston, Mass., under Hayford's patent method of creosoting timber, are shown in "*Railroad Gazette*" . . . . * xxiv. 267.

See also cut 7337, p. 2811, "*Mech. Dict.*"

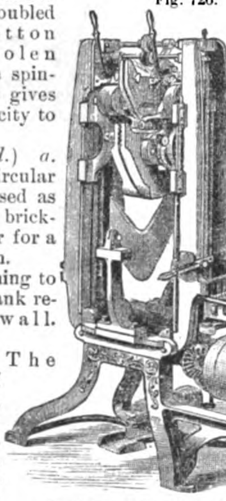
"*Iron Age*," . . . . xx., Dec. 27, p. 7.

See "*Treatise on Dry Rot in Timber*," by T. A. Britton, Spon.

Crest'ing. The ornaments or finials on the summits of iron posts, or along the rails of an iron fence, a balustrade, or on the crest of a roof.

Cre-tonne'. (*Fabric.*) A French dress goods woven on a taffeta loom: it has a doubled and twisted cotton warp, and a woolen weft. The close spinning of the warp gives a peculiar elasticity to the goods.

Fig. 726.



Jamison's Crimping Machine.

Crib. (*Add.*) *a.* (*Mining.*) A circular frame of wood, used as a foundation for bricking in a shaft, or for a pneumatic caisson.

b. A timber lining to a shaft, or the plank revetment of a wall. *Cribbing.*

c. (*Fishing.*) The bowl or pound of a POUND NET, which see.

Crib Break'-wa-ter. One made of logs or timbers notched into each other in the manner of a log house. See instance in Breakwater at Michigan City, Ind.

"*Report of Chief of Engineers, U. S. Army*," 1879, * ii., page 1588.

Crib Dam. One made log-house fashion, supporting a bank of earth which holds the water.

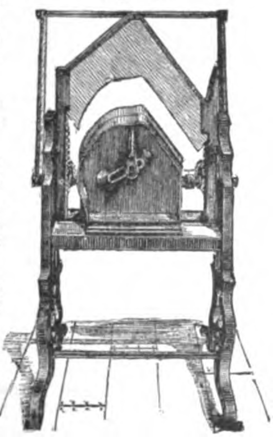
See plans and sections of a dam at New Harmony Cut-off, on the Wabash River. "*Report of Chief of Engineers, U. S. Army*," 1879, * ii., 1440.

Kanawha River, *Ibid.*, 1878, * ii. 467.

Rock Island, Ill. "*Report of Chief of Ordnance, U. S. A.*," 1877, * 354, and Plate XII.

Fox River, Wis. *Ibid.*, 1876, vol. ii., Part II. Appendix x. 4, p. 416.

Fig. 727.



Makepeace Crimp Brake.

Crib Muz'zle. (*Manége.*) A muzzle used to correct the equine habit of cribbing.

Crimp Brake. See CRIMPING MACHINE.

Crimp'ing Ma-chine'. 1. (*Sheet Metal Working.*) A machine for crimping the tops and bottoms on can bodies.

2. A machine for crimping the ends of stationary blind slats. An effective machine swages the ends of 150 slats per minute.

3. A machine for crimping uppers of boots and bootees. The piece of leather is forced over a curve-edged board to give it shape.

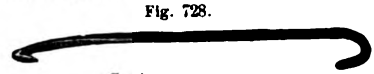
The *Jamison* machine, Fig. 726, has a pair of descending cheeks which slip over the sharp edge of the bent former, crowding the leather over the latter and pressing it at all points, to prevent wrinkles, and to produce regular thickness. It is driven by power.

The *Makepeace* machine, Fig. 727, is driven by hand, and the action is the reverse of the other machine, the bent former descending and crowding the leather into the slit between the two cheeks, which press forcibly against it and smooth out all wrinkles.

The French *cambreuse*, of *Pilon*, Mans, France, operates in yet another way, the jaws ascending to press the leather over the suspended and rigid former. It is specially intended for making upper and back in one piece, and joining at the back (*bottes d'officier, dites "jointure derrière"*).

Croch'et. (*Surgical.*) An obstetric hook for withdrawing the fetus.

Fig. 728.



Crochet, or Blunt Hook.

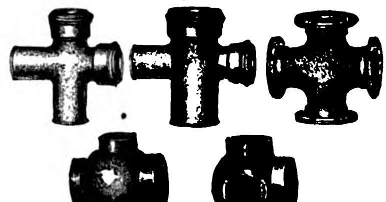
Crooke's Mill. Another name for the radiometer of Professor Crooke. See RADIOMETER.

"*Manufacturer and Builder*" . . . * ix. 229, 241.

Crop'per. A powerful hand machine for shearing off bolts or rod iron. It has holes of varying diameters for different sizes of iron, and the shears operates by a long lever.

Cross. A quadrangular pipe coupling.

Fig. 729.



Pipe Crosses.

a. Cross; two bell ends. *b.* Reducing cross; two bell ends. *c.* Four-flanged cross. *d.* Reducing globe cross. *e.* Corner-fitting globe cross.

Cross'-bar. (*Fire-arms.*) The small bar in a break-joint breech-loader, which, when the barrels are falling, presses out the extractor.

Cross'cut Saw. *Hand.* Crosscut saws are one or two-handled, see p. 649, "*Mech. Dict.*"

Power. The cross-cutting sawing machine, for the woods, is usually a *drag* saw, of which one instance is given in Fig. 1522, p. 649, "*Mech. Dict.*"

Cross-cutting machines for the factory are described under CUTTING-OFF SAW, which see.

See also BRACKET CUTTING-OFF SAW.

Cross File. One having curved faces unequally convex.

Cross-gain'ing Ma-chine'. A machine for cutting gains or slots in timbers crosswise of the grain or stuff. See Fig. 2144, p. 935, "*Mech. Dict.*"

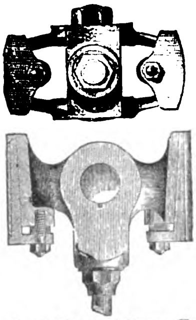
Cross Head. 1. The cross-bar on the end of a connecting-rod or piston, having gibs on each side to fit the slides.

In the instance given, the cross-head has adjustable gibs on each side, turned to fit the slides, which are cast solidly in the frame, and bored out exactly in line with the cylinder. This permits it to freely turn on its axis, and in connection with the adjustable boxes in the connecting-rod, allows a perfect self-adjustment to the line of the crank-pin. Fig. 730.

2. (*a.*) A cruciform-shaped four-handled bar, at the upper end of a drill-rod or earth-auger, and by which the latter is turned; used for drilling or sounding wells or shafts. Fig. 731.

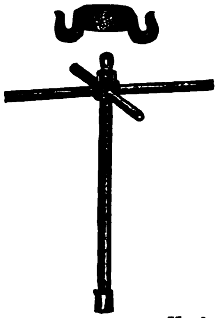
(*b.*) A sleeve with hooks for the suspension tackle of a well-drill. Fig. 731.

Fig 730.



Cross Head of Steam Engine.

Fig. 731.



Well Drilling Cross Heads.

Cross-head, locomotive, *Alexander.* * "*Sc. Am.*," xxxv. 246.

Cross-peen' Ham'mer. One the *peen* of which is crosswise of the direction of the handle.

Cross Rais'ing Ma-chine'. A machine for cross raising the nap of cloth.

Fig. 732.

Cross-peen Hammer.

In cotton machinery a machine for this purpose carries bands of cards by a circular motion in one direction over the face of the cloth.

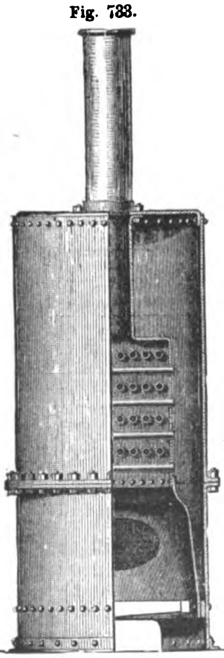
In Delamare & Chandelier's machine (Rouen, France), the cloth is carried by and is stretched across a pair of rollers; over the suspended part of the cloth, rollers covered with metallic cards revolve in a direction at right angles to that of the traverse of the fabric; these rollers have at the same time a to-and-fro motion across the piece, so as to insure their action upon the whole width of the piece.

"*Bulletin of the Industrial Society of Rouen*," reported in the "*Textile Manufacturer*" and "*Scientific American Sup.*," * 2581.

Cross Tube Boil'er. In the usual vertical form, this boiler has one or more horizontal cross tubes, 6″ to 8″ in diameter, placed across the fire-box. See VERTICAL BOILER. The water circulates in these while the heated gases pass around them, and are then conducted by a straight flue to the chimney.

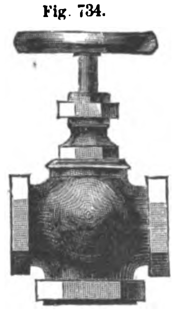
Fig. 738 is another form in which the tubes are smaller and more numerous. The upper and lower portions of the shell are connected by flanged joints bolted together, and the uptake is secured to the crown-plate in a similar manner. The lower part of the fire-box is circular, but above the fire-door it is worked into a square form to receive a square upper box, into which are fitted a number of parallel tubes of such diameter as may be most suitable for the size of boiler and the heating surface required. These traverse horizontally the flame space, the volatile products passing upward among the tubes and escaping by the vertical central flue. The tubes connect the water-space which forms a jacket around the fire-box and flue.

Fig. 733.



Appleby's Cross Tube Boiler. (*British.*)

Fig. 734.



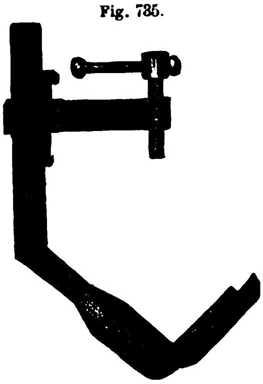
Cross Valve.

Cross Valve. A valve at the crossing or rectangular divarication of a pipe. Fig. 734.

Croup Ket'tle. (*Surgical.*) A small kettle and alcohol lamp for quickly raising a steam for inhalation in cases of croup.

Crow. An implement for gripping beneath a main and holding a tapping-brace above it, when tapping street mains.

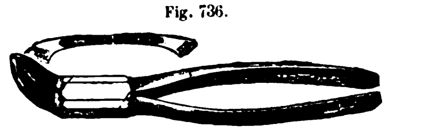
Fig. 735.



Crow.

Crowd'ed-teeth For'ceps. (*Dentistry.*) A narrow-beaked full-curved forceps for removing superfluous teeth which mar the symmetry of the row.

Fig. 736.



Crowded Teeth Forceps.

Crown Arch. An arched plate over a furnace supporting the crown sheet.

Darby's crown-arch for locomotive fire-boxes replaces the ordinary crown bars by an arched plate, 5-16″ thick, with a rise in the center of 6½″. This is riveted at each end of the crown sheet and then stayed in the ordinary way between the ends, with 7-8″ bolts spaced 4½″ from center to center. Angle iron is riveted to the top, to which suitable sling stays are attached.

"*Railroad Gazette*" . . . . * xxii. 356.

Crown Bar. (*Locomotive.*) One of the bars supporting the crown sheet of a boiler.

Crown Poun'cing Ma-chine'. (*Hat Making.*) A machine for pouncing the crowns of hats. The name is derived from pounce or fine sand, and the operation consists in sand-papering the surface of the hat body, or the hat after it has been blocked. See POUNCING MACHINE.

Crown Tel'e-phone. An instrument consisting of two magneto-electric crown telephones united. Each of these consists of a coil, diaphragm of iron, and six permanent magnets, which latter are placed with their like poles together in the center of the coil, the other poles being bent round, into contact with the periphery of the diaphragm. Thus the diaphragm forms the other pole to that within the coil, and in this way the magnetic field is intensified. In the double-crown form the two diaphragms are separated by an air-chamber, with a mouth-piece or orifice, into which a person speaks. The coils are so connected in circuit that the vocal currents generated in each coil strengthen one another. — *Phelps.*

"*Telegraphic Journal,*" vi. 399. See also *Hinkley's, Ibid.,* * vi. 476.

Crown Tre-phine'. (*Surgical.*) A crown saw used in removing sections of the cranium. *b*, Fig. 6647, p. 2624, "*Mech. Dict.*"

Cro'zing Ma-chine'. A machine for making the grooves in casks to receive the edges of the heads.

The work when done by machinery is usually combined with chamfering and howeling and sometimes with leveling.

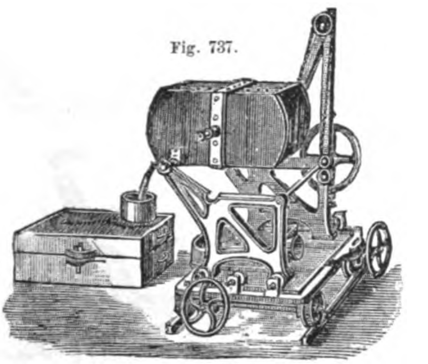
See BARREL CROZING MACHINE; CHAMFERING MACHINE; see list under BARREL MACHINERY.

"*Manufacturer & Builder*,"	* xi. 55.
Steel & Munson's machine	Patent Nos. 160, 966.

Cru'ci-ble Fur'nace. One of the most notable departures in crucible furnaces is that of M. Piat, of Paris, in which the crucible and furnace are moved together to the place where the casting is to be made.

The crucible is fixed within the furnace wall, the weight of both coming upon trunnions when they are lifted from the

Fig. 737.

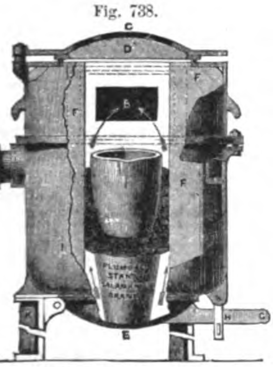


Piat's Crucible Furnace on Movable Carriage.

lower furnace wall. The space between the crucible and the refractory lining of the furnace wall is filled with combustible, the ashes from which fall through holes in the furnace into the ash-pit when the crucible is over the draft. It is moved on a car or by crane to the place of casting, and tipped on its trunnions to pour the metal.

Fletcher's annular hot-air furnace for melting metals has no fire-bars, but a dished bottom secured by a lever. The draft from the fan is admitted at *A*, and courses through the ducts around the fire-clay lining *F*. The crucible stands on a fire-clay pillar and is surrounded by fuel, the gaseous products escape at *B*. *C* is the hinged cover or lid with fire-clay lining *D*. *E* is the hinged bottom with lever *G* and detent *H*. *I* is the outer case or lining, *K* the legs of the stand.

Fig. 738.



Hot-air Crucible Furnace.

The French *calebasse*, a form of crucible used in Europe in melting quantities of iron below the usual duty of a cupola, is shown in *Laboulaye's* "*Dictionnaire*," etc., i., Figs. 355–357, ed. 1877, article "*Calebasse*."

On Crucibles, *Kirk*	"*Iron Age*," xxi., May 9, p. 3.
Furnace	* "*Sc. American*," xlii. 35.
Annular, *Fletcher*, Br.	* "*Engineer*," xlvi. 74.
	* "*Sc. American Sup.*," 2271.
Tilting, *Piat*	"*Iron Age*," xxii., Aug. 29, p. 9.
	* "*Sc. American Sup.*," 2111.
Making crucibles	* "*Sc. American*," xxxvii. 242.

Cru'ci-ble Steel. (*Metallurgy.*) Steel made in crucibles. The Indian plan for making wootz. The invention of *Huntsman*, of Sheffield, England. Cast steel.

Cruik'shank Bat'te-ry. (*Electricity.*) The original trough battery invented by Cruikshank. The partitions forming the cells in the trough were composed of two plates of copper and zinc soldered together and the spaces filled with acidulated water.

Niaudet, Am. trans. . . . . * p. 14.

Crush'er. A machine for degrading rock, fossil manure, etc. See STONE CRUSHER, DISINTEGRATOR, etc.

See *Blake*	* "*Min. & Sc. Press*," xxxiv. 257.
(New)	* "*Sc. American*," xlii. 210.
Stone, ore, etc., *Blake*	* "*Sc. American*," xliii. 210.
Mill, *Walker*	* "*Sc. American*," xxxix. 341.
Baugh	* "*Eng. & Min. J.*," Nov. 4, 1876.

Crush'er Gage. A registering instrument exposed in the bore of a gun to measure the pressure developed by the explosion of a charge. See PIEZOMETER; CUTTER.

To illustrate: a 16-ton steel gun of Vavasseur, fired at Woolwich, had a projectile of 400 pounds, 70 pounds of pebble powder made up into a cartridge 25″ long. The charge being fired at the center, the crusher gage at the rear of the charge showed a pressure of 21 tons to the square inch, the gage at the base of the shot, 18 tons; initial velocity of the shot 1412′ per second. The charge fired at the base, the gage gave pressures of 45.1 and 50.1 tons respectively at the rear of the charge and base of the shot.

"*Engineer*"	Sept. 16, 1870.
"*Scientific American*"	xl. 133.
"*Scientific American*"	xlii. 393

Cry'o-lite. Greek *kryos*, "ice," *lithos*, "stone," from its beautiful snowy appearance. This mineral is a double fluoride of sodium and aluminium, and has long been known in cabinets, and to chemists, but has but lately assumed commercial importance.

It has been found at Miask, in the Ural Mountains, in limited amounts, but its great source is the west coast of Greenland, where it is procured in immense quantities at Ivigtout, on Arsuk Fiord, between Julian's Hope and Frederick's. The main deposit here forms a mass, according to reliable authority, 600′ in length, and 200′ in width, and descending to an unknown depth.

The mineral occurs in partially translucent masses of a snowy white color, having very much the appearance of snow ice, whence its name. It is frequently associated with galena, blende, iron and copper pyrites, and spathic iron ore.

In 1850, Julius Thomsen, a Danish chemist, discovered a cheap method of rendering cryolite available for the manufacture of soda and alum.

The employment of Greenland cryolite in the manufacture of aluminium is attributed to Rose, of Berlin. It is also used in the later Deville aluminium process. See ALUMINIUM.

Cryolite is largely used by the Pennsylvania Salt Manufacturing Company at Natrona, Penn., and a number of cryolite products are there made.

It has been used also in making what has been variously called "cryolite glass," or "hard porcelain," a vitreous semi-translucent material, well fitted for some purposes. The proportions used are about, cryolite 1, sand 3; the resulting glass is easily molded and cut, and is noted for its tenacity. See CAST PORCELAIN.

For the milky variety a mixture is employed consisting of the following materials: One part of oxide of zinc, four parts of cryolite, and ten parts of sand, fused in a common pipe-clay crucible, developing a large amount of fluosilicic acid. The pipe-clay is, however, not much attacked by it. This development continues throughout the fusion, and even after it, during the working, to a small extent.

"The utilization of cryolite depends upon Thomsen's observation, that the mineral may be completely decomposed by treatment with lime, either in the wet or dry way, the products of this treatment being, generally speaking, caustic soda, aluminate of sodium, and fluoride of calcium. The ease with which this decomposition can be effected, and the notable percentage (35 per cent.) of soda which the mineral thus yields, renders it a very valuable commercial source of soda and its compounds. The alumina which it contains is used for the production of alum salts.

"Where the dry process is employed, the cryolite is dried, ground to a fine powder, and mixed with slaked lime, or with pulverized chalk, in such proportions that for each equivalent of cryolite there shall be about six of lime. This mixture is then calcined in a furnace at a dull red heat, — not sufficient, however, to fuse it. After a charge has cooled, it is lixiviated, and the dissolved soda and aluminate of soda drawn off from the insoluble residue (fluoride of calcium). By passing carbonic acid gas (obtained from the combustion of coke) through this solution, the soda is converted into the carbonate, and the alumina is precipitated.

"In the wet process, the cryolite is boiled with milk of lime; and according to the proportions of lime employed, the resultant products are caustic soda and aluminate of sodium, or, where the proportion of lime is greater, caustic soda and aluminate of lime, fluoride of calcium being formed of course in both cases. The latter process gives all the soda of the cryolite in the caustic state, the only operation required being evaporation to dryness.

"The aluminate of sodium produced in the operation above described is used in the manufacture of soaps, in place of soda and potash lye. It is completely decomposed by passing carbonic acid gas through it, and the resulting alumina which is precipitated is converted into sulphate of aluminium and alum. The fluoride of calcium, which is a by-product of the treatment of cryolite, is used as a flux in the reduction of gold, iron, and other metals." — *Polytechnic Review.*

See the following references: —

"*Iron Age*,"	xx., Sept. 13, p. 7.
"*Scientific American*,"	xxxv. 375.
"*Scientific American Sup.*," (uses).	990.
"*Manufacturer & Builder*,"	ix. 215; xii. 192, 256.
"*Mining & Scientific Press*"	xxxviii. 177.

Cryp'to-graph. An apparatus designed for secret correspondence.

A metallic plate is perforated with holes.

A tablet is marked off with squares. A plate of the same size and rulings is perforated at a number of the squares in an irregular manner. The plate being laid on the tablet, the message is written, the letters in the consecutive holes as they may run in the line and succeeding lines. The plate is then rotated one quarter round and the message continued, so on for the other two positions of the plate. The result is a confused lot of letters with breaks of continuity. It may be read by a similarly perforated plate laid on the paper, and moved successively as by the writer.

Crys'tal. (*Glass.*) Another name for *flint glass*; a silicate with a base (usually) of lead and potash; but the Bohemian has a base of lime and potash.

Cube Pow'der. Large grained gunpowder for slow burning in large charges in heavy ordnance. *Prismatic powder.*

"*Engineer*" . . . Sept. 16, 1870; March 17, 1876, p. 185.

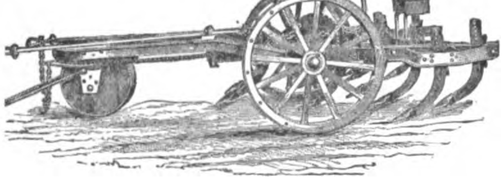
Cu'bic Foot Meas'u-rer. An apparatus used in estimating and testing gas.

Goodwin . * "*Am. Gas-light Journal*," July 3, 1876, p. 4.

Cuff Frame. A knitting machine specially constructed for knitting cuffs for cardigan jackets and underwear Campbell & Clute.

Cul'ti-va'tor. Fig. 739 is the turning cultiva-

Fig. 739.



Steam Turning Cultivator. (*Fowler & Co., Leeds, England.*)

tor, adapted to be worked by all systems of steam-plow machinery. It may carry from 5 to 13 tines, and rests on 3 wheels, one of which is the steering-wheel. The axle of the two hind-wheels is cranked, so that by its being turned the frame is raised or lowered, and by this means the penetration of the tines adjusted.

The long end of a draft bar or turning lever is provided with two arms to which the two ends of the rope are attached. The arms are set at an angle for keeping the tail rope clear of the implement. The lever itself is held by a vertical stud fixed to the frame considerably behind the steering-wheel. This position of the draft-stud gives the necessary liberty and power to the steering-wheel and enables it to lead the implement at almost any angle out of the line of the pulling-rope.

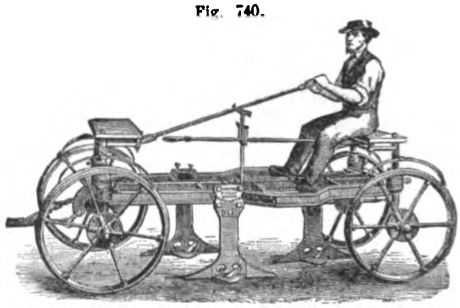
On the short end of the turning-lever is a chain communicating with a quadrant on the crank-axle, and as the lever is pulled round, the chain, acting on the quadrant, turns the axle, lifts the frame, and raises the tines out of the ground.

The plan of operation is as follows: As soon as the cultivator is brought up to the headland, the reverse pull brings the lever around, turns the quadrant, rotates the bent axle, and lifts the tines out of the ground, in which position the cultivator frame is held up by a catch; when lifted the required height, the lever strikes against a stop, and the implement turns into new ground. The man, who never leaves his seat, releases the catch, the tines drop into the ground, and the implement is re-drawn across the field.

This, after the plow, is the most important and efficient implement of the series. Its size is only limited by the power of the engines, which are thus used up to their capability. It pulverizes the soil, working steadily to a uniform depth. The largest machines require but one man in attendance upon them.

Fig. 740 shows the steam cultivator for very deep working, say 16″. It may have 3 or 5 tines, which lift the soil and leave it loose. It has a strong flanged steel frame, shares of various widths from 2″ to 13″, and oblique wings to lift the soil. The tines rock on the frame, so that when the imple-

Fig. 740.



Double Action Steam Cultivator. (*Howard, Bedford, England.*)

ment is to return across the field the points at work are slightly depressed and the hinder points raised.

The *Deere* walking cultivator is shown in Fig. 741. It has the usual two double-shovel plows, attached to a two-wheeled frame with a tongue alongside of which are hitched the two horses which travel on the respective sides of the row under cultivation.

It is peculiarly open and clear, not obstructing the view of the crop, and the spring coupling lifts the plows on their pivots to any adjustable extent, so that a part of the weight is carried and they bear with any desired force upon the ground to turn a moderate furrow when the corn is small, or a deeper one when the crop is more matured. The pitch of the shovels is also adjustable by vertical adjustment of the end of the beams. The distance apart of the shovels is adjustable. One of the wheels is broken to expose the parts more fully.

Cultivators are classed as: —

Ordinary,	Disk,
Wheeled,	Walking,
Rotary,	Riding,
Straddle-row,	Vineyard.
Parallel.	Expanding.

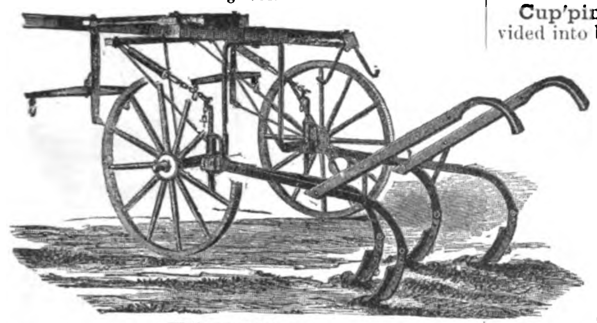
Besides these characteristic names, several of which apply to single implements, as for instance the popular Western implement, the *Walking, Straddle Row, Wheeled Cultivator,* there are several other classes of implements which naturally fall under so general a caption as cultivator: such are known as *scarifiers, extirpators, shovel plows, horse-hoes,* etc. Which see in "*Mech. Dict.*," *et infra.*

The author's report on Class 76 at the Paris Exposition shows the following ("*Paris Exposition* (1878) *Reports,*" vol. v., pp. 90-93): —

French horse-hoes.
French scarifiers.
English lever cultivator.
French extirpator.
"Peerless" cultivator, U. S., American riding cultivator.

English Five-tine horse-hoe and grubber.
Also: French vineyard cultivators, Figs. 221-231, pp. 216-240.
English steam cultivators, Figs. 84-88, pp. 83-86. *Ibid.*

Fig. 741.



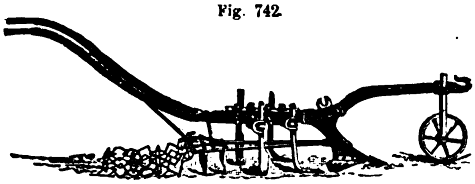
Walking Cultivator.

Cultivator for beets, French, *Bertel.* "*Dept. Agric. Spec. Rept.*," No. 28, Plates V., VI.
Cultivator with saws, *Stone* * "*Scientific Amer.*," xxxv. 4.

Cul'ti-va'tor Plow. Fig. 742 shows an English single-row horse-hoe or cultivator plow, made for cultivating root crops in drills. The implements can be adapted either for flat or ridge cultivation.

The share with lateral wings precedes, and is followed by cultivator shares, these by harrow tines, and lastly by a chain harrow.

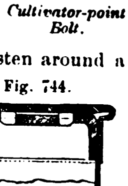
Fig. 742.



Cultivator Plow. (*Corbett & Peale, England.*)

Cul'ti-va'tor-point Bolt. A bolt of peculiar form used to connect the shares of cultivators with their standards or sheths. The head has two flat sides and two straight bevels, as shown in Fig. 743, to adapt it to the two-sided countersink of the shovel.

Fig. 743.



Cultivator-point Bolt.

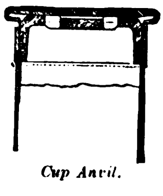
Cup. An oil cup. See Crank Cup; Oil Cup; Lubricator.

Cup An'vil. A cup-shaped reinforce inside the head of a cartridge to strengthen it. Fig. 744. See also Disk Anvil, U. S. Ordnance "*Report on 'Metallic Cartridges,'*" 1873, Plates XXIX., XXX.

Cup Leath'er. A leather to fasten around a pump plunger or bucket. Cups are made like sleeves for buckets and with solid bottoms for plungers.

Quilted cups are used for hot liquors.

Fig. 744.



Cup Anvil.

Cu'po-la. A melting furnace in a foundry. See p. 658, "*Mech. Dict.*"

And tuyere, *Lawrence.* * "*Iron Age*," xviii., Oct. 5, p. 1.
Return flue, *McKenzie*, straight. * "*Iron Age*," xx., Oct. 18, p. 16; * xx., Nov. 8, 19.
Furnace, *Voisin*, Fr. . . . . * "*Iron Age*," xvii., May 18, p. 5.

Cup'ped Sound. (*Surgical.*) A urethral syringe with cup-like depressions on its surface.

Van Buren's, Fig. 52, Part III., *Tiemann's "Armamentarium Chirurgicum."*

Cup'ping In'stru-ments. (*Surgical.*) Divided into bloody and dry.

Bloody cupping. See Fig. 1552, p. 659, "*Mech. Dict.*," and Scarificator, Fig. 4662, p. 2052, *Ibid.*

Cupping glasses are shown in Roman tombs as emblems of the profession of the deceased.

Dry cupping. See Depurator, "*Mech. Dict.*;" Aërotherapy Apparatus, p. 8, *supra.* For Junot's arm and boot, see Arm; Boot.

Cup'ping Ma-chine'. (*Cartridge.*) The first machine in bullet-making. It has two stamps or dies, one working inside the other; the outer one cuts the blank out of a sheet of copper, and the next draws it into a cup-shape, making it ready for subsequent drawing in other machines.

Cup'ping Tool. A blacksmith's swage of cup shape, used in pairs. The one with a square shank stands in the hardy hole of the anvil. The other has a handle, and is struck by a hammer, the piece of iron under treatment being between the two cups.

Fig. 745.

Blacksmiths' Cupping Tool.

Cu'pro Man'ga-nese. See Manganese Bronze.

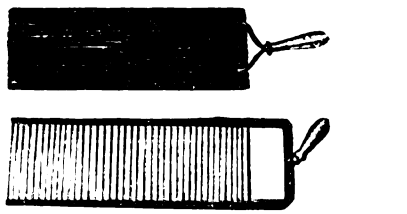
Curb. (*Mining.*) See Crib.

Curb Sen'der. (*Telegraphy.*) An instrument, the joint invention of Sir Wm. Thomson and Prof. F. Jenkin, designed to gain speed in the working of telegraphic cables by overcoming the *tailing out* of the signal.

The object is, that as soon as the receiving end has received sufficient current to move the indicator, the charge remaining in the cable should be immediately removed; that is to say, instead of putting the line to earth immediately after making contact with the battery, as is done by the ordinary sending key, the *curb-sender* automatically puts the line to the other pole of the battery, *i. e.*, the removal of the residual charge is effected by the application at the sending end of an electro-motive force opposite in kind to that by which the signal had been produced.

"*Telegraphic Journal*" . . . . * v. 27.
Sir W. Thomson, "*Engineering*" . . . . * xxiii. 103.
Thomson & Jenkin. Well illustrated paper in "*Jour. Soc. Tel Eng.* . . . . * v. 213, 248

Fig. 746.

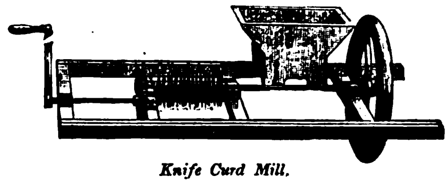


Curd Knives.

Curd Knife. A cutting implement passed through the cheese curd in the vat in order to divide it into small cubical blocks, to facilitate drainage from it of the whey.

The knives shown are perpendicular and horizontal respectively, and by suitably using each in turn the curd is equally and rapidly divided.

Fig. 747.



Knife Curd Mill.

Curd Mill. A cutting machine for dividing cheese curd into small fragments. In use the hopper (shown removed) is placed over the knives, which are rotated at a rapid rate by means of multiplying gear.

Cu-rette′. A scoop, loop, or finger, for removing foreign matter from a cavity. For instances: —

Hebra's bone scoop	Fig. 78 *b*, p. 22, Part I.
Buck's ear curette	Fig. 194 *a*, p. 44, Part II.
Speir's ear curette	Fig. 201, p. 45. Part II.
Daviel's eye curette . . .	Fig. 92, p. 27, Part II.
Emmett's curette forceps .	Fig. 105, p. 13, Part V.
Tieman's rectal curette . .	Fig. 57, p. 120, Part III.
Siemen's uterine curette . .	Figs. 295, 299, p. 74, Part III.
Sim's uterine curette . . .	Fig. 294, p. 74, Part III.

Tiemann's "Armamentarium Chirurgicum."

Quires' nasal and ear curette, "*Medical & Surgical Reporter*," July 3, 1880.

See also ENUCLEATOR.

Cu-rette′ For′ceps. (*Surgical.*) A long, narrow forceps, with hollow prongs to grasp and contain foreign substances in the process of extraction. See reference in CURETTE.

Curl′ing Stick. A slightly tapering hot-water tube, around which to curl the hair. — *Oppenheimer.*

Cur′rent. (*Electricity.*) The supposed flow or passage of electricity or electric force. It originates at the zinc surface in contact with the solution, and passes from the zinc to the copper or other negative metal *in the liquid* of the battery, and from the *negative* metal through the connections *externally* to the zinc. The quantity of current flowing through a given conductor is measured by the heat generated, by its influence on a neighboring permanent magnet, or by the amount of gas set free by its electrolytic action.

Cur′rent Ap′pa-ra′tus. (*Hydraulic Engineering.*) Devices used to ascertain the strength, rate, etc., of a current. See CURRENT METER.

Cur′rent Cool′er. (*Brewing.*) One for cooling a liquid *in transitu.*

Fig. 631, p. 264, "*Mech. Dict.*" Also, for Austrian forms, "*Scientific American Sup.*," Fig. 8, * 4077. Also forms of condensers, "*Mech. Dict.*," pp. 507–609.

Cur′rent Me′ter. The subject of current meters has been very carefully considered, and the apparatus tested in determining the velocity of the Connecticut River.

See "*Report of the Chief of Engineers, U. S. Army*," 1878, * ii. 304 and Plate VII. The plans adopted were by surface floats and the *Waltman* tactiometer.

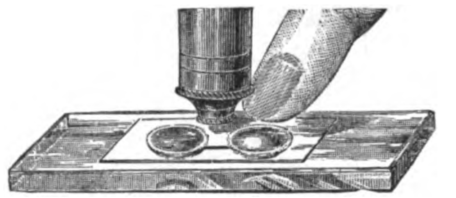
Cur′rent Reg′u-la-tor. An apparatus for regulating the motion of dynamo-electric machines.

That of Hospitalier is composed of a resistance bobbin, formed of insulated wire wound on in a single layer, and having each turn stripped of its insulating covering for about 0.4 of an inch at the same spot. A curved lever, controlled by an electro-magnet at one end, and by an adjustable spring on the other, moves forward or backward on the bare portion of the bobbin if the current weakens or strengthens, until the resistance is adjusted by the decreased or increased number of turns in the circuit, and equilibrium is produced.

Hospitalier	"*Telegraphic Jour.*," vii. 153; * 216
Maxim	"*Scientific American*," xliii. 255.

Cur′rent Slide. A device used in microscopy for the examination of blood. The slide is a slip

Fig. 748.



Holman's Current Slide.

of glass with two basins ground in it, and covered by a thin glass plate. A small canal unites the two cups, and the blood, which only partially fills the cups, is driven from one to the other by pressure of the finger on the cover, being examined in a thin film in transitu.

"*Manufacturer & Builder*" . . . . . . * xii. 205.

Cur′rent Wheel. One driven by the force of an open water current.

Cleaveland	* "*Am. Miller*," vii. 41; * 307.
Submerged, *Hill*	* "*Sc. Amer.*," xxxiv. 181.

Cur′tain. (*Hydraulic Engineering.*) A woven curtain of willows, used to reduce a current and promote deposit of silt. See WILLOW CURTAIN.

Cur′va-ture Ap′pa-ra′tus. (*Surgical.*) Apparatus for correction of spinal or other curvature.

The Figures refer to *Tiemann's "Armam. Chirurgicum."*

Shoulder brace	Fig. 3, Part IV.
Spinal caries apparatus	Fig. 14, Part IV.
Potts' curvature brace (posterior) . . .	Fig. 4, Part IV.
Lateral curvature brace (scoliosis) . . .	Figs. 7, 9.
Tibia brace for anterior curvature . . .	Fig. 75, Part IV.
Knock-knee brace	Fig. 74, Part IV.
Weak leg supporter	Fig. 69, Part IV.
Bow-leg brace	Fig. 78, Part IV.
Torticollis brace	Fig. 11, Part IV.
Wry neck brace	Fig. 18, Part IV.

See also CLUB-FOOT APPARATUS.

See also under various heads, in "*Mech. Dict.*," and list under SURGICAL INSTRUMENTS.

Curve. A bend in a pipe, less than a quarter. See BEND.

Curve In′stru-ment. Instruments for making curves by means of a pen connected with two pendulums swinging in planes at different angles to each other, or a pen to one pendulum and the paper platform to another; with discussions of the methods of Donkin, Tisley, Spiller, Knoblauch, Peaucillier, Lissajou, Woodward: "*Scientific American Supplement*," * 505, 726, 727.

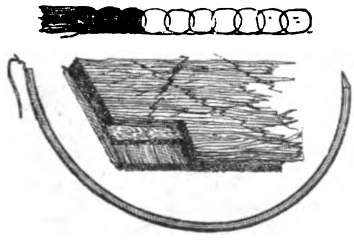
Delineator, *Scheffler* . . .	* "*Railroad Gaz.*," xxii. 491.
Measurer, *Dale*, Br. . . .	* "*Engineer*," xlvi. 223.
Curvograph, *Curve Scribe Co.*	* "*Man. & Builder*," viii. 186.
	* "*Iron Age*," xvii. May 25, p. 9.

Curved Mat′tress Nee′dle. (*Hydraulic Engineering.*) A needle for sewing brush mats with No. 13 wire. The brush is laid in two layers, with a stratum of hay between, and sewed in seams 4′ apart, and then diagonally; or the brush may be laid in two layers at right angles, and sewn diagonally at right angles. Fig. 749 shows the curved needle on a much enlarged scale; the form of stitch, and a piece of mat with portions of one corner removed.

Cush′ioned Ax′le. One with a rubber cushion interposed between the axle-box and the wood of the hub, in order to absorb the jar. See AXLE, Fig. 141, p. 62, *supra.*

Miller's . . . . . "*Iron Age*," * xx., Aug. 2, p. 18.

Fig. 749.



Mattress Needle.

Cush'ioned Ham'mer. A hammer with cushions interposed between the power and the hammer helve. See *Bradley's*, Fig. 6449, p. 2571, "*Mech. Dict.*"

Cus'pa-dore. A slop jar, or spittoon of vase-shaped pattern.

Cutch'er. (*Paper.*) The cylinder around which passes the endless felt in a paper machine.

Cu'ti-punc'tor. An instrument for puncturing the skin to introduce medicament. See Acupuncturator, Fig. 27, p. 12, "*Mech. Dict.*"

Dr. Sherwell's . . . . "*Medical Record,*" * Jan. 3, 1880.
Elliott's . . . . . . "*Scientific American,*" * xxxv. 22.

Cut'lers' Ce-ment'. For fastening blades of dinner knives in ivory handles; rosin, 4 parts; beeswax, 1 part; brick-dust, 1 part. Fill the hole in the handle with the cement, heat the tang of the blade, and press it into the handle.

Cutlery manufacture, *Sheffield* . "*Sc. Amer.*," xxxvi. 297.
Pocket . . . . "*Man. & Builder,*" xii. 155.

Cut'-off. 1. An apparatus used in steam engines to admit steam to the cylinder during a portion only of the stroke of the piston, allowing it to work expansively after the entrance of live steam from the boiler has been *cut off*.

Pages 665, 667, "*Mech. Dict.*," give illustrations, Figs. 1566–1571, of the cut-off arrangements of
Corliss.
Winter.
Stevens.
Allen.
Slide Valve.
Slide Valve, Merrick.
Sickels.

At the Paris Exposition, 1878, a great variety of cut-off valves was shown, the slide valve, however, being used by more than half the builders represented there. Double-beat valves, Corliss valves, and a few of piston form, were used by the remainder.

In all cases of slide-valve engines, except of very small ones, some arrangement for cut-off, by the use of an additional slide, was adopted; while in but few cases did the plan obtain of dividing the valve in two parts, that is, placing a valve at each end of the cylinder, so as to reduce the port contents, or distance from the under face of the valve to the cylinder, the advantage of which arrangement is apparent and would be considerable.

There were several instances in which an additional valve on the back of the main slide had some form of trigger release for working expansion, which, controlled by a governor, can close suddenly, while some few others used four separate slides — two for admission and two for exhaust — placed at the ends of the cylinder. Some of the compound engines had a single slide for both cylinders. There were some examples of receiving-valves, double-beat, above the cylinder, with slide valves for their exhaust placed below the cylinder.

The usual practice in horizontal engines is to place at least the exhaust valves underneath the cylinder, in order to allow ready escape for water, the receiving valves being on top of the cylinder; but there were examples where all four of the valves were below the cylinder or were arranged on its side. In engines having Corliss valves the usual arrangement was maintained of placing the valves above and below the cylinder.

The Wheelock engine valves are all beneath the cylinder.

Valve movements were in large variety in Paris, the most important being those having an automatic variable cut-off controlled by the governor. This point receives more attention in Europe than any other single feature in steam engines.

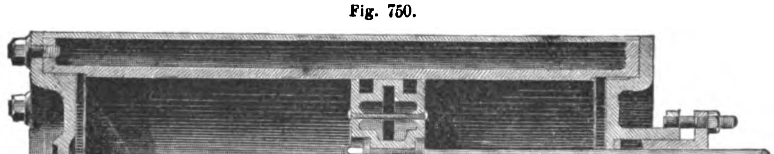
Many novel methods are in use, but all those using piston or double-beat valves employ some arrangement for tripper-gearing, by the introduction of a detent, or the alteration of the position of a wedge or incline. In some cases the motion is taken from the pitman, but generally from an eccentric on the main shaft or on a lay-shaft alongside, the governor controlling the position of the device for determining the point of cut-off.

Several automatic cut-off arrangements are in use in Europe with slide-valve engines, but the larger portion of them have some form of extra slide-valve, whose position is determined by right and left screws, the screw-shaft being rotated by the governor. Either this arrangement, or something its mechanical equivalent covers all, excepting those where the Rider gear is used and some other cases where the governor rotates an eccentric which varies the point of closure.

The Wheelock steam-engine furnished the power to operate the machinery in the United States, Swedish, and Norwegian sections at the Paris Exposition, and received a Grand Prize.

The peculiarities of this engine are a reduction to the simplest expression of the instantaneous cut-off valve, which forms the chief feature in the modern first-class engine. Side and sectional views of the cylinder are shown. Instead of four ports this engine has but two, one at each end of the cylinder, directly underneath it. There is at each end of the cylinder, close behind the port, one main and one cut-off valve, views of which are shown in Figs. 750 and 751. Each main valve has a cavity for exhaust, is slightly conical in shape, and is carried in hardened-steel bushes on hardened-steel trunnions

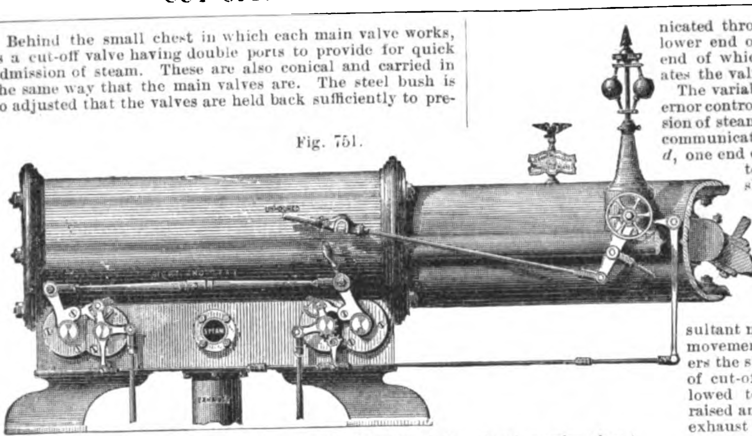
Fig. 750.



Wheelock's Steam Engine. (Longitudinal section through cylinder.)

Behind the small chest in which each main valve works, is a cut-off valve having double ports to provide for quick admission of steam. These are also conical and carried in the same way that the main valves are. The steel bush is so adjusted that the valves are held back sufficiently to prevent contact between the sliding surfaces, thus transferring the slight wear to the gudgeons and bushes, which would be inconsiderable in very long service. The cut-off valves are released by the action of the governor, and are closed by weights falling in dash-pots.

Fig. 751.



Wheelock's Steam Engine. (Side view of cylinder, showing valve glass.)

nicated through a lever, *a*, to the lower end of a toggle, *b*, the other end of which attaches to and operates the valve-stem, *c*.

The variable motion from the governor controls the duration of admission of steam into the cylinder, being communicated to the toggle by a rod *d*, one end of which attaches to the toggle and the other to a slide, *e*, carried on an arm, *f*, worked by the positive motion, the position of which slide on the arm is regulated by the action of the governor, through the rod *g*, the arm *h*, and the rod *i*, and the resultant motion gives a determined movement, which raises and lowers the steam-valve for all degrees of cut-off. The valve is never allowed to drop, but is quickly raised and quickly lowered. The exhaust valve may be operated in any convenient manner.

The arrangement not only reduces the clearance to a minimum, but guards against a trouble found in four-port cylinders, in a waste of steam through the exhaust-port if there be a leakage in the cut-off valve.

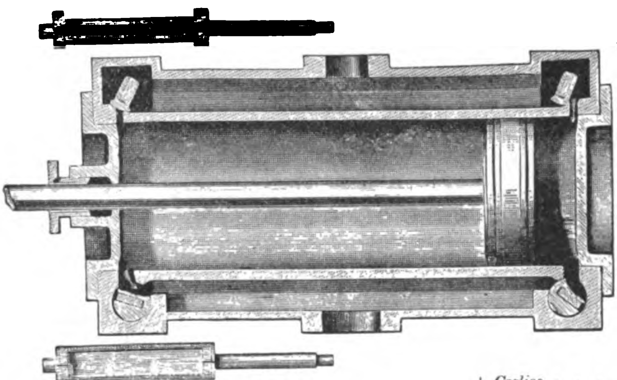
The mechanism for moving the valves is exceedingly simple and effective, easily gotten at, and not liable to excessive wear.

The packing-rings are self-adjusting segmental lap-joint rings, making an effective and tight piston. This was demonstrated on several occasions by removing a cylinder-head and operating the engine with the cylinder open.

The dimensions of the engine exhibited were —

Diameter of cylinder, 17″.

Fig. 752.



Corliss Steam Engine.

Length of stroke, 48″.
Diameter of fly-wheel, 14′.
Width of face, 25″.
Average steam pressure, 60 lbs.
Revolutions per minute, 62.
Estimated horse-power, 125.

The arrangement of the Corliss valves is shown in Fig. 752. There were in Paris many representatives of this form of engine from most European countries; although, as at Vienna, in 1873, Mr. Corliss personally did not exhibit, yet his engine was largely and admirably shown by other parties. See, also, Fig. 5666, p. 2341, "*Mech. Dict.*"

The steam-engine exhibited by A. Collmann, of Vienna, Austria, has an ingenious arrangement of valve-gear differing from the usual system of catches and pawls.

The engine is shown in a perspective view in Plate VIII., and in transverse section in Fig. 753.

The valves for the admission of steam are caused to operate by means of the combination of two motions, one of which, taken from the main shaft through miter-wheels, is constant, while the other, taken from a governor, is variable. Referring to the Plate, a constant motion is commu-

The following references may be consulted: —

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Gen. Engine & Boiler Co. * xxi. 357–359.
Corliss . . . . . . * xxviii. 154, 189, 487; * xxix. 324.
Corliss . . . . . . xxi. 187, 418, 356; xxii. 12.
Tremper . . . . . * xxii. 2.
Wanneick & Köppner . * xxiii. 173.
Coltman . . . . . * xxiv. 473; xxv. 46; * xxviii. 109.
Duvergier . . . . . * xxv. 428.
Dick & Stevenson . . * xxv. 184.
Winterthur. Brown . * xxv. 475.
Marshall . . . . . * xxvi. 31, 450, 453; * xxviii. 4, 24.
Sulzer Bros. . . . . * xxvi. 133.
Halpin . . . . . . * xxvii. 480.
Virck . . . . . . * xxviii. 187–90.
Hartnell . . . . . . * xxviii. 8.
Proell . . . . * xxix. 416.
Trappen . . . . . . * xxvii. 520.

"*Engineering and Mining Journal.*"

Buckeye Eng. Co. . * xxiii. 334; xxvi. 224.
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"*Mining and Scientific Press.*"

Dingley . . . . . * xxxvii. 361.
Wheelock . . . . xl. 257–265.
xl. 56, 364, 369.

"*Paris Exposition Reports.*"

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Collmann . . . . . . * iv 372.
Winterthur . . . . . * iv. 375.
Beer . . . . * iv. 376.
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Herman-Lachapelle . * iv 379
Brotherhood . . . . . * iv. 380.

"*Iron Age.*"

C. B. Brown & Co. xviii., Sept. 7, p. 7.
Buckeye Eng. Co. xviii., Sept. 7, p. 7
Corliss . . . . xviii., July 27, p 1.
Putnam Mach Co. . . . . . . xviii., July 27, p. 1
Wheelock . . . . xviii., Sept. 21, p. 3.
Woodruff & Beach . . . . . xviii., Sept. 21, p. 3.
Wetherell & Co. . . . . . . xviii., Sept. 21, p. 3.
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Prorter-Allen . . . . * xxii., Oct. 10, p. 1.
Tappen . . . . * xxiv., Aug. 7, p. 1.

"*Manufacturer and Builder.*"

Buckeye Engine Co. . . . . * xi. 73
Cobb . . . . * xi. 126.
Whitehill . . . . xii. 241.

"*Mining and Scientific Press.*"

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Crohn . . . . . * xli. 394.

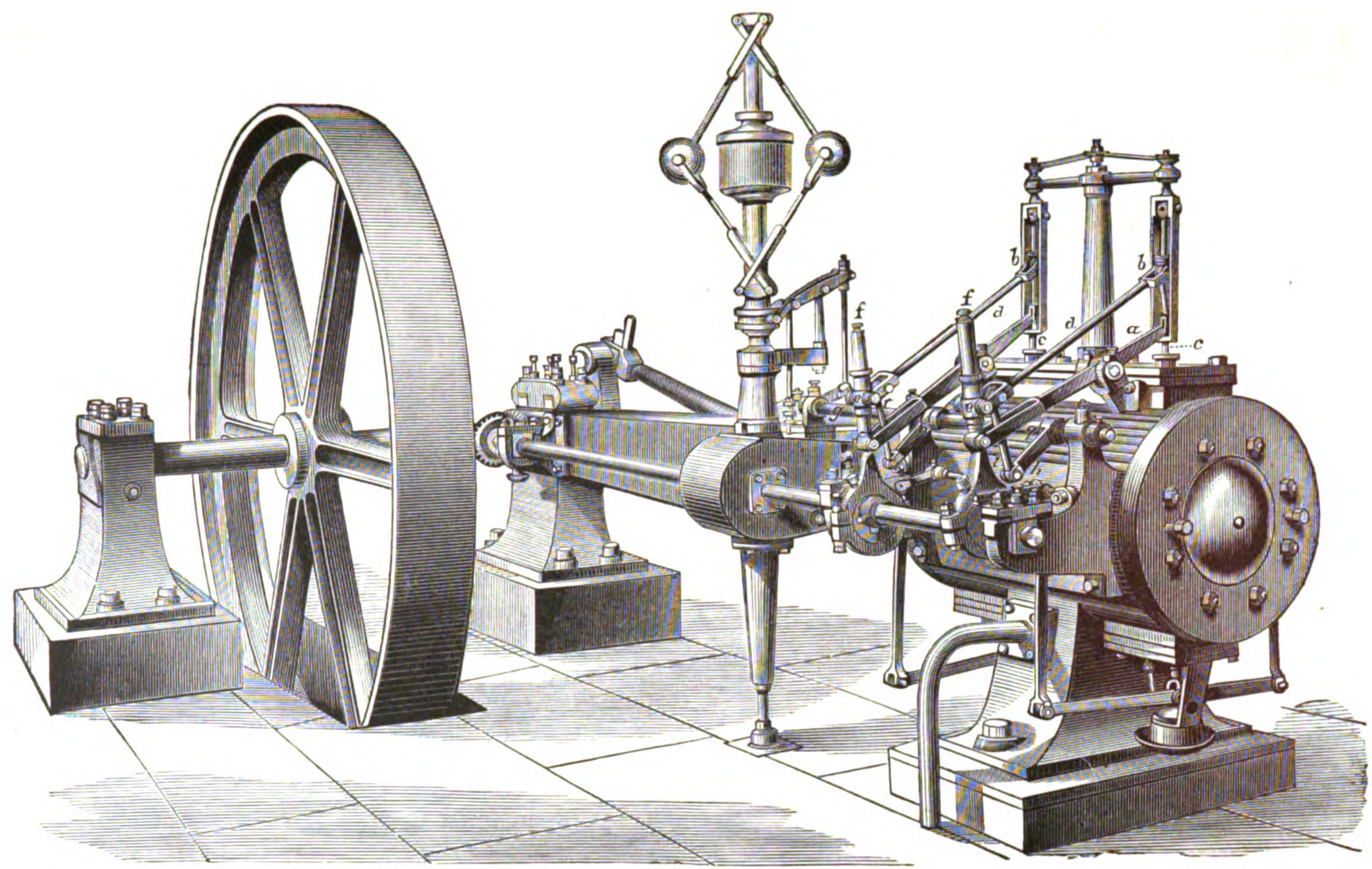
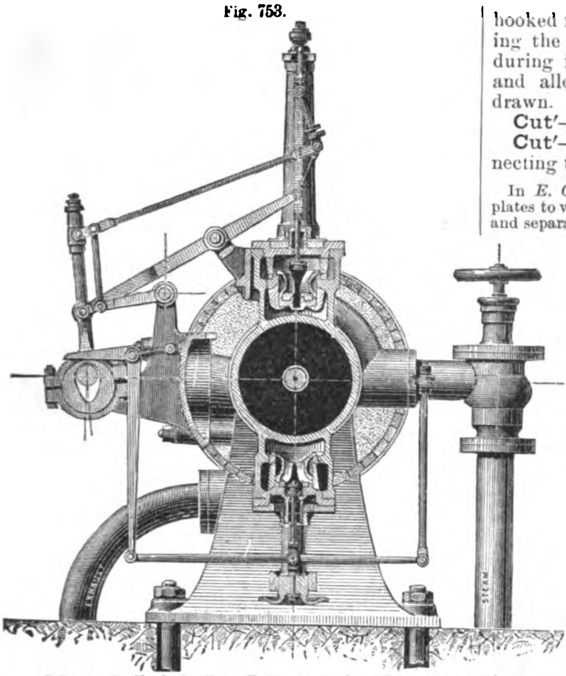


PLATE VIII. COLLMANN'S VARIABLE CUT-OFF STEAM ENGINE. (*Perspective View.*) *See page* 238.

Fig. 753.



Collmann's Variable Cut-off Steam-engine (Transverse section).

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Ruston, Proctor & Co.	* xlvii. 460.
Davey, Paxman & Co.	* xlviii. 3.
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Galloway	* xlvi. 241.
Dingley	* xxxvii. 358, 361.

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Slide	* xxv. 16.
Corliss	xxiv. 155.

"Scientific American."

Harris-Corliss	* xli. 175; * xxxv. 95; * xli. 175.
Collins	* xli. 102.
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Corliss	* xxxiv. 351; * xxxv. 340.
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Fish	* xxxvi. 166.
Brown	* xxxvi. 1.
Cobb	* xl. 310.

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Penny	* 404.
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Soc. Anon. de Marcinelle	* 4136.
Wannieck	* xxiv. 387.

"American Miller."

Regulations for tests, Cincinnati, 1880	viii. 55.

"Polytechnic Review."

"Buckeye"	* Aug. 12, 1876.
Bilgram	* Jan. 27, 1877.

See also EXPANSION VALVE GEAR.

2. A device in a stove magazine to separate the ashes and clinker from the fire, and to hold the fire in position while the ashes and clinker are tumbled off the grate and then removed. The grate being restored, the cut-off is withdrawn, and the fresh fire is allowed to fall upon the grate.

3. (*Sewing Machine.*) A device used with a hooked needle for the purpose of closing and opening the barb, to retain the thread in the needle during its passage through the goods or leather, and allow it to escape after the needle is withdrawn.

Cut′-off Saw. See CUTTING-OFF SAW.

Cut′-out. (*Electricity.*) A device for disconnecting telegraph instruments from the main line.

In *E. Gray's* (Patent 110,970), two springs hinged to the plates to which the terminals of the main line are connected, and separated by an insulating block, are provided each with a platinum-tipped contact-screw, and are so arranged that when turned into one position said screws bear against each other and complete the main circuit; but when in the other position, the springs bear against the terminal beveled studs of the loop or instrument circuit, thereby separating the contact screws and completing the circuit through the loop.

Cut Splice. (*Nautical.*) A loop splice made by a short piece of rope, the strands laid open at the ends and spliced into a standing rope, as in *k n*, Fig. 5435, p. 2279, "*Mech. Dict.*"

Cut Stone. (*Stone Cutting.*) Another name for ashlar, which see. The term covers all squared stones with smoothly-dressed beds and joints.

The following are modes of face-dressing (which see): —

Bush-hammered.	Pointed.
Crandaled.	Rough pointed.
Fine pointed.	Rubbed.
Peen-hammered.	Tooth-axed.

Cut′ter. 1. (*Ordnance.*) An instrument for determining the pressure per square inch exerted within the bores of cannon or small arms by the ignition of powder.

This form of instrument for the purpose derives its name from the fact that the pressure of the igniting powder is exerted upon a piston, the reverse of which has a cutter which makes a mark (cut) upon a copper block. See, also, CRUSHER GAGE; PIEZOMETER.

Fig. 754.

Milling Cutters. (Brown & Sharpe.)

Plates III., X., accompanying Appendix I. *b*, to "*Report of Chief of Ordnance, U. S. A.*," 1877, are illustrations of such *cuts*, and the text accompanying pp. 373-396, describe the instrument and results, referring to Plates I.-X.

Several forms of cutters are there described.

The Rodman cutter is also used in Lieutenant Metcalfe's recoil dynamometer for small arms. "*Ordnance Report*," 1878, Appendix N., p. 109.

2. (*Agriculture.*) An instrument attached to the plow to cut the sod or weeds in advance of the share or the breast of a plow. There are several kinds and modes of attachment. See COLTER.

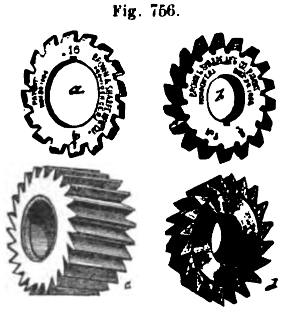
Fig. 755.

Milling Cutter.

3. (*Machinery.*) A cutting tool in a lathe, planer, or milling machine. Figs. 754, 755, 756, show several forms of rotary in milling machines and some forms of special machinery of cognate character.

Fig. 754 shows two forms of milling cutters: the upper one is for cutting the teeth of gear wheels,

Fig. 756.



Screw-slotting Cutters.

a. For making twist drills.
b. For grooving taps and reamers.
c. Grooving and milling cutter.
d. Angular cutter.

and can be sharpened by grinding without changing their form.

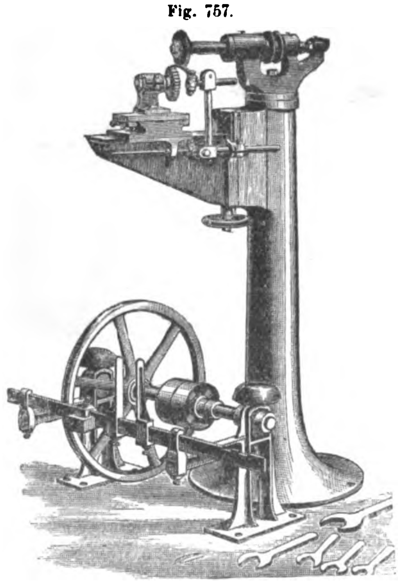
The lower cutter in the figure is for milling sewing machine and gun parts of irregular form.

Fig. 755 is a screw-slotting cutter.

Fig. 756 shows four cutters.

Cut'ter Grind'er. Is a tool for shops and manufactories in which rotary cutters of any style are used for gear-cutting, milling, or slotting. A columnar support, with a broad base, sustains the spindle-head, the cutter-holder and guide. The platen to which the holder and guide are attached may be adjusted in height to suit the diameter of the cutter to be operated upon. The guide rests against the tooth that is being ground, thus gaging the work accurately, even though there may be irregularity in the size of the teeth. The machine is adapted to cutters of all sizes and styles of teeth, whether straight, beveled, or spiral.

Fig. 757.



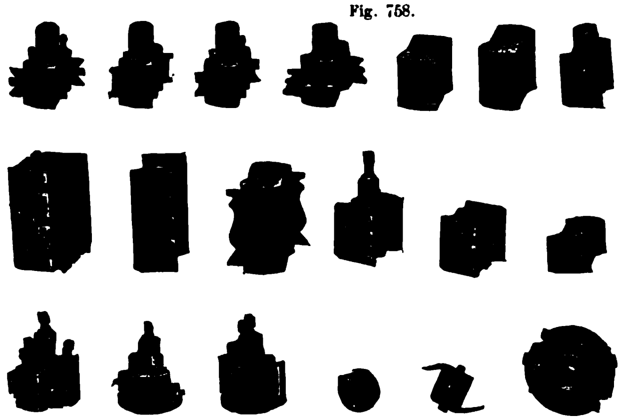
Cutter Grinder. (*Smith & Coventry, British.*)

Either small grindstones or emery wheels may be attached to the spindles.

Cut'ter Head. (*Wood Working.*) A rotary cutter stock in a planing, grooving, matching, or similarly-acting machine.

The illustration shows a variety of heads, includ-

Fig. 758.



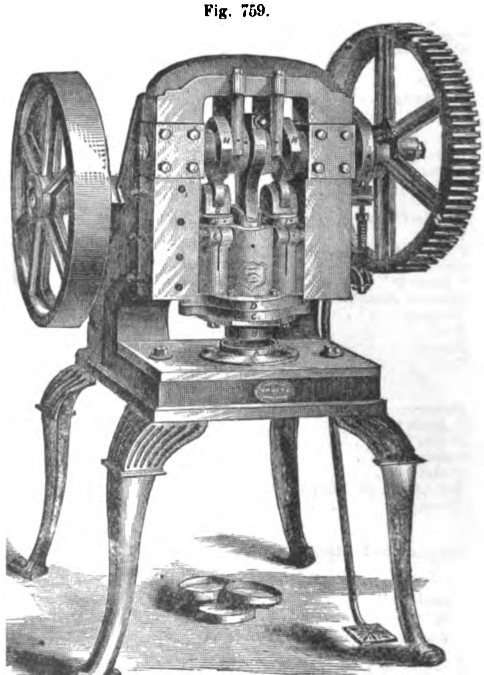
Cutter Heads.

ing sash, door, straight-cap, slotted combination molding, panel, matching, grooving, gaining, beading, coping, etc.

Cut'ting and Draw'ing Press. A machine made in various sizes for different grades of work in cutting a blank out of sheet-metal and forming it into shape at one operation. The machine shown is adapted for articles not exceeding 8″ in diameter and $1\frac{1}{4}$″ deep.

The die *A* is secured to the bed of the press and the cutting punch *B*, which also acts as blank-holder, to the adjustable plate *C*. The pressure of the punch upon the blank is regulated by the screws *F F*, which are bored out to receive the casing *G G*, on the lower end of which are rubber washers to allow for difference in the thickness of the tin. The

Fig. 759.



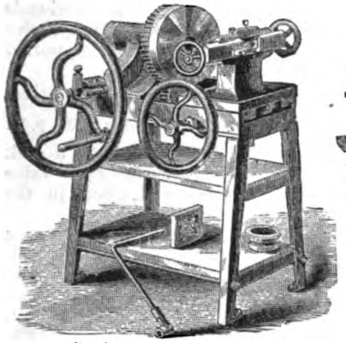
Cutting and Drawing Press.

cams *H H* force down the cutting punch and blank holder and a central drawing punch forces the blank into the shape required. The slide is kept against the cams by a weight.

The *Bliss* cutting, drawing, and stamping press performs at one operation, the cutting of the blank, drawing it into shape and embossing any required design upon it. It is particularly designed for work that is lettered, beaded, countersunk or embossed, such as sardine and blacking boxes, covers and bottoms of cans and lard pails, etc.

Cut'ting and Screw'ing Ma-chine'. A machine especially adapted for cutting off wrought-iron pipe and tapping the ends for coupling lengths. The pipe is held in the hollow head which has a universal chuck, and the dies are held on an adjustable pillar. The chuck-head is revolved by crank and fly-wheel or by power.

Fig. 760.

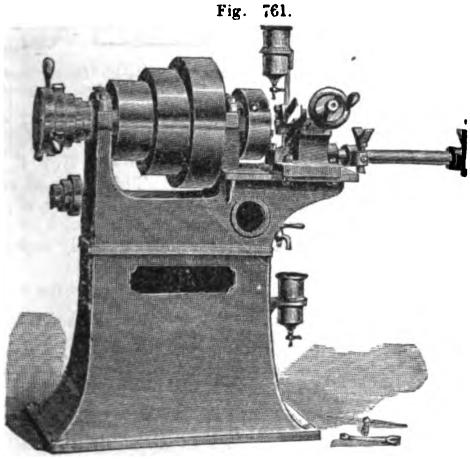


Cutting and Screwing Machine.

Cut'ting Ma-chine'. A machine for cutting crackers from the blanket of dough. See CRACKER MACHINE.

Cut'ting-off Lathe. A machine with which rods, bars, and pipes are cut to length. The object is passed through a collet at the rear end of the spindle, and held in front by a concentric chuck. The steadying collets are changed to fit various sizes of bars. The feed is automatic or by

Fig. 761.



Cutting-off Lathe.

hand and the speeds variable. The *Slate* cutting-off tool is used, the stock of which receives the cutter in a channel on its side, and the cutter is held in place by flanges on the stock and two hook-headed bolts, allowing the cutter to be advanced as it is ground for sharpening.

* "*Engineer*" . . . . xlii. 42.

Cut'ting-off Saw. The cutting-off saw is a cross cutting machine adapted to the shop. The cross cutting machine for the woods is a *drag*-saw. Fig. 1739, p. 738, "*Mech. Dict.*"

16

Cutting-off saws are of several kinds: single and double; the latter may be *double-enders*, for sawing boards to a length, cutting off both ends at once.

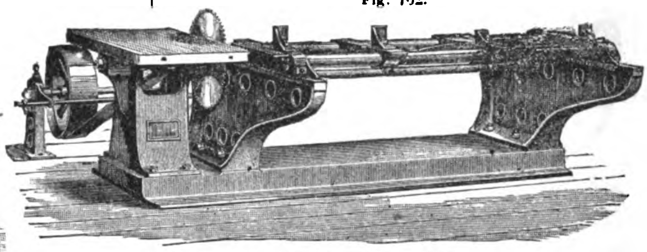
1. In the *railway cutting-off saw* the saw arbor is on a carriage which traverses on planed guides, to and fro. Fig. 4134, p. 1867, "*Mech. Dict.*"

2. The *bracket cutting-off saw* traverses on a bracket above the table upon which the staff lies. See BRACKET CUTTING-OFF SAW, *supra*.

3. The *swing cutting-off saw* is pendulous from the ceiling, Fig. 6127, p. 2471, "*Mech. Dict.*"

4. The *carriage cutting-off saw* has a carriage in which the stuff lies and which moves on ways transversely to present the stuff to the saw.

Fig. 762.



Carriage Cutting-off Saw.

Cut'ting-off Shears. A bar shears for cutting bar or rod iron to lengths. Fig. 586, p. 241, "*Mech. Dict.*"

Cut'ting Punch. A circular-edged punch used for cutting grommet holes in sails, cutting wads from cloth or paper, disks or planchets from leather or metal, making tongue-holes in straps and in various other uses and connections. See WAD-PUNCH, Fig. 7001, p. 2717, "*Mech. Dict.*"

Oval or oblong cutting punches are used for some purposes, — for setting-in oblong grommets, for instance.

Cy'clad. A circular iron-clad. A style adopted in several vessels of the Russian navy, as the "Novgorod," "Admiral Popoff."

"*Engineer*" . . . . * xli. 75, 93, 244.

Cy-cloid'o-graph. An instrument invented by *Dr. S. Zmurko*, for the practical drawing of cycloids.

"*Scientific American Supplement*" . . . . . . 505.

Cy'clo-graph. An instrument invented by Worthington (Eng.), for drawing arcs of great radius.

It is a rolling instrument having two wheels of different diameters on a single shaft, one being capable of adjustment towards or from the other. The nearer the two are in relation to each other, the smaller will be the radius of curve described by a pencil attached to the shaft near the larger wheel.

"*Scientific American Supplement*" . . . . . * 3907.

Cy-clom'e-ter. An instrument for counting revolutions. Shown as adapted to a bicycle in —

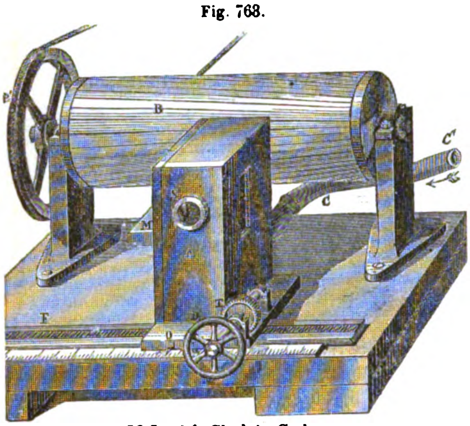
"*Engineer*" . . . . * xlv. 234.
"*English Mechanic*" . . . . * xxvii. 321.
"*Mining & Scientific Press* . . . . . . xxxvi. 403.

Cy'clo-scope. An instrument invented by Professors McLeod and Clarke of the Royal Indian Engineering College.

Its purpose is to measure the velocity of revolution, and enable it to be determined at the moment of observation.

B, Fig. 763, is the cylinder with its ruled paper covering. The wheel *R* serves to put it in communication with the machine, the rotary speed of which is to be measured. The movable box contains a reed or vibrating lance, which performs the functions of a tuning-fork, and to which is fastened a small plate of zinc, in which there is a slit about equal in width to the breadth of the lines traced upon the cylinder. The lance vibrates 60 times per second. The small-toothed wheel *T*, and the wheel *D*, being situated upon the same axis with the box *A*, the latter can, by simply turning the wheel *D*, to the right or left, be moved to any position in front of the cylinder. At *S* is an opening through which the lines are examined; it contains a lens for the purpose of magnifying the images. When the apparatus is to be operated the plate is caused to vibrate by means of a small bellows, the tube of which is seen at *C C'*. The box *A* carries an index by means of which the speed is

Fig. 763.



McLeod & Clarke's Cycloscope.

read upon a graduated scale. Supposing that the cylinder is revolving and that we wish to learn its speed, we place the eye at *S*, and with the right hand turn the wheel *D*, until we meet with the stationary wave which has served to determine the divisions; the index *O* will then point to the figure that indicates the speed.

The idea of the machine is founded upon the observation that if a series of objects (points, for instance) are moving with a certain velocity, the eye loses their outlines and

Fig. 76.

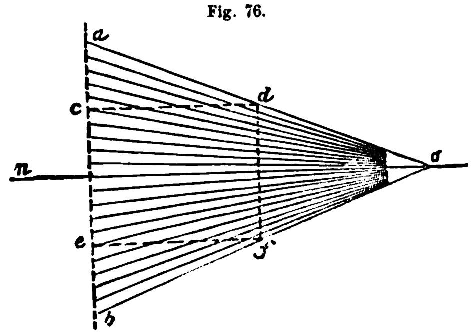


Diagram of Ruled Paper for Cycloscope.

blends them together into a line. The ruling of the paper on the cylinder is such that the lines are much farther apart at one end than the other, and this is conveniently accomplished by cutting an oblong piece sufficient to wrap the cylinder, out of a piece ruled as in the figure.

It will be evident that when the cylinder is revolving at a given rate the number of repetitions of the line, which, as viewed through the slit, is equivalent to a dot, will be much greater at one end of the cylinder than at the other.

The device is much more fully described in "*Proceedings of the Royal Society*," in "*Popular Science Review*" and "*La Nature*," and copied into the "*Scientific American*," xli. * 131; "*Scientific American Supplement*," 1188, 1366. See also "*Engineer*," xlviii * 225.

Cyl'in-der Bor'ing Ma-chine'. A cylinder borer, portable, and adapted to the reboring and refacing of locomotive cylinders while the cylinder is attached to the engine, is made by the New York Steam Engine Co. under Chapman's patent.

The machine is so arranged that it can be attached to an engine standing on the track, and is driven or worked either by hand or power to bore the cylinder and turn and face the edges of the flanges. The boring head slides upon a bar 4″ in diameter, one end of which is placed in a bushing fastened in a stuffing-box, and the other end runs in a bearing bolted to the cylinder-flange. The boring head has three tool-holders, which will receive either boring, facing, or turning cutters, and each or all of the cutters have an automatic and a hand feed. These machines will bore a cylinder as small as 15″ and as large as 20″ in diameter, with an extreme traverse of head of 32″.

Boring machine.

Sharpe, Stewart & Co., Br. "*Sc. Am. Sup.*," 2094.
Portable . . . . . . * "*R.R. Gaz.*," xxii. 355.
Flanders . . . . . . * "*Min. & Sc. Pr.*," xxxvi. 289.
Measuring instr., *Giegly* . * "*Engineer*," xlix. 259.
Molding, *Tuck* . . . . . * "*Sc. Amer.*," xxxv. 51.

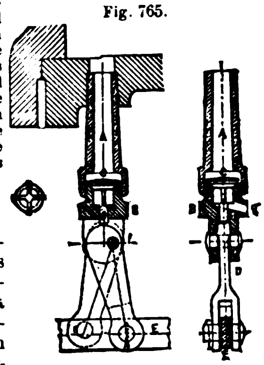
Cyl'in-der Car. A cylinder with wheel-ends adapted to run on a railway track. The cylinder is loaded full, and rolls, the load not being supported on axles.

There have been many patents on this idea.
Prosser's . . "*Scientific American*," xli. 293.
"*American Manuf.*," March 26, 1880, p. 12.

Cyl'in-der Cock. Figure 765 shows a cock operated by pressure of an eccentric against a valve normally closed by the pressure of steam in the cylinder.

The view shows two sections at right angles. The tube *A* is screwed into the cylinder, and into it is screwed a plug *B*, the end of which is the seat of valve *C*. The eccentric of the lever *D* is pivoted at *f*, and is moved by the rod *E*, pressing the eccentric against the stem *s* of the valve. *g* is the exit for the steam or the water of condensation, as the case may be.
"*Railroad Gazette*," * xxiii. 436.

Fig. 765.



Hayes & Schlack's Locomotive Cylinder Cock.

Cyl'in-der For'ging Mill. Blakey's forging mill for making tubes consists of a rotating mandrel, operating in combination with a series of surrounding rolls, which first bend the blank, then weld it, and, by continued rolling, impart a finish to the welded article.

"*Iron Age*" . . . . * xviii. July 27, p. 1.

Cyl'in-der Glass. (*Glass.*) This method of manufacture is much older than is generally supposed. It is so much superior to the *crown-glass* process that it has at length almost entirely superseded it.

The Venetians and Bohemians blew cylinders for the windows of the 12th and 13th centuries.

Cylinder blowing was introduced into France from Bohemia in the beginning of the 18th century.

France now manufactures it in great quantity. *La Compagnie des Verreries de la Loire* produces annually 590,000 square yards of white, and 89,000 yards of colored glass.

In the north of France 25 to 30 furnaces of 8 pots produce 4,500,000 to 5,000,000 square yards.

Annual production value: 1873, $4,400,000.
1878, $3,000,000.

Composition of French window glass: —

White sand	100
Sulphate of soda	35 to 40
Lime	25 to 35
Powdered coke	1.5 to 2.0
Binoxide manganese	0.5

Cullets in variable quantity, usually the same quantity as the sand. Arsenic is sometimes added to refine the glass; vaporizing in the pot, it passes through the glass, stirring the mass, and refining it.

Green sticks of wood are used for the same purpose, and, in Bohemia, a potato at the end of an iron bar. It is the steam in each case which escapes through the *metal*, as the melted glass is termed.

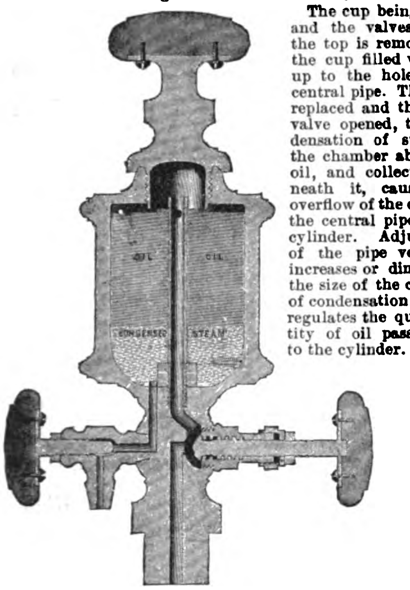
A workman usually blows during 20 hours and averages from 16 to 17 per hour, making sheets 22″ × 21″.

The cylinders are split with a diamond on the stick, guided along the edge of a wooden rule laid inside the cylinder. See Flattening Oven.

Cyl'in-der Grind'er. A machine tool with automatic traverse feed, for finishing cylindrical gages, such as those for gun-bores, etc. See Cylindrical Gage.

Cyl'in-der Lu'bri-ca-tor. An apparatus for supplying a regulated and constant quantity of oil to a cylinder.

Fig. 766.



Cylinder Lubricator.

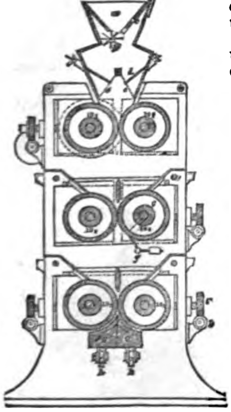
The cup being empty and the valves closed, the top is removed and the cup filled with oil up to the hole in the central pipe. The cover replaced and the steam valve opened, the condensation of steam in the chamber above the oil, and collecting beneath it, causes the overflow of the oil down the central pipe to the cylinder. Adjustment of the pipe vertically increases or diminishes the size of the chamber of condensation, and so regulates the quantity of oil passing to the cylinder.

Cyl'in-der Mill. A grinding mill in which the action of rollers is substituted for that of face stones.

(*Milling.*) The cylinder or roller mill, the *Walzenmühle* of the Hungarians, consists of two small parallel horizontal steel or porcelain cylinders placed near to each other, arranged for adjustment and revolving from above towards each other. In the great mill of Pesth the rollers are about 5″ in diameter, the surfaces of some having sharp longitudinal furrows.

Fig. 767 shows a mill with three pairs of rollers and an intervening space between the pairs. The action depends upon the distance of the rollers from each other and the character of their surfaces.

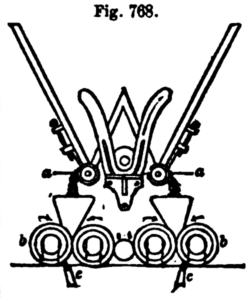
Fig. 767.



Cylinder Grinding Mill.

Smooth, and revolving with uniform speed, the action is to crush soft wheat or split hard wheat into fragments; or, if far apart, to split the berry lengthwise.

Fig. 768.



Wegmann's Porcelain-cylinder Mill.

Smooth and revolving with unequal velocities, the action is to mash the grain.

Grooved cylinders, with equal velocity, indent and crack the grain; with unequal velocities tear it.

The product is not heated; no dust flour is produced. In the Pesth mill the wheat, before attaining its last disintegration, passes between from 18 to 24 pairs of rollers. Its effect is a grade between *high milling* and *low milling* (which see).

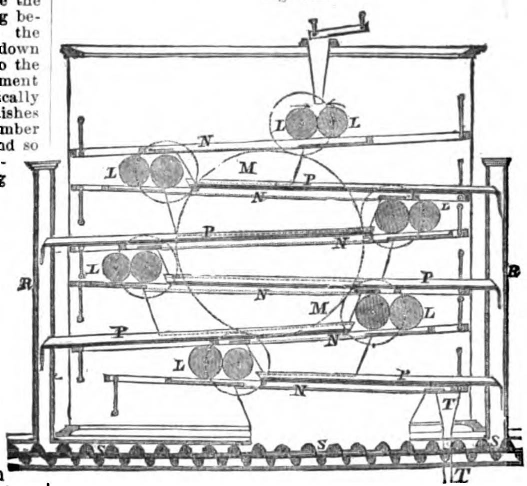
It is claimed to render grits and middling purifiers unnecessary.

That it is impossible to injure the quality of the flour in milling.

To secure a larger proportion of clean, pure flour.

Fig. 768 is a sectional view of *Wegmann's* porcelain-cylinder mill. *aa* are the feed cylinders; *bb*, the porcelain cylinders; *cc*, scrapers with glass edges to clean the cylinders.

Fig. 769.



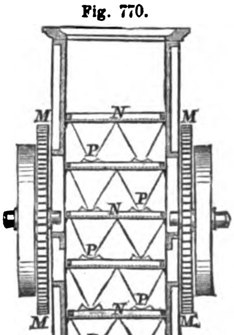
Buchholz Cylinder Grinding and Bolting Mill. (*Section.*)

See also Grits Mill.

Figs. 769, 770, show the *Buchholz* roller mill.

The cylinders revolve with unequal velocity and are all set in motion by a single large cog-wheel *M*. The pointed and purified grain is fed in between the highest pair of rollers *L L*, to be cracked, as it passes through, into coarse fragments, and more or less flour, grits, and bran, which are received upon the inclined shaking-sieve *N*, where they are sorted; the grits and fine flour passing through to the trough *P*, to be discharged into the upright receiver *R*. The groats and bran pass on to the next pair of rollers, to be further reduced to finer groats, grits, flour, and bran. Falling upon the second sieve the flour and grits pass through to the trough *P*, while the bran and groats pass on to the next pair of rollers, and so on until the groats having been reduced to grits and flour, all the bran is collected in *T T*, and all the flour and grits in *S S*. The screw conducts the flour and grits to a bolt, where the flour is bolted off, and the remaining grits graded in the centrifugal machine.

Fig. 770.



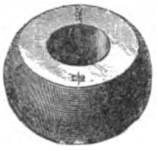
Buchholz Roller Grinding Mill. (*End View.*)

Beyer, * "*Technologiste*," xxxix. 348.

The whole system of milling has undergone great alterations within a few years past, and the new processes, which have given a name (*new process*) to the flour produced are largely used at the principal flour centers of the United States, Minneapolis, for example. Some of these improvements concern the method of grinding, *high* or *low*; others the principle of grinding, attritition (stones), or mashing (rollers); others the mode of handling the result, bolting and purifying.

Cy-lin'dri-cal Gage. A gage for measuring the external or internal diameter of cylinders. The plan was initiated by Whitworth, of England, and the system is often referred to under his name as "Whitworth" gages.

Fig. 772.



Cylindrical Gage.

They are made in sets, arranged in a box, of sizes from $\frac{1}{16}''$ to $2''$, varying by sixteenths of an inch.

They consist of steel cylinders and rings hardened and ground very accurately to standard sizes. These fit into each other. The first is used for measuring the size of holes, and the last for measuring the outside of cylindrical objects, and they are called *internal* and *external cylindrical gages*. They are generally used as standards alone, from which other tools and gages are made of the proper size.

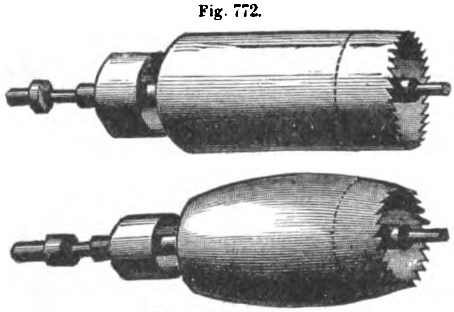
Cy-lin'dri-cal Glass. 1. A form of glass made to correct astigmatism; *i. e.*, a non-spherical form of the cornea of the eye.

2. A reading glass, for avoiding the distortions produced by an ordinary spherical reading glass.

Cy-lin'dri-cal Saw. "General Sir Samuel Bentham made cylindrical and crown saws for the British Admiralty previous to 1804. Its extensive application is, however, American." — *Richards.*

In the form shown in Fig. 772 the length of stuff that can be sawed is limited, but in another form described by *Richards* it consists of a tubular shaft or cylinder, around

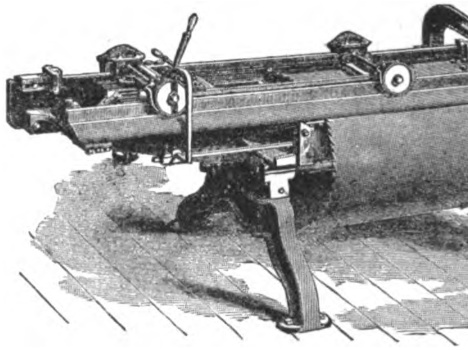
Fig. 772.



Straight Cylinder Saw.
Bilging Cylinder Saw.

which the belt passes supported in semicircular or half-bearings of the same diameter: to the end is attached a short crown saw that is as much larger than the cylinder as will clear the belt. The belt is wide, very thin, and uniform in thickness. The wood is carried over this saw by means of a carriage, the saw cutting out a semicircular core, the belt *running in the kerf* and passing through with the saw. It is

Fig. 773.



Whitney's Stave Saw.

intended for making cylindrical wooden pipes, or more especially eave troughs and conductors for the roofs of buildings.

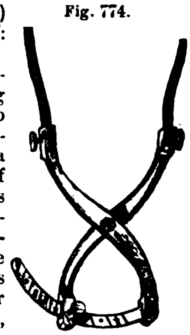
Fig. 773 shows *Whitney's* cylindrical saw, for making pail-staves out of the balk. A steel cylinder with teeth at one end is carried at the extremity of a well-supported horizontal spindle. The length of the cylinder is somewhat greater than that of the bucket for which the staves are destined, and its diameter is such as to give them the requisite curve.

Cy-lin'dri-cal Sieve. One in which the wire surface is cylindrical; the material being usually fed in at one end and discharged at the other.

See Grain Cleaner, Starch Sieve, Drying Machine, etc.. for examples.

Cyr-tom'e-ter. (*Surgical.*) An instrument for diagnosis: for measuring the chest.

Fig. 774.



Dr. Weed's Cyrtometer.

Flint's cyrtometer is a compass with short arms holding strips of lead long enough to encircle the chest. An indicator may be set at any point by a thumb-screw. The strips of lead are easily molded so as to fit any elevation or depression of the chest; the thumb-screw is then loosened, and the instrument removed. The parts being restored to their former position and placed on paper, the exact shape of the chest can be traced by a pencil.

Fig. 272, p. 84, Part I., *Tiemann's "Armam. Chirurgicum."*

Dr. Weeds' cyrtometer has flexible aluminium strips to bend around the chest, and is not designed to obtain the shape, but the circumference merely.

Cys-ti'tis Eye'let. (*Surgical.*) A short flanged tube, used in inflammation of the bladder.

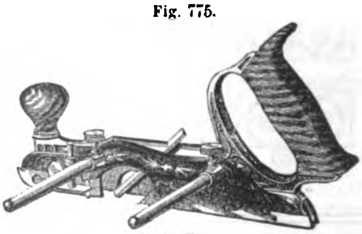
D.

Da'do. (*Add.*) (*Arch.*) A die with a projecting panel.

Da'do Plane. A tool consisting of two sections: a main stock with two bars, and a sliding section, having its bottom face level with that of the main stock.

It can be used as a dado of any required width by inserting the bit into the main stock, and bringing the sliding section snugly up to the edge of the bit. The two spurs, one on each section of the plane, will thus be brought exactly in front of the edges of the bit. The gage on the sliding section will regulate the depth to which the tool will cut.

Fig. 775.



Dado Plane.

By attaching a guard-plate to the sliding section the tool may be converted into a plow, fillister, or matching-plane.

Dai'ry Im'ple-ments. See CREAMERY; CHEESE; CHURN, etc.

Dam. 1. (*Hydraulic Engineering.*) A bank or structure across a stream.

Mattress and rubble dams in river and harbor improvements, jetties, revetments, and dams proper, are shown in the "*Reports of the Chief of Engineers, U. S. Army.*" Among others the following: —

Savannah River, 1879 . . . . • i. 742.
Corpus Christi, 1879 . . . . • i. 934.
Coffer Dam (Kanawha River), *Ibid.*, 1878 • ii. 466.
Crib dam, *Ibid.*, 1879 . . . . • ii. 1440.
Crib and rubble, "*Report of Chief of Ordnance*," 1877 . . . XII.; 1880, • 354, and Plate ii. 1753-1762.
Movable dam, "*Report of Chief of Engineers*," 1879 . . . . • ii. 1338, 1342.

Mat and stone dam, Wisconsin River Improvements, "*Report of Chief of Engineers, U. S. Army*," 1876, Appendix X, 4, vol. ii., Part II., pp. 402, 412, and Figs. 1 to 12.

See also Reports of General Weitsel and Colonel Merrill, "*Reports of Chief of Engineers*," U. S. A., 1874-1876.

Chanoine's system . "*Scientific American*," xxxix. 318.
Chanoine barrage, Seine, Port à l'Anglais. *Watson's* Report on Civil Engineering, "*Vienna Exposition Reports*," vol. iii., § c, pp. 37-43, Plates A, B, C, D.
Davis Island, Ohio, "*Eng. & Min. Journal*," 1879, 456. "*Scientific American*," xli. 392.
Kanawha River, "*Sc. American Supplement*," 1251.

See also BARRAGE; CURTAIN; DIKE; MATTRESS, etc. Also list under HYDRAULIC ENGINEERING, "*Mech. Dict.*," *et infra.*

2. (*Mining.*) *a.* A stopping of sand, clay, or brick-work built across a passage to exclude water or choke-damp, or prevent access of atmospheric air to fire-damp.

b. Choke-damp or foul air (Cornish).

3. A shield of sheet rubber clasped around the crown of a tooth to exclude saliva while the tooth is being excavated and filled.

Dam'as-ceen'ing. (*Fine Art Metal Working.*) The art of incrusting one metal on another and thoroughly incorporating. Generally, the incrusting is of gold or silver wire on the surface of iron, steel, or bronze.

The surface is engraved and undercut, the wire laid in, and the object is then hammered.

There are several common forms of damasceening: *Kuft* work and *bidiri* work, for instance. Cheap kuft work is merely gold leaf laid on to a rough etched surface, to which it adheres, while it is wiped off the smooth surfaces.

Bidiri work has for a ground an alloy of copper, lead, and tin, blackened by dipping in a bath of sal-ammoniac, saltpeter, salt, and blue vitriol.

Da-mas'cus Steel. (*Metallurgy.*) A steel made from the native iron obtained by bloomary process; broken, melted in a crucible with pieces of wood, the crucible luted and the steel melted. It is an Indian cast-steel, better known as *Wootz.* See p. 2264, "*Mech. Dict.*"

"*Mining & Sc. Press*" . . . . . . xxxvii. 87.

Dam'ask-ing Met'als. (*Add.*) (*Fine Art Metal Work.*) The Japanese process called *mokume*, which may be translated "veins of the wood," is a sort of damask pattern composed of variously colored metals, chiefly white silver, red copper, and a dark blue alloy. Pieces of this very difficult sort of workmanship are produced by overlaying and soldering together a certain number of plates of the metals or alloys, by hammering, welding, resoldering, filling up the hollow spaces with new metal, and repeating these operations many times; finally, when stretched out into a thin sheet, this composition shows a peculiar pattern, composed of veins of the different metals.

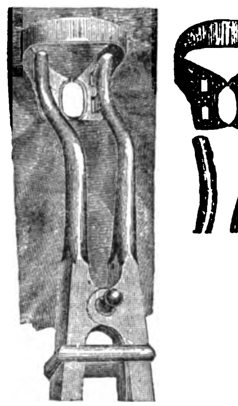
Dam Clamp. (*Dentistry.*) A device to hold a rubber dam in position around the tooth. Fig. 776 shows several forms and patterns, one of them *in situ.*

Fig. 776.

Rubber Dam Clamps.

Dam Clamp For'ceps. (*Dentistry.*) A device for putting a rubber dam clamp in position around a molar. The prongs are held at their distention by the slider on the handles, studs on the forceps jaws engaging in perforations in the flanges of the clamp. — *Dr. Elliott.*

Fig. 777.



Dam Clamp Forceps.

Damp'en-ing. 1. (*Leather.*) The moistening of hides previous to skiving or shaving.

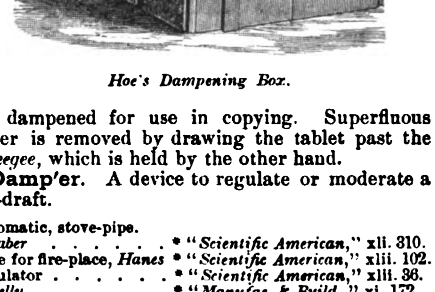
Leather under treatment is occasionally moistened with a wet sponge to make it dry evenly.

2. (*Copying.*) The wetting of bibulous paper or tablets for copying letters, etc.

3. (*Printing.*) The wetting of paper previous to printing.

Damp'en-ing Box. A case in which tablets are dampened for use in copying. Superfluous water is removed by drawing the tablet past the *squeegee*, which is held by the other hand.

Fig. 778.



Hoe's Dampening Box.

Damp'er. A device to regulate or moderate a fire-draft.

Automatic, stove-pipe.
Taber . . . . . . • "*Scientific American*," xli. 310.
Plate for fire-place, *Hanes* • "*Scientific American*," xliii. 102.
Regulator . . . . . . • "*Scientific American*," xliii. 36.
Kelly . . . . • "*Manufac. & Build.*," xi. 172.
"Peerless" . . . . • "*Manufac. & Build.*," xii. 30.
• "*Manufac. & Build.*," ix. 232.

Damp'er Reg'u-la'tor. A self-acting arrangement in which pressure of steam acts upon a damper or register to regulate the sectional area of a flue or draft-hole. As the steam increases in pressure in a chamber, a piston or diaphragm is moved, and acts upon the damper in the flue. There are many forms of the device, agreeing in the main features.

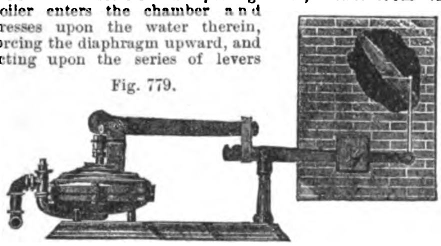
Barrett's flue damper is a butterfly valve regulated by the steam pressure in a special chamber, connecting by steam-pipe with the boiler, and adjusted by means of a balance arm and ball.

In Kelly's and Woodruff's the steam acts upon rubber diaphragms, passing between them, lifting the upper one and depressing the lower, the effective motion being the sum of the two.

In Watton's device (British), the escaping steam from a safety valve fills a subsidiary chamber, and, by depressing the piston, acts upon the lever of the damper.

In the "Peerless" damper-regulator, steam from the boiler enters the chamber and presses upon the water therein, forcing the diaphragm upward, and acting upon the series of levers

Fig. 779.



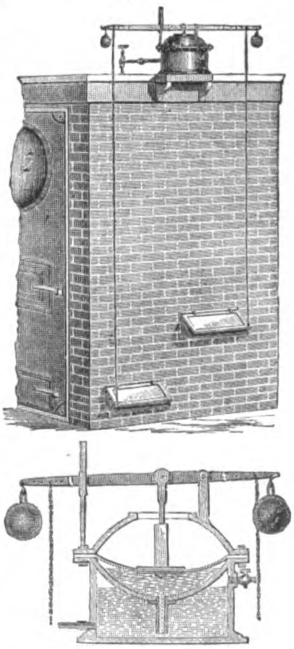
"*Peerless*" *Damper Regulator.*

which controls the damper. The steam pressure is always present, and its extent is the measure of the area of sectional opening in the flue.

The Norcross steam damper-regulator works without diaphragm or plunger, acting by displacement of water in a counterbalanced arm.

Fig. 780 gives two views of the Nason draft or damper-regulator. The upper view is a perspective of the side of the low-pressure boiler furnace, showing the apparatus *in situ*, and the connection with the draft doors. The lower figure is an enlarged sectional view of the apparatus itself.

Fig. 780.

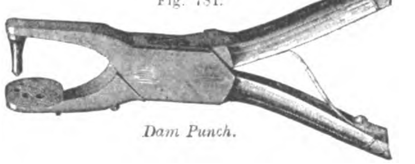


Damper Regulator.

Damp Sheet. (*Mining.*) A large sheet placed across the gate road to divert the course of the air.

Dam Punch. (*Dentistry.*) A cutting punch, for perforating coffer-dam rubber, to be used in excluding saliva from a tooth while being filled. It has on one jaw a solid cone which cuts against either one of a series of perforations of graded sizes. The die may be rotated to bring either hole beneath the punch. Stretching enlarges the size of the hole to go over a tooth. *Dr. Ainsworth.*

Fig. 781.



Dam Punch.

Dan'cing Flame. A small drum has a very delicately sensitive elastic skin stretched over it. A stream of gas passed through this drum will burn as usual till some one begins to sing near it, when the flame, under the influence of the vibrating skin, commences to shake in a manner which is varied indefinitely, according to the pitch and intensity of the notes of the tune.

Dan'iell Bat'te-ry. (*Electricity.*) One having its zinc in sulphuric acid, and its copper in sulphate of copper, with an intervening porous cell. "The most perfect battery yet invented." *Niaudet.*

See CONSTANT BATTERY.

Prescott's, "*Electricity*"	* p. 48 ; Ganot, * 686.
Sabine, "*Electric Telegraph*"	London, 1867, p. 221.
Niaudet, Am. translation	* London, 1867, p. 86.
Noad	* London, 1859, p. 209.
"*English Mechanic*"	* xxvii. 321.
du Moncel	Paris, 1856, p. 101.
Shaffner	* N. Y., 1859, p. 91.
Kiemer, impt. on Daniell	Sabine, 224.
Watson, mod. of Daniell	"*Sc. Am. Sup.*," * 524.
Hall, impt. on Daniell	Shaffner, * 94.
Lodge, impt. on Daniell	"*Teleg. Jour.*," vi. 54. "*Sc. Am. Sup.*," 1815.
Browning, impt. on Daniell	"*Sc. Amer.*," * xliii. 181.
Carré, impt. on Daniell	Niaudet, p. 108.
Kruger, impt. on Daniell	Niaudet, p. 128.
Trouvé, impt. on Daniell	"*Eng. Mechanic*," * 326.
Onimus, impt. on Daniell	"*Sc. Am.*," * xxxv. 67.

Dark Tent. A portable dark chamber for photographers in the field. It is mounted on a light tripod stand. The tent, camera, trays, and plate pack in a box. The windows are of orange-colored silk oil-cloth, protected by yellow cloth.

Two forms, for buggy and for hand respectively, are made.

Fig. 782.

Robbin's Dark Tent.

Darn'ing Ma-chine'. A machine for darning stockings, clothing, etc. The article or fabric to be darned is held between notched blocks, which throw it into corrugations so that the series of needles carried by a reciprocating needle-bar will pass through and through portions of the fabric.

Fig. 782.

Darning Machine.

The eye-pointed needles move in grooves in the blocks, their eyes in the same horizontal plane, and when they are passed through the fabric are all threaded by the same thread. This thread is then drawn out in loops from between each needle, and each loop is placed on a pin of a loop-holder (shown to the left) adjustable to or from the work-holding blocks to adapt the loop to the size of the hole, and on the return movement of the needle bar each needle draws a doubled loop through the fabric at each side of the hole to be darned, and leaves the thread extended across the hole. The loops of thread are then cut at the eyes of the needles and the fabric is turned on the holding blocks and clamped, so that the needles in their next movement will draw the loops then to be formed across and interweave them with the loops of thread or yarn previously laid by the needles.

Fig. 784.

Dash Lamp.

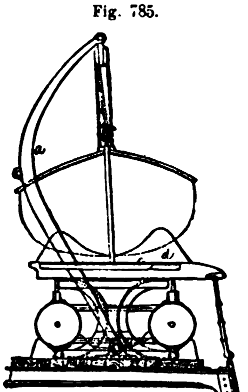
Dash Lamp. A lamp for the dash-board of a vehicle.

Daub'ing. (*Leather.*) Or dubbing. A mixture of tallow with either neat's-foot oil or sperm oil. With it dampened leather is coated, rendering the leather supple and impervious to water. *Stuffing.*

Dav'it. The boat-lowering and hoisting apparatus of the vessels of the American Steamship Company (British) is shown in Fig. 785.

The davits *a* are of round iron bent to the form shown, and hinged to brackets *b* on the deck. Each davit passes through a slot in a horizontal guide *c*, attached to suitable standards, and connected with the hand-rail of the ship. The boat is slung from eyes in the heads of the davits by suitable tackle, and is supported upon the standards by blocks *d*. These blocks are hinged to the standards, and the davits are kept in the ordinary position by a key and pin passing through the slot. When it is desired to lower a boat the pin and key are removed, the supporting blocks thrown over on their hinges, and the davits fall forward, throwing the boat clear of the ship's side. It can then be lowered by the tackle. The illustration also shows the form and position on board, of the sheet-iron rafts which these vessels all carry. The rafts are stowed under the boats, the whole being very compactly arranged, but always ready for an emergency.

Fig. 785.



Ship's Davit.
(American Steamship Co)

Boat-lowering apparatus,

Allardyce, Br.	* "*Engineer*," xli. 325.
And Life-raft, *Cramp* . . .	* "*Engineering*," xxii. 262.
American Steamship Co. Br.	* "*Scientific Am. Sup.*," 728.
Parker, Br..	* "*Scientific Am. Sup.*," 802.

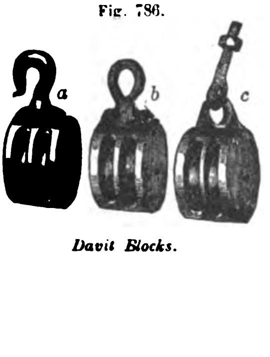
See Boat-lowering Apparatus, p. 114, *supra*; Davit, p. 678, "*Mech. Dict.*"; Boat-lowering Davits, p. 314, *Ibid.*

Dav'it Block. (*Nautical.*) One specially adapted for the tackle of ships' davits. The figure shows three kinds.

a. Swivel-hook block.
b. Swivel-eye block.
c. Screw-bolt and nut-block

Other davit-blocks have beckets to complete the combinations. See also Detaching Hook.

Fig. 786.



Davit Blocks.

Dead Blocks. (*Railway.*) Blocks projecting from the end of a freight car to receive the concussion when the buffer springs are compressed.

Dead Lock. 1. One having a supplementary bolt which acts as a detent to the main bolt to prevent its being moved even by the key.

2. (*Railway.*) A car-door lock operated in each direction by the key alone.

Dead Stroke Ham'mer. A hammer the stroke of which is not affected by the recoil of the crank or helve by which it is operated. Fig. 1600, p. 680, "*Mech. Dict.*"

Hull & Belden, * "*Engineering & Mining Jour.*," xxiii. 338.

Dead Weight. The weight of rolling stock, the live weight being the *load.* The following is from the report of Captain Galton, one of the British Commission at the Philadelphia Exhibition, 1876: —

The following Table shows a Comparison between the Weights and Carrying Capacity of some Railway Cars: —

Gage.	Weight of Car in lbs.	Capacity in lbs.	Total Weight.	Proportion of Dead Weight to Paying Loads.
Flat Car.				
4′ 8½″	16,000	20,000	36,000	1 to 1.25
3′.	7,500	19,000	26,500	1 to 2.5
Box Car.				
4′ 8″.	17,000	20,000	37,000	1 to 1.17
3′.	10,000	17,600	27,600	1 to 1.6
Coal Car.				
4′ 8½″	17,000	30,000	47,000	1 to 1.7
3′.	9,000	20,000	29,000	1 to 2.2

Deal Frame. A saw-mill for ripping pine logs into boards, p. 2042, and Fig. 1601, p. 680, "*Mech. Dict.*"

Ransome, Br. . . .	* "*Engineering*," xxv. 424.
Worssam, Br.	* "*Engineering*," xxvi. 490.

De'bris E-vac'u-a-tor. (*Surgical.*) An instrument for removing powder and fragments of calculi after crushing, in the operation of lithotrity.

The following may be found on pp. 44, 45, Part III., *Tiemann's* "*Armamentarium Chirurgicum*": —

Nelaton's evacuating apparatus.
Van Buren's debris syringe.
Glover's evacuating apparatus.
Tiemann's debris tube and obturator.
Van Buren's evacuating catheter.
Tiemann's double current catheter.
Nott's double current catheter.

See also Stringes in same work. See also Chip Stringe, *supra* and list under Surgical Instruments.

De-cal'co-ma'nie. The art of ornamenting by transfer.

De-can'ter. 1. An apparatus designed by Evrard, of St. Etienne, for sorting the tailings of coal washings.

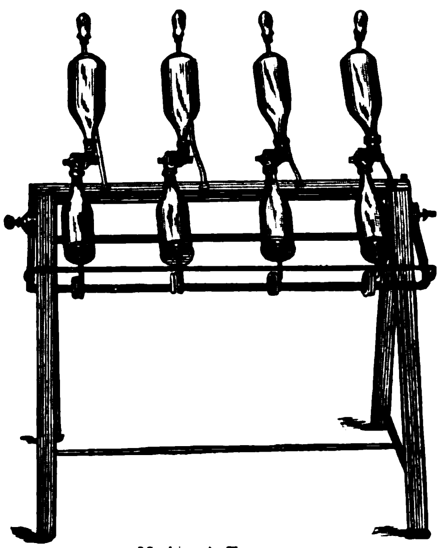
Althan's report in Group I., "*Centennial Exhibition Report*," * vol. iii., p. 297.

2. A glass bottle to contain wine at table.

3. An apparatus for transfusion of wine.

The machine by Tricout & Co., of Reims, is constructed of unoxdizable material, and, being for the champagne cellar, operates without the loss of gas. A machine with 4 faucets operates on 1,500 pint bottles per day. The full bottles being beneath and the empty ones above, a turn of the handles reverses the relative position, and the wine passes into the other bottles. See Fig. 787.

Fig. 787.



Machine à Transvaser.

De-cap'i-ta'ting Hook. (*Surgical.*) A curved instrument, sharp in the concave, for beheading the fetus in cases of obstructed labor.

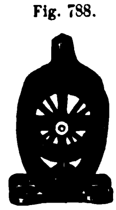
Fig. 527, Part III., *Tiemann's "Armam. Chirurgicum."*

Dec'i-mal Meas'ur-ing Ma-chine'. A lever scale in which the weight and the object weighed are as 1 : 10. The *bascule-décimale* is much used in France. Made by Paupier, of Paris; Duru, of Bordeaux.

Kerr, Br. . . . . * *"Engineer,"* xliii. 162.

Deck Block. (*Nautical.*) One attached to the deck, as in the illustration, in which a small block is pivoted to a base-piece, which is bolted to the deck.

Fig. 788.



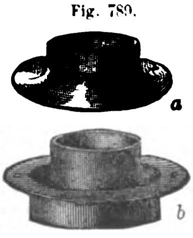
Deck Block.

Other deck blocks are connected by beckets to deck-hooks, or by hooks to deck-eyes.

Deck Hoist'ing En'gine. (*Nautical.*) A hoisting apparatus on deck, used for getting in and out cargo and stores, getting guns, etc., aboard. It is also used on the deck of a lighter for pile-driving, or snag-lifting. As shown, Fig. 790, it is intended for working from two different points. The drums are worked independently of each other by friction, and the operations of hoisting, lowering, and stopping are controlled by the use of levers on the side of the engine, no foot-brake being needed.

Deck Pipe. One leading through a deck, affording a passage for a smoke-pipe, wind-sail, etc.

Fig. 789.

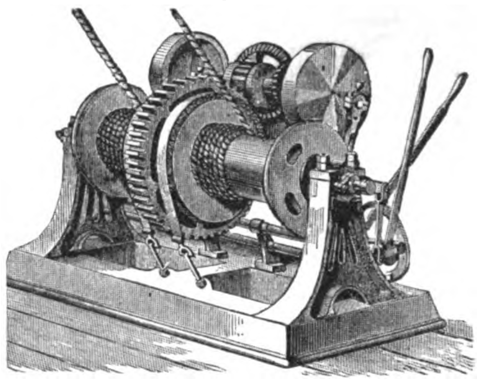


Deck Pipes.

a. Plain deck pipe.
b. Water deck pipe.

Deck Pump. One arranged to screw into a metallic deck-plate when required for use, and to unship the whole working gear when not required; a cap covering the opening in the plate, and leaving the deck perfectly clear.

Fig. 790.



Bacon's Deck-hoisting Engine.

De-com-pos'ing Fur'nace. A chemical furnace. Used in the soda industry in decomposing chloride of sodium with sulphuric acid.

Jones & Walsh's decomposing furnace, Middlesborough, England. Paper read before Newcastle Chemical Society, March 23, 1876. Reported in *"Scientific American Sup.,"* 305. See also Professor Jenkins's Report, *"Paris Exposition Reports,"* 1878, iv., pp. 44 *et seq.*

De-cor'ti-ca'tor. An instrument or machine for removing the skin, such as the bran of wheat or other grain; the surplus bark or moss from neglected fruit-trees, etc.

Glove and bow, *Sabate*, * *"Scientific American,"* xxxvi. 182.

De-coy'. When artificial, a wooden, tin, or real-plumaged bird to induce wild birds to settle within range of the ambushed gunner.

Ducks, brants, pigeon, plover, curlew, snipe, are among the commoner kinds.

Decoy duck, *Redmond* * *"Scientific American,"* xli. 247.

Deep Sea Ther-mom'e-ter. One for ascertaining the temperature of the sea at any required depth. It has in some respects the features of a sounding instrument, as the knowledge of the depth is one part of the problem. See SOUNDING APPARATUS, pp. 2247–2249, " *Mech. Dict.*"

The thermometer is contained in a heavy brass frame, finished at the bottom by a propeller-like spiral fan. The fan revolves as it passes through the water, and a registering device put in motion. The required depth being reached, the motion is stopped, by which action the thermometer is turned over and the temperature registered.

Subject discussed in a paper by Dr. Mann, read before the Society of Arts, and reproduced in *"Scientific American Supplement,"* 934, 935.

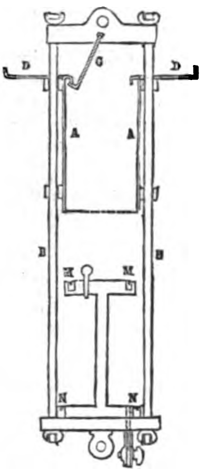
Negretti & Zambra . . * *"Scientific American,"* xxxix. 83.

Deep Wa'ter Bot'tle. A bottle for fetching up sea-water from determinate depths to ascertain its saltness, aërial contents, and temperature.

Four Swedish instruments for this purpose were shown at the Philadelphia Exhibition in 1876. They are all grounded on the same principle. The water-specimen is drawn up in a cylindrical vessel, the walls of which form a separate piece, which, while the instrument is sinking in the water, is raised above the bottom and top of the vessel, but falls and unites with these at the depth from which the sample is required. Thus during the descent the water passes freely through the cylinder, but at the depth required the different parts of the vessel come together and inclose therein the water, which is thus obtained altogether unmixed with the water of the upper strata.

The instrument of Ekman of Stockholm, is shown in Fig. 791. *a* is the open cylinder, sliding on two bars *b b*: before the instrument is immersed in the water, the cylinder is raised and suspended by the hook *c*. Attached to the cylinder is a horizontal flange, *d d*, the size of which is so calculated, that its resistance against the water, when the instrument is descending at the rate of about 6 decimeters per second, is equal to the combined weight of the flange and cylinder. As the instrument really sinks faster than that, the cylinder, as soon as the descent begins, is immediately raised somewhat more, and the hook *c* falls aside. The cylinder nevertheless still continues raised in consequence of the water's resistance to the flange, as long as the instrument continues to sink; but as soon as the line to which it is fastened is hauled in, the cylinder falls. Its under and upper (down-turned) edges then enter into the ring-shaped grooves *m m* and *n n* in the bottom and top, which are filled with a compound of wax and tallow, in which marks have been previously made with the cylinder. The cylinder contains the last body of water which occupied it: that at the level where its downward course was arrested.

Fig. 791.



Ekman's Deep-water Bottle.

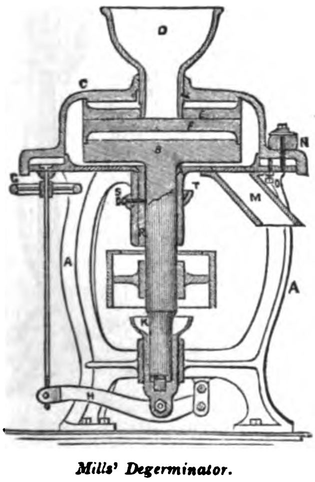
Def'e-ca'tor. An apparatus for removing the feculencies of juices and sirups. See p. 683, "*Mech. Dict.*"

Vibrans (sucre).
"*Technologiste*," xxxvii. 323.

De-flec-tom'e-ter. Askenasy's apparatus for measuring the curve of deflection of a metallic bridge under a passing load, and used upon a bridge over the Rhine at Mayence, has a drum attached by a clamp to the bridge and moved by interior clock-work to rotate it once in 10 minutes. At the approach of a train the detent is released and the drum commences to rotate. By a special arrangement the rate of movement of the drum may be regulated to obtain curves of equal length for trains of different speeds. The drum is covered with a roll of paper gummed at the edges, so as to answer for numerous experiments, the portion covered by the curve being detached after each experiment. The tracing is made by a pencil in a stationary position, the drum oscillating vertically in front of it. Shown in Class 54, Group VI., Paris Universal Exposition. See also EXTENSION MEASURING APPARATUS.

De-form'i-ty Ap'pa-ra'tus. (*Surgical.*) Instruments for curvature of the spine or legs, for club feet (*talipes*), etc., are classed under this head.

Fig. 792.



Mills' Degerminator.

See CURVATURE APPARATUS, CLUB-FOOT APPARATUS, TORTICOLLIS, TALIPES APPARATUS, etc.

De-germ'i-na'tor. (*Milling.*) A mill for rupturing the wheat berry along its crease to detach the germ, which is afterwards separated from the split wheat by a short reel covered with wire cloth.

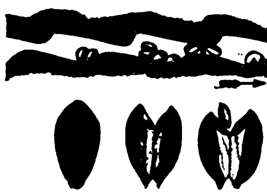
Mills' degerminator is of iron, with two furrowed disks 16″ in diameter, of the same metal, between which the wheat is rolled and cracked, freeing the germ. The disks *E F* have marginal rounded corrugations, with smooth depressed bosoms. Fig. 792.

A is the frame; the spindle-head *B*, resting in the oil-pot *K*, supports the runner *F*, which is raised and lowered by the lighter-bar *H* and handwheel *G*.

D is the hopper; *C* the husk which carries the upper stationary disk *E*, which is trammed to the lower one by the set-screw *O* and bolt *N*. *T* is the tallow-pot and *S* a set-screw regulating the gib *R*. *M* is the delivery spout.

The wheat, previously graded as to size, rolls on its side along the bosom till it reaches the corrugated skirt; ascends the easy incline (see sectional view), rotating on its axis, until it bears with its creased side on one or the other disk, when it is split open and the germ escapes from the broken grain.

Fig. 793.



Sectional View of Disks in Degerminator. Wheat Natural and Degerminated.

The figures are — a vertical section; a section illustrating the action of the disks; and wheat in its natural and degerminated conditions.

De-gla'zing. (*Glass.*) The process of giving a dull or ground surface to glass by acid or mechanical means.

De-gum'ming Ma-chine'. A machine used in treating silk before dyeing. See SILK-DEGUMMING MACHINE.

De la Rue Bat'te-ry. (*Electricity.*) A battery in which chloride of silver forms the negative. See CHLORIDE OF SILVER BATTERY.

Delft Ware. (*Ceramics.*) Ware made at the city of Delft in Holland, which has been celebrated for its potteries for over three centuries. As England was largely supplied from that city, the word became a synonym for table-ware pottery.

Ware of the better kinds was made as thin as China porcelain, pure in color and of most various and fantastic shapes; sets of dishes to represent all the viands served upon them being among the number.

Pottery probably came from Delft to England.

"Crockery, china, and delft" was the refrain of an English song.

Dem'i-fixed. Or *semi-fixed*. Said of a steam-engine which is not intended to be stationary, but which has supports of such a nature that it may be moved by proper appliances, but has not wheels for transportation like the *portable* engine.

Dem'on-stra'tion Len'ses. (*Optics.*) A set of lenses showing the various forms, viz.: —

Double concave.	Plano concave.
Double convex.	Meniscus convex.
Plano convex.	Meniscus concave.

Den-sim'e-ter. An instrument for ascertaining the density or specific gravity of an object.

1. The instrument of Colonel Mallet and M. Bianchi for ascertaining the specific gravity of gunpowder, is described on p. 685, "*Mech. Dict.*"

The densimeters used in the office of the constructor of ordnance, U. S. A., for determining the specific gravities of metal for cannon, and for ascertaining the specific gravities of large grained powders, are described and illustrated in the

"*Report of the Chief of Ordnance, U. S. A.*," 1877, iii. pp. 394-400, and Plates I., II., accompanying.

In the British service the density of powder is rigorously determined, each cake being tested.

The density of rifle powder is fixed at	1.725
Pebble powder	1.77 to 1.81
R. L. G.	1.67

The *densimetre à mercure* is employed in the Russian arsenals to obtain the specific gravity of gunpowder Shown at Plate II. accompanying Appendix 1 (c), "*Ordnance Report*," 1877.

See also the mercury densimeter of Colonel Mallet of the French army, "*Ordnance Report*," 1879, Appendix 1., p. 111, and Plate VI., Fig. 14.

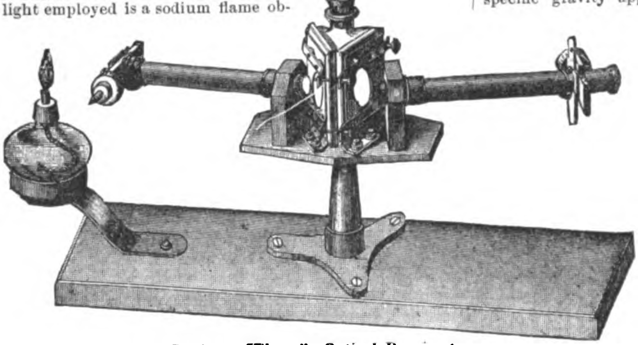
Densimeter for gunpowder, Br. . * "*Engineering*," xxv. 236.

2. The instrument invented by Professor Hilgard of the U. S. Coast Survey, for determining the density of sea-water by its refractive power, is shown in Fig. 794. It is an efficient substitute for the hydrometer or salinometer, as it is not affected by the motion of the ship. See U. S. Coast Survey Report, "Methods and Results," Appendix No. 10, Report for 1877.

The Hilgard densimeter follows the suggestion of Prof. Wolcott Gibbs for an apparatus for the "Hassler" in 1871, 1872.

Fig. 794.

The basis of this instrument is the change in the refractive power of a saline solution of greater or less density. The instrument consists of a hollow prism filled with the water under observation, transmitting from a collimating telescope a line of monochromatic light to an observing-telescope in which the refracted position of that line is read by means of a micrometer. The monochromatic light employed is a sodium flame ob-



Professor Hilgard's Optical Densimeter.

tained by adding a small proportion of a solution of common salt to the alcohol of the lamp. The temperature of the liquid under observation is found by means of a thermometer inserted through the neck of the hollow prism, but which is withdrawn when the optical observation is made.

The glass prism rests on three little knobs so as to have a firm support. Attached to the stand carrying the telescopes are two guides, by means of which the prism is made always to occupy exactly the same position, so that all observations are made under the same angle. A small thumb-screw on the side of the prism, not seen in the plate, forces the prism closely into the guides.

The slit in the focus of the collimating lens is very readily made by drawing a fine line through a black coating (such as engravers' etching ground) on the inner surface of a glass diaphragm. In the illustration this diaphragm appears mounted on a micrometer slide, which was deemed desirable for general experimental purposes, in order to make the observations under the condition of equal refraction on both faces of the prism: but in the instruments for practical use on board ship the slit is in a fixed position. The image of the slit in the field of the observing-telescope is a sharply-defined bright-yellow line, which is pointed upon with a fine dark spider line carried by the micrometer.

The relation of the angle of refraction to the density of sea-water having been ascertained experimentally in the office, as well as the temperature-corrections for different degrees of salinity, it is only necessary to determine for each instrument the difference of micrometer reading between distilled water and sea-water of an ascertained specific gravity, and from this and the ascertained law construct two tables for its use: one giving the reduction to the standard temperature of 60° Fahr., in terms of micrometer-divisions, the other giving the specific gravity for the difference of reduced readings on distilled water and on the specimen of sea-water under observation.

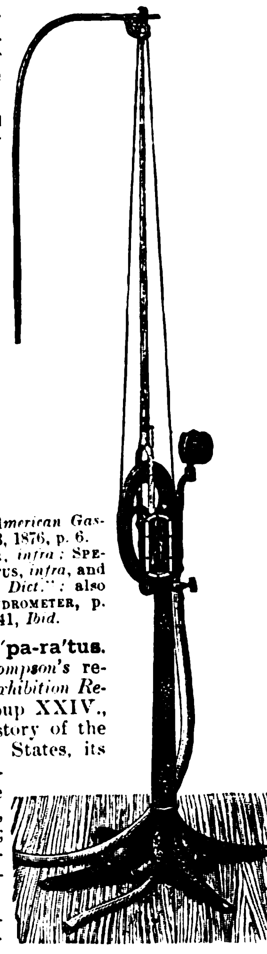
3. Huch's densimeter is adapted to indicate in either degrees Baumé or Brix, the exact density of saccharine solutions continuously during the whole operation of boiling.

"A chamber like a salinometer tube or water-gage is attached to the head of the boiler, and in this is a floating areometer. A platinum weight is suspended from the areometer, and being in the solution, which is continually renewed, the areometer index finger shows constantly the graduation corresponding to the gravity of the sirup.— "*Dingler's Journal*." Reproduced in "*Scientific American Sup.*," * 2560.

Den'si-ty. (*Electricity.*) Used erroneously as an equivalent to *intensity* or *tension*. The same *quantity* of electricity may pass through different sized wires, but the *density* of the current passing through the smaller wire will be greater than the density of the current passing through the larger wire. Other things being equal, the density bears an inverse proportion to the sectional area of the conductor.

Den'si-ty and Spe-cif'ic Grav'i-ty Ap'pa-ra'tus. An apparatus for testing as to relative and actual weight.

Fig. 795.



White's Water Motor Dental Engine.

Goodwin's density and specific gravity apparatus for gas testing, "*American Gas-light Journal*," * July 3, 1876, p. 6.

See also DENSIMETER, *infra*; SPECIFIC GRAVITY APPARATUS, *infra*, and pp. 2255-2257, "*Mech. Dict.*"; also BALANCE, p. 212; HYDROMETER, p. 1153; AREOMETER, p. 141, *Ibid.*

Den'tal Ap'pa-ra'tus. See *Dr. J. H. Thompson's* report," *Centennial Exhibition Reports*," vol. vii., Group XXIV., p. 11, *et seq.* "History of the art in the United States, its progress and modern practice. Base plates of Vulcanite, Celluloid, etc.; Dentures; Mechanical and Operative Dentistry."

Dental foil manufacture, *Williams*, * "*Sc. Amer.*," xxxv. 18.

See also list on p. 685, "*Mech. Dict.*"

Den'tal En'gine. A machine for running the dental burs, drills, etc., which act by rotation. In the ordinary dental engine, the S. S. White and Morrison patterns, the power is by treadle to a fly-wheel and a band from this to a grooved pulley on the summit of the column, thence by flexible shaft to the drill. The illustration, Fig. 795, shows the application of a water-motor engine, which has from 15 to 20 pounds pressure. The multiplying effect is such that a speed of 3,000 revolutions per minute of the bur is attained.

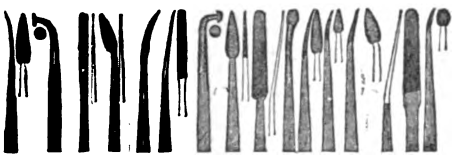
A counterbalance is connected with the rocking arm by a chain, the links of which are caught over a hook or pin. By lengthening or shortening the chain the tension may be varied at pleasure; or the counterbalance may be so adjusted that the rocking arm will remain in any position in which it is placed.

The water motor is attached to the portable stand and swivels or turns in the top of the column. The frame of the motor carries the driving wheel to the trunnions of which the rocking arm is hinged. The supply and waste water-pipes are shown in the cut.

Petit, Electro-magnetic, * "*Scientific American*," xxxiv. 259.
Allen, Plugger, electric, * "*Telegraphic Journal*," iv. 209.

Den'tal File. These are very numerous, minute, and peculiar, adapted for plug finishing, for lateral and crown cavities, etc. See Fig. 796.

Fig. 796.

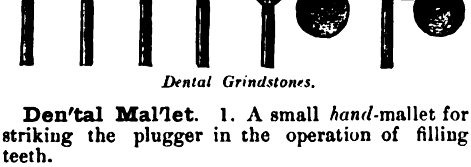


Murphy's Dental Files.

Den'tal Grind'stone. Grinding stones fastened on mandrels and made in a variety of forms for the delicate and minute operations of mechanical and operative dentistry.

They are made of Arkansas stone, Hindostan stone, or Scotch stone (Water of Ayr).

Fig. 797.



Dental Grindstones.

Den'tal Mal'let. 1. A small *hand*-mallet for striking the plugger in the operation of filling teeth.

A *live-blow* mallet is of steel.
Wood-cased mallets are of seasoned laurel or brier root, filled with metal a little harder than pure lead.
Metal-cased mallets are seamless tubes filled with lead, and give a *dull blow*. They are in sizes 3, 4, 6 ounces.
Tin mallets are made in sizes $1\frac{1}{2}$, $2\frac{1}{2}$, $3\frac{1}{2}$ ounces
Composition mallets are of an alloy a little harder than lead.

2. An *automatic* hammer, operated by spring interiorly. See Figs. 1610, 1611, p. 686, "*Mech. Dict.*"; also Figs. 3835, 3836, p. 1749, *Ibid.*

3. An *electric* mallet, in which the impulse is given by electro-magnetism. See p. 1749, "*Mech. Dict.*," and instances cited. Fig. 3837, p. 1750, *Ibid.*

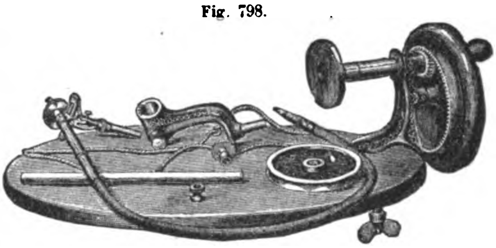
Spencer . . . . . * "*Scientific American*," xxxv. 18.

Den'ti-phone. An instrument for conveying audible pulsations of the air by way of the teeth to the bony structure of the head, and thus to the ear. See AUDIPHONE.

Den'tist's Lathe. A small table lathe adapted for turning, grinding, drilling, polishing, etc., in mechanical dentistry. The *dental engine* occupies the same relation in operative dentistry.

The apparatus shown in Fig. 798 will perform the duties of both laboratory and operative lathe. It is shown

Fig. 798.



White's Dentist's Lathe.

mounted as a lathe proper, but the parts are shown lying upon the table which, when mounted, constitute the apparatus as an engine or drill, having the functions shown in Fig 795.

De-ox'yd-ized Bronze. A mixture of copper and tin, conpounded under certain conditions of proximate purity, and with a certain flux.

It is said to possess superior malleability, approaching gold alloys in this respect, while its tenacity and solidity are very great. It flows readily, is easily handled, and is capable of being re-worked. It is also receptive of a high, smooth finish; wears well, and is used for machine journals, car bearings, etc. It is now in use at the Philadelphia Mint.

De-phos'pho-riz-ing Pro'cess. (*Metallurgy.*) A process for the elimination of phosphorus from iron in the refining furnace.

Snelus, in England, patented in 1872 the use of lime or of limestone for the lining of furnaces, in which iron is refined while fluid.
Thomas & Gilchrist patented in 1879 a basic calcareous or magnesian lining for convertors, adding lime or oxide of iron and lime to the charge. See BASIC LINING.
The U. S. Patent of Jacob Reese is dated 1866.
Kunkel's U. S. Patent, dated 1866, claims the use of dolomite in the treatment of iron.
See also Hargreave's English Patent, 2461, of 1868.
See discussion in "*American Manufacturer*," June 6, 1879, p. 10, etc., and authorities therein cited.

Dep'i-la-tor. (*Surgical.*) An instrument, tweezers, for example, for pulling hairs.

Henry's depilating forceps . . . . . . p. 2, Part II.
Cilia forceps . . . . p. 2, Part II.
Tiemann's "*Armamentarium Chirurgicum.*"

De-pol'ish-ing. (*Ceramics.*) A term applied to the process of removing the vitreous glaze from porcelain, and leaving it with the peculiar dull luster of the ordinary surface of ivory. It is known as ivory porcelain. Gold work ornaments show upon it with a fine effect.

The parallel process in glass working is called *deglazing*.

Lockert on . . . . "*Technologiste*," xl. 51.

De-pos'it-ing Dock. (*Hydraulic Engineering.*) A caisson for raising vessels clear of the water and depositing them on staging for examination, cleaning, or repairs, the caisson retiring to repeat the operation on other vessels.

The depositing dock of *Clark & Standfield*, of London, built for the Russian Government at Nicolaieff on the Black Sea, is shown in Plate IX. Its duty is to raise or lower vessels, to deposit them upon fixed timber staging and again remove them when required; also to lower into the water vessels built upon an even keel on such staging.

The staging on which the vessels are deposited consists of a number of parallel rows of piles driven into the ground in a direction transverse to the length of the vessel: the space between each row is clear and open and of sufficient width to receive the projecting pontons of the dock, which carry the vessel at a height somewhat above the top of the piles.

The pontons of the dock are tubular, parallel and fixed at one end to a longitudinal frame or floating girder: at the other end they are free so that the whole structure represents a comb, of which the pontons are the teeth and the girder the back. The dock is sunk beneath the vessel, and the water being pumped out the dock rises, carrying the vessel with it. It is then floated to the staging, the pontons entering into the openings between the stages, and the vessel itself with its gridiron and bilge-blocks being clear above them. A little water admitted into the pontons allows them to sink and deposit the vessel and its grid on the staging. The girder, to which the horizontal pontons are connected, and which form the floor of the dock, carries a row of hollow vertical cylinders of such a length that when the pontons are submerged beneath the vessel, the tops of the cylinders are a convenient height above water. A platform occupies the tops of the cylinders, and this vertical portion contains the engines, pumps, and valves for working the dock.

The stability of the structure is effected by an arrangement of parallel bars attached to a floating caisson at the back of the dock, so that while the dock is free to ascend or descend in the water it cannot move out of its horizontal position without capsizing the caisson, which is made sufficiently wide and heavy to render such movement impossible. The pontons have sufficient buoyancy to support the vessel without any assistance from the floating girder or vertical tubes. The latter are in fact carried by the girder.

Each of the pontons is divided into 6 independent water-tight compartments, irrespective of the compartments in the girder and vertical tubes, and the pontons vary in number in action from 15 to 30; the whole dock is divided into from 100 to 200 separate water-tight compartments connected with the pumps by independent pipes and valves. A number of compartments are horizontally sealed up, so that the structure cannot entirely sink even were the valves to be left open.

The dock is so constructed that it can be divided at mid-length into two halves, each provided with its own engine and pumps, and either part is capable of docking the other.

"*Engineer*"	* xlvi. 64; * 75.
"*Sc. Am. Supplement*"	* 392; * 661.

See also list under DOCK.

De-pres'sor. (*Surgical.*) A clamp or valve to hold an object out of the way during an operation.

Tongue depressor	Fig. 265 *b*, Part II.
Vaginal depressor	Fig. 246, 8, Part III.

Tiemann's "Armamentarium Chirurgicum."

Der-i-va'tion Reg'u-la'tor. (*Electricity.*) A form of *polyphote* regulator for voltaic arc lights in which the regulation is effected by the variations in the differences of potential in the lamp. There is but one regulating electro-magnet, with fine wire and *in derivation*. — "*Electrician.*"

The Gramme and Crompton regulators on the continuous current principle and the Mersanne, Gérard, and Lontin fed by alternating currents, are of the derivation order.

Der'ma-to-log'i-cal In'stru-ments. (*Surgical.*) Instruments for skin-grafting, etc. See *Tiemann's "Armamentarium Chirurgicum."*

Transplantation scissors	Fig. 291, Part I.
Nævus needle	Fig. 80, Part V.
Scarifying spud	Fig. 84, Part V.
Epilating forceps	Fig. 85, Part V.
Glass pleximeter	Fig. 90, Part V.
Piffard's needles	Figs. 82, 83, Part V.
Depilating forceps, etc.	Fig. 7, Part II.

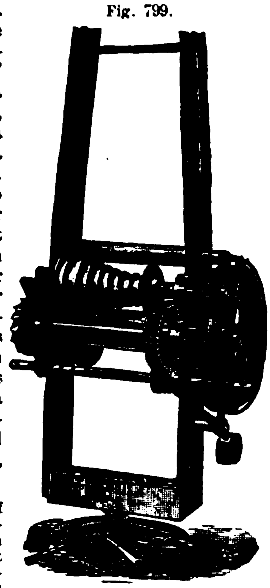
Dermopathic instruments are considered under ACUPUNCTURATOR, HYPODERMIC SYRINGE, SCARIFICATOR, LEECH ARTIFICIAL, DEPURATOR, CUPPING GLASS, etc.; also in "*Mech. Dict.*"

Der'rick. A species of hoisting apparatus: the term properly includes the machines which have an adjustable boom stayed from a central post which is held vertical by guys.

Mason	* "*Scientific Amer.*," xxxviii. 223.
Steam, *Lyman*	* "*Am. Manfr.*," June 27, 1879, p. 13.
Revolving	* "*Scientific American*," xlii. 114.

Der'rick Crab. The winch or hoisting arrangement at the foot of the leg of a derrick. The distinction made on p. 687, and elsewhere, "*Mech. Dict.*," being maintained — a *derrick* has one leg, with a swiveled post; a *shears* has two legs, a *crane* has a post and jib, or a curved jib which answers for both when a sufficient anchorage or base can be obtained to render a stay for the upper end of the post unnecessary; a *whin* has a vertical axis on which a rope winds and is moved by a horse sweep; a *capstan* has a vertical drum rotated by bars, etc.

Fig. 799.



Derrick Crab.

Fig. 799 shows one of Appleby's crabs for derricks, adapted to be run by hand cranks (not shown). The actual derrick shown is for 1½ tons and is erected in Columbo Harbor, Ceylon.

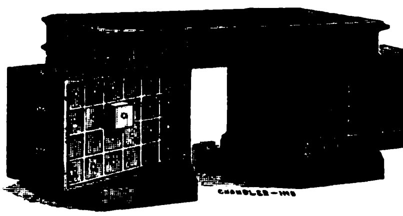
De-sil'ver-iz-ing Lead. A process used in reducing argentiferous galenas.

Lautenthal	"*Eng. & Mining Jour.*," xxx. 236.
Flach's zinc process	"*Scientific American*," xxxvi. 238.

See also PATTINSON'S POTS, pp. 1638, 1639, "*Mech. Dict.*"

Desk. Figs. 800, 801, show a flat top office desk, the lower sections of which are pivoted to the

Fig. 800.



Wooton Flat Top Office Desk. (*Open.*)

frame-work of the body of the desk and can be rotated so as to expose the pigeon holes or shelves, or to hide and shut them. The cases are rotated by the turn of a key, and the whole interior space exposed to view.

The Stiles combined folding paper-rack with reading and writing desks was shown at the Centennial Exhibition, Philadelphia, 1876.

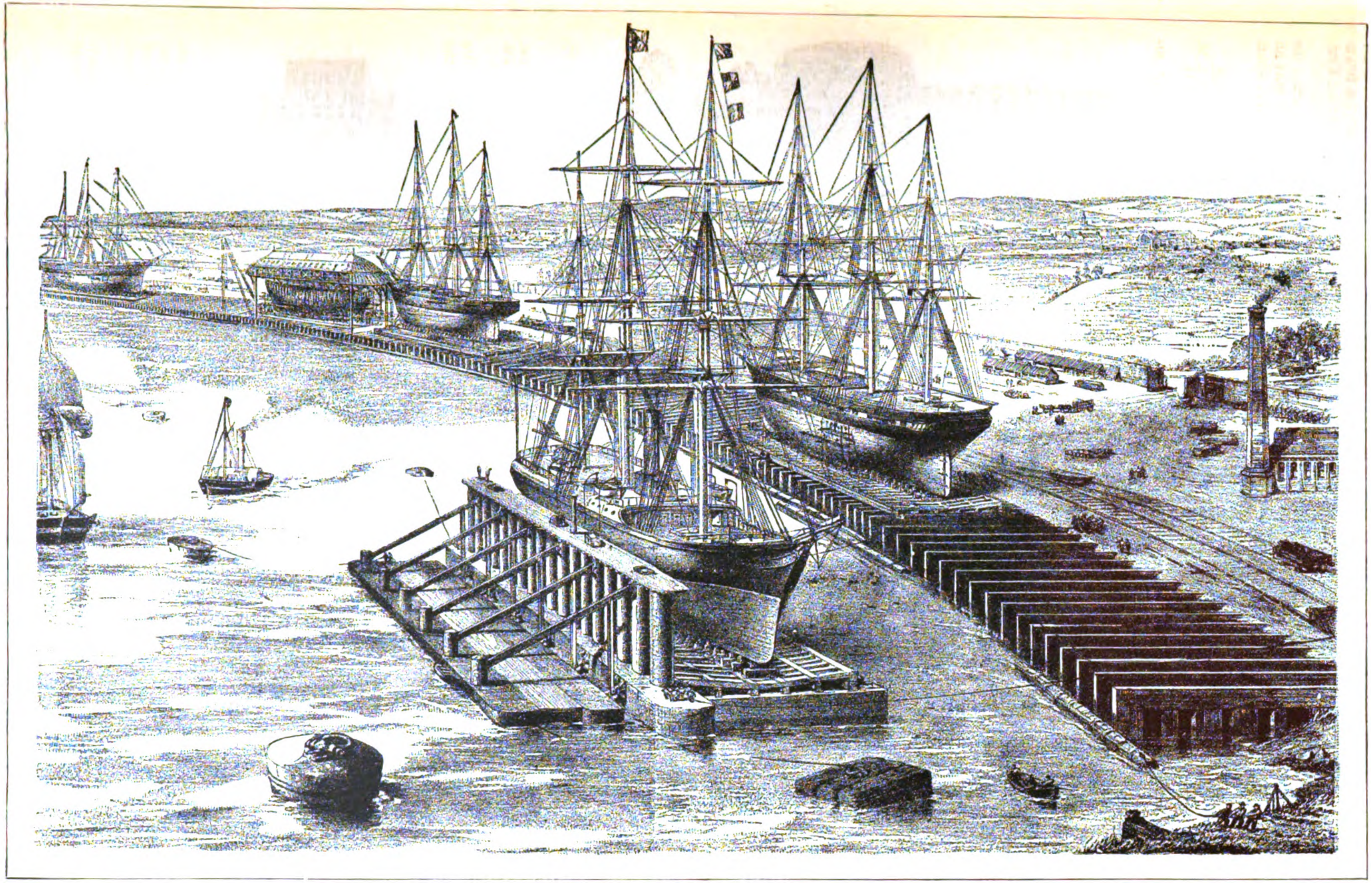
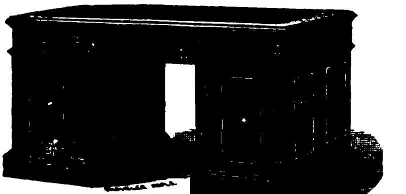


PLATE IX. DEPOSITING DOCK. See page 252.

Fig. 801.



Wooton Flat Top Office Desk. (*Shut.*)

Atkinson	* "*Scientific American*," xxxiv. 246.
Stiles	"*Scientific American*," xxxv. 326.
Chair, *Taylor*	* "*Scientific American*," xxxv. 294.
Satchel, *Kaplan*	* "*Scientific American*," xl. 323.

Des'si-ca-tor. An apparatus, in a laboratory, for promoting the absorption of the moisture of bodies. A porcelain dish with capsules or watch glasses, under a bell-glass, an absorber of moisture being included under the bell.

The term is also applied — somewhat inaccurately — to a similar inclosure to keep substances dry while weighing.

A *bain-marie*, or a sand-bath, may be used.

De-sul'phur-iz'ing Fur'nace. A roasting furnace for ores containing sulphur. See p. 690, "*Mech. Dict.*," and CALCINING FURNACE; DECOMPOSING FURNACE; ROASTING FURNACE, etc., *supra et infra*.

Willard . . * "*Mining & Scientific Press*," xxxvii. 145.

De-tach'a-ble Tooth Saw. Another name for the *insertable tooth* saw.

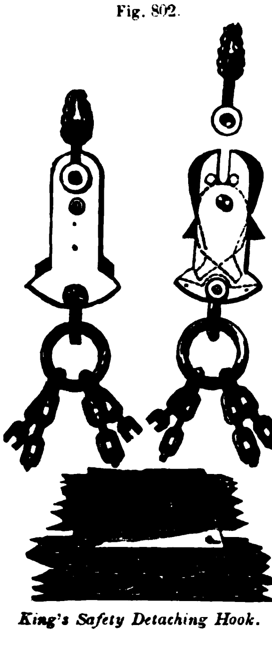
See 26 examples, Fig. 4593, p. 2035, "*Mech. Dict.*" Also as applied to stone saws, 20 examples in Fig. 5884, p. 2402. *Ibid.*

Brunet & Cochot's French patent, *Brevets*, vol. iv., Plate XV.

De-tach'ing Hook. 1. One for releasing the traces of a horse from the carriage. Referred to on p. 690, "*Mech. Dict.*"

2. One for casting loose the cage from the hoisting rope in case of overwinding in mine shafts.

Fig. 802.



King's Safety Detaching Hook.

King's safety detaching hook for mines and collieries, is shown in Fig. 802. It prevents the cage from passing over the wheel in case of overwinding, that is, when the steam-engine is not stopped in time. The figures show it as it appears at work, and as detached in the case of accident. Also the safety plate on which the cage remains suspended in case of becoming detached. 1500 of these hooks are said to be in use in British mines.

Fig. 803.

Cathcart's Detaching Hook.

3. One for releasing a boat from the davit tackle, as soon as the water is struck. Figs. 1596, 1597, p. 678, "*Mech. Dict.*"

Fig. 803 shows Captain Cathcart's detaching hook. It has a gravitating trigger which throws the ring out of the hook as soon as the weight is taken off the latter. The figure shows it in both conditions.

De-tect'or Gal-va-nom'e-ter. (*Electricity.*) A low resistance galvanometer used in testing condition of wires, etc., in laboratories and telegraph offices.

Dev'il's Claw. (*Nautical.*) A hook used to stopper the cable when the windlass is wanted for other uses.

De-vit'ri-fi-ca'tion. (*Glass.*) A process of subjecting glass for a long time to a high heat renders it opaque and hard like white porcelain.

Reaumur, in 1727, succeeded in the experiment by exposing it as described for 12 hours. It becomes extremely hard, acquires a noticeable fibrous structure, becomes a better electrical conductor. Glasses with a potassic base are more amenable to the process than those with a sodic base.

Bottle and window glass devitrify readily, and the contents of a pot in working will sometimes acquire the quality, losing its transparency.

Di'ag-nos'tic In'stru-ments. (*Surgical.*) Those for exploring, to ascertain the condition, natural or morbid, of parts.

The list embraces the following. They may be found in the specific lists (surgical), and under their specific titles, *infra* and in "*Mech. Dict.*" Also in Part I., *Tiemann's* "*Armamentarium Chirurgicum*," on the pages noted: —

Clinical thermometers	Page 75.
Urinary examination apparatus	Page 77.
Auscultation instruments, stethoscopes, pleximeter, and percussor	Page 81.
Stethometer	Page 84.
Cystometer	Page 84.
Cardiameter	Page 84.
Æstheslometer	Page 85.
Sphygmometer	Page 87.
Hæmarheumoscope	Page 88.
Dynamometer	Pages 88, 285.
Piezometer	Page 88.
Microscope	See *infra*.

Di'a-gom'e-ter. Palmieri's diagometer is an instrument designed to test the quality of oils, and is based upon the principle that olive oil is a poorer conductor of electricity than any other oil in common use. The oil is poured into a glass vessel, into which dip two brass rods which are kept the same distance apart while experimenting with different oils which are in succession poured into the glass. An electroscope determines the relative conductivity of the oils as the electricity passes from point to point through the oil.

The instrument may also be employed to detect the presence of cotton in silk fabrics. — *Professor Ricco.*

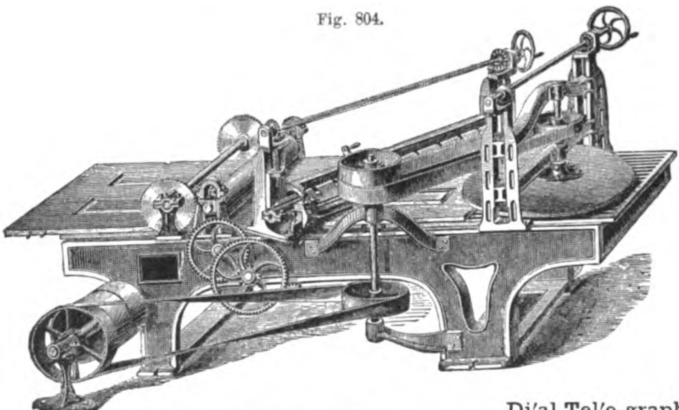
"*Scientific American*" . . . . . . * xxxix. 185.

Di-ag'o-nal Pla'ner. A wood-planing machine in which the planing cylinder has an oblique position relatively to the line of motion of the stuff under treatment. The machine is especially intended as a substitute for hand-planes in making doors, frames, blinds, etc. A door is shown as passing through the machine, beneath the feed-roller, then under the diagonal planing cylinder, and then below the polishing disk. Fig. 804.

"*Mining and Scientific Press*" . . . . * xxxv. 49

"*Manufacturer and Builder*" . . . . * x. 151.

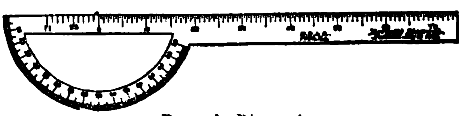
Fig. 804.



Diagonal Planing and Polishing Machine.

Di'a-graph. A platting instrument, combining a protractor and scale.

Fig. 805.



Barnett's Diagraph.

Dial. A graduated circle with numbers or point marks.

See illustrated article "*Cadrans Solitaire*," *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," vol. iv., ed. 1877.

One found at Tusculum	* "*Scientific American Sup.*," 4098.
Self recording, *Davis*	* "*Scientific American Sup.*," 616.
Self registering sun, Br.	"'*Scientific American*," xxxvii. 97.
Illuminated	"*Scientific Amer.*," xxxix. 402.
Luminous watch . . .	"*Scientific Amer. Sup.*," 2822.

(*Add.*) 6. (*Mining.*) A compass for taking bearings in mines.

7. (*Lock.*) The lettered or numbered face-plate of a permutation lock.

8. Various modes have been proposed and some of them put in practice for illuminating dials and signs at night.

Recordon's plan for watch dials is to place a Geissler tube containing a gas which gives a brilliant light in front of the dial. A battery about the size of a thimble is attached as an ornament to the watch chain. To consult the watch, press a spring and the current passes and illuminates the dial. The battery lasts a year in operation.

A plan for an illuminated public clock dial, is to employ a magic lantern to throw the picture of a common watch upon a suitable white screen in a public place.

Illumination of a town clock dial by gas in the rear of the glass dial plate is common; also by reflected light, p. 1171, "*Mech. Dict.*"

Phosphorescent paints for luminous dials and signs: —

1. Heat strontium theo-sulphate for 15 minutes over a Bunsen lamp and then for 5 minutes over a blast lamp.

Or 2. Heat equal parts of strontium carbonate and lac sulphuris gently for 5 minutes and then strongly for 25 minutes over a Bunsen lamp, and then over a blast lamp for 5 minutes.

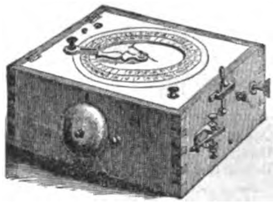
Or 3. Precipitate strong aqueous solution of strontium chloride by means of sulphuric acid; dry the precipitate and heat to redness for some time in a current of hydrogen. Then over a Bunsen lamp for 10 minutes, and 20 minutes over a blast lamp.

Mix either of these with pure paraffine for use as a paint and expose to sunlight.

1 and 2 give greenish phosphorescence; 3 a bluish phosphorescence.

The luminous clock dial of M. Balmain, of Paris, is painted with a composition into which enters a phosphorescent salt; storing up the light of day to give it out at night. Sulphide of calcium in varnish is stated as the preferable agent.

Fig. 806.



Dial Telegraph.

Di'al Tel'e-graph. A simple form of telegraph adapted for the use of persons who do not know the special systems or alphabets. It is only necessary to move the handle to any letter or number on the dial and a delicate needle in a corresponding instrument will point to the same letter. The needle of the receiving instrument is shown in the center of the dial, the sending handle on the exterior. The needle of the receiving apparatus passes through the center of the hollow shaft of the transmitting apparatus, and the same dial answers for both. A call-bell is attached to the instrument.

Di-al'y-sis Ap'pa-ra'tus. An apparatus consisting of a large flask with a faucet, a series of glass funnels and connecting siphons, and a final receiving vessel. Each funnel has a plaited filter made of parchment paper.

The process is described and the apparatus represented in "*Journ. de Pharm. et Chim.*" Reproduced in "*Scientific American Supplement*," * 2672.

Di'a-mag-net'ic. (*Electricity.*) A term applied to substances like glass, resin, bismuth, the poles of which tend to move from the strong to the weak places of electro-magnetic force. — *Gordon.*

Dia'mond. Mechanical uses of the diamond are noted in the following references: —

Millstone dresser, *Millot*	* "*Engineer*," xlvi. 255.
Drill (Pa. Co.)	* "*Scientific American Sup.*," 495.
Boring machine, *Penn. Diam. Drill Co.*	* "*Engineer*," xli. 447.
Mounting tools, *Millot Switz*	* "*Engineer*," xlvi. 255.
Stone-saw, *Emerson* . .	* "*Min. & Sc. Press*," xxxiv. 177.
Technical uses of . . .	"*Iron Age*," xviii., Dec. 14, p. 5.

See also pp. 696, 697, "*Mech. Dict.*"

Dia'mond, Ar'ti-fi'cial. A gem made of a clear white strass.

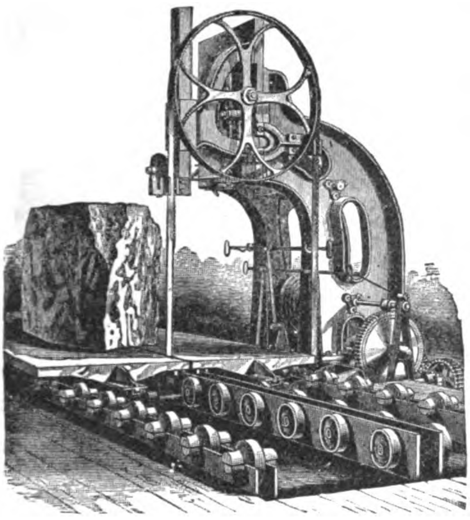
Loysel's paste:	Pure silica	100
	Red oxide of lead	150
	Potash, calcined	30
	Borax, calcined	10
	Arsenious acid	1

The paste has great brilliancy, refractive and dispersive powers and a specific gravity similar to that of the oriental diamond. It fuses at a moderate heat, and acquires great brilliancy by keeping in a fused state for several days to expel the superabundant alkali and perfect the refining.

Dia'mond Band'-saw. An application of the band-saw to the cutting of stone. The endless blade is set with diamonds and propelled by mechanism, which at the same time moves a bed-plate carrying the material to be sawn.

For sawing curves and scrolls narrow blades are used. The feed is made variable according to the kind of stone and its thickness. On one occasion, at the American Institute Fair, it sawed a block of

Fig. 807.



Diamond Band Stone-cutting Saw.

Newark brownstone, 3′ 2½″ × 3′ 3″, a superficial area of cut of 1,501¼ sq. inches in 22 minutes.

For circular stone saw see Fig. 5883, p. 2401, "*Mech. Dict.*"

Dia'mond Pan'eled Stone Work. (*Stone Cutting.*) Stone ashlar with the margin tooled and the face rising gradually in four triangular planes to an apex at the center.

The *sunk* diamond panel has a sunken margin, while the *raised* diamond panel starts immediately from the inner line of the usual tooled margin.

Dia'mond Stone Saw. A saw furnished on its edge with diamonds and used in cutting stone.

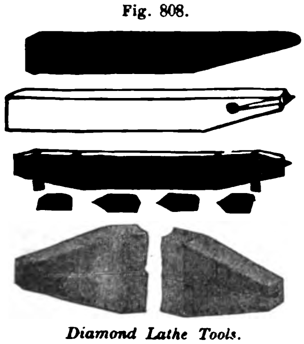
See Diamond Band Saw, Fig. 807; Stone Saw Circular, Fig. 5883, p. 2401, "*Mech. Dict.*"
Young's diamond reciprocating stone saw. *Hinton's* Report, "*Vienna Exposition Reports*," 1872, vol. iv., section D, p. 16.
Willard, Whittier, & Co's. diamond saw quarrying machine. *Ibid.*, p. 17.

Dia'mond Tool. 1. A tool which has a diamond mounted in a handle or holder and used to dress and turn up emery wheels, grindstones, hardened steel calender rolls, etc.

2. For forms of carbon points, see Fig. 1098, p. 461, "*Mech. Dict.*"

Fig. 808 shows diamond holders in which carbons are set permanently or in adjustable stems for the purposes above expressed. The lower figures in the cut show Dickinson's patent clamp.

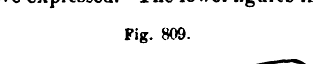
Fig. 808.



Diamond Lathe Tools.

Fig. 809 is a diamond hand-tool.

Fig. 809.



Diamond Hand-tool.

Dia'mond Truck. (*Railway.*) A car-truck with iron side-frames which are diamond-shaped. The journal-boxes are rigidly bolted to the sides, and have no vertical motion in the frame. See figures on p. 489, "*Mech. Dict.*"

Di'a-nem'o-scope. An instrument invented by M. Stanek, and having for its object the analysis of the more complicated motions of a double slide-valve system.

Proceedings of the "*Institution of Architects and Engineers in Bohemia.*" Reported in "*Engineering*," * xxiii. 420.
* "*Scientific American Sup.*," 1332.

Di'a-pa'son Clock. A form of clock made by Breguet, of Paris, in which a diapason (tuning-fork), is substituted as a regulator in place of a pendulum or spring balance-wheel.

* "*Reports of Artisans at Paris Exposition to the London Society of Arts*," p. 361. (Published by Bell & Bately, London, 1867.)

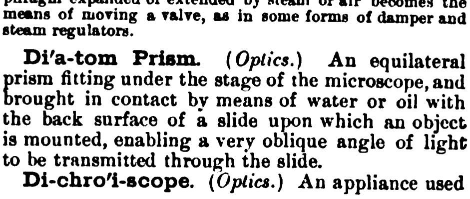
Di'a-pho-nom'e-ter. An instrument used in testing spirits (*Savalle*, Fr.). By it is determined the relative transparency of the sample when the reactive principle is added to the spirit. The degree of transparency preserved is the measure of the purity, and the comparison is made by the eye, the sample being held alongside specimens of determinate quality. * "*Technologiste*," xl. 169.

Di'a-phragm Fur'nace. (*Metallurgy.*) A roasting furnace in which ore is treated while dropping from one to another of a series of diaphragms in a vertical shaft. — *Haskins.*

Di'a-phragm Valve. One which closes by the pressure of a diaphragm against an opening, and *vice versa*. See Fig. 1636, p. 698, "*Mech. Dict.*"

Fig. 810 shows the principle adapted to a ball valve, where the ball floating in a cistern or boiler closes the water-induction opening on arriving at a certain height in the cistern.

Fig. 810.



Diaphragm Ball Valve.

Another form of diaphragm valve is that in which a diaphragm expanded or extended by steam or air becomes the means of moving a valve, as in some forms of damper and steam regulators.

Di'a-tom Prism. (*Optics.*) An equilateral prism fitting under the stage of the microscope, and brought in contact by means of water or oil with the back surface of a slide upon which an object is mounted, enabling a very oblique angle of light to be transmitted through the slide.

Di-chro'i-scope. (*Optics.*) An appliance used

Fig. 811.

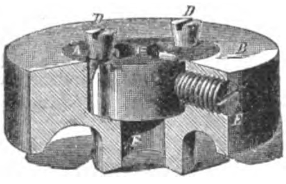
Sorby's Dichroiscope.

with a double image prism to give the complementary colors of an object examined under the micro-spectroscope. See Fig. 1640, p. 699, "*Mech. Dict.*"

Die. A hollow screw-cutter for cutting threads in bolts, etc.

Fig. 812 is Wiley & Russell's adjustable die. *A* is the die proper; *E*, the collet or holder; *D*, taper-head screws which govern the size of the cut; the points of these screws hold in a rim at the bottom of the socket; *E*, binding screws which close the dies together from the sides and hold them firmly; *F*, guides for bolts being threaded.

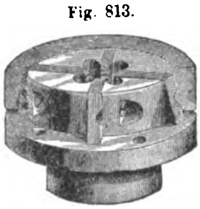
Fig. 812.



Wiley & Russell's Adjustable Die.

Fig. 813 is the Pratt & Whitney die. It consists of four chasers inserted in radial recesses in an iron disk or collet, encircled by a heavy wrought-iron ring, with adjusting screws. Each chaser is beveled in the ring, and is grooved on one side to receive the hardened point of a screw that is inserted in the collet to hold it firmly in position. Four screws extend up through the central flange of the collet, two of which serve to draw down the ring and move the chasers simultaneously toward the center to reduce the cutting size of the die, the other two screws hold the ring in the desired position or force it upward to enlarge the die.

Fig. 813.

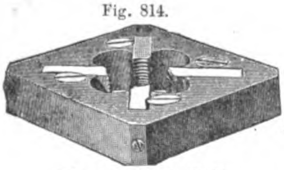


Pratt & Whitney's Adjustable Die.

The chasers, when dull, can be slipped out and ground on an ordinary grindstone, and be thus sharpened till worn out.

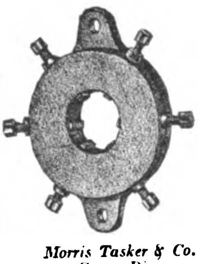
Fig. 814 is the Morse adjustable die. The die is fitted with chasers which are readily adjusted to take up wear or any variation in the size of the pipe. They can be sharpened when dull by grinding. The parts are made interchangeable.

Fig. 814.



Morse Twist Drill Co. Adjustable Die.

Fig. 815.



Morris Tasker & Co. Screw Die.

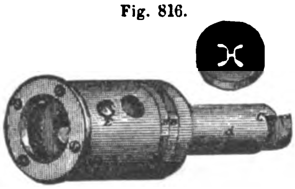
Fig. 815 is the Morris, Tasker & Co. die, with six chasers set up by screws. It is to be used in the head of their screwing machine.

See, also —

Nozzle tempering, *Harmstead*	* "*Scientific Amer.*,"	xl. 307.
Stock, *Walker & Williams* . .	* "*Engineer*,"	l. 420.
	"*Scientific Am.*,"	xliii. 230.
Lead pipe press	* "*Man. & Builder*,"	ix. 173.
Ore stamps	* "*Scientific Am. Sup.*,"	1512.

Die Hold'er. A head clutch or clamp for dies in a stock, brace, or machine. It is a form of chuck, the obverse of the drill chuck, shown on p. 276, *infra*.

Fig. 816.



Die Holder.

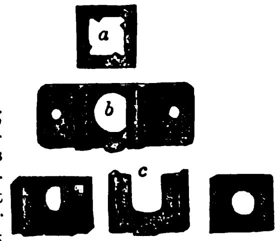
Fig. 816 is *Brown & Sharpe's* die holder for use in the revolving heads of screw machines, especially where it is desirable to cut the thread up to a shoulder or to a given point, or to run the tap into a shoulder for a given distance only, and this is necessarily a delicate operation, requiring expertness to avoid breaking the threading tool or injuring the shoulder of the screw. The engraving represents a patented device to remedy this difficulty, without regard to the skill with which it is operated.

Fig. 817 shows a solid die and die holders of the *Morris Tasker & Co.* screwing machine.

Di'e-lec'tric Ma-chine'. A simple and powerful static conduction machine constructed by M. Carré. It has revolving wheels of hardened rubber, the electricity being supplied by friction on stationary rubbers placed in front. It is a machine of singular power and capacity as evinced in the production of sparks, illumination of Geisler tubes, piercing of glass and charging batteries of Leyden jars.

Abbe le Dantec.
* "*Sc. Am. Sup.*," 3902.

Fig. 817.

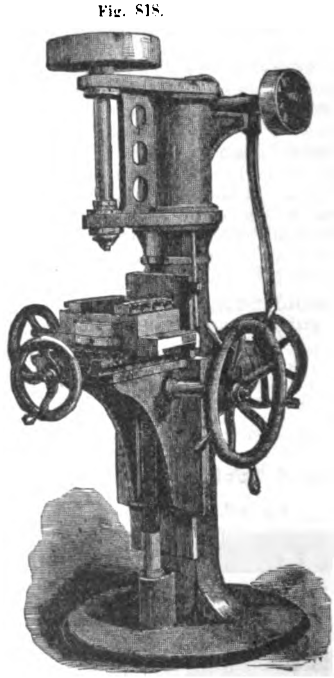


Die Holders for Screwing Machine.

a. Solid die.
b. Solid die holder for use in head of screwing machine.
c. Reducing pieces for holding square dies.

Die-sink'ing Ma-chine'. In principle this machine is similar to the profiling machine, but it has a far greater range. The work may be moved in all directions, and may be guided by a pattern or controlled by the hand of the operator. It is well adapted to forming recesses of a circular, annular, or irregular shape; works very smoothly and free from chatter. The various feeds are entirely independent.

Fig. 818.



Die-sinking Machine.

The work to be operated upon is held in the vise, which may be moved in all directions horizontally by compound slides on the table of the machine, and may be elevated or depressed by the vertical movement of the platen. The cutter, which may be of any suitable size or form, revolves with the spindle which is driven by a belt, giving much smoother action than is possible with gears. The greatest distance between the end of the spindle and top of the table is 24″. The platen has a vertical adjustment of 16″, and the horizontal movements of the vise are 10″. The countershaft has two sets of pulleys, giving two speeds, which may be varied on the spindle by a cone with three grades.

Di'e-ther'o-scope. An instrument invented by *M. Lurini* for measuring the variations in the refractive condition of the atmosphere.

"*Scientific American Supplement*" . . . . * 477.

Dif'fer-en'tial. (*Electricity.*) A coil of electrified wire having such relation to another electrified coil or to an armature (or needle) common to both as to produce polar action contrary to that produced by such other coil.

(*Electric Lamps.*) A conductor of high relative resistance — used with electric lamps in series, — which operates in the twofold capacity of shunting surplus current to the next lamp and of shortening the arc of its own lamp, so as to maintain equal action in all lamps of the series. (See ELECTRIC LAMPS.)

Dif'fer-en'tial Ap'pa-ra'tus. See under the following references and the articles *infra.* DIFFERENTIAL PULLEY, etc.

Thermometer, *Dufours* . . . . * "*Sc. Amer. Sup.*," 3952.
Pump, *Hathorn, Davis & Co.*, Br. * "*Engineering*," xxvi. 197.
Screw Jack . . . . * "*Engineering*," xxv. 522.
Wheels, C. W. MacCord . . . * "*Sc. Amer. Sup.*," 2123.

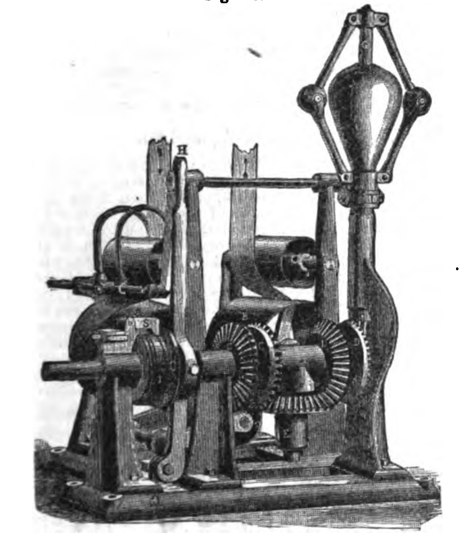
Dif'fer-en'tial Gal'va-nom'e-ter. (*Electricity.*) An apparatus consisting of a needle as in an ordinary galvanometer, but round the frame of which are coiled two wires of the same kind and dimensions carefully insulated from one another; separate currents being passed through them in opposite directions, the needle by the direction and extent of its disturbance indicates which current is the stronger and in what degree.

Dif'fer-en'tial Gov'er-nor. A water-wheel governor. The motion is positive, the revolving balls are merely indicative of the speed of the motor and are not regulators.

The operation of the governor is as follows: —

Two pulleys, *A* and *B* are geared respectively to *C C* and *D D*. Pulley *A* is the frustum of a cone, its diameter at the center of its face being the same as that of the regular pulley *B*. The gears *C C* and *D D* are loosely set on the shaft *F*. The gear marked *E*, enters into *C* and *D*, and is loose on a stud which is fastened to the shaft *F*. The shaft carrying the pulley *A* has upon its end a small gear (not shown in the engraving) which communicates motion to the

Fig 819.



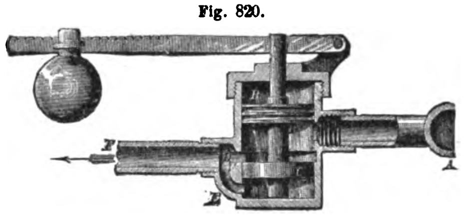
Weaver's Differential Governor.

gears *C C*. Upon the end of the shaft carrying the pulley *B* is a similar small gear (not shown in the engraving), which gives motion to the gears *D D*. Motion is communicated to pulleys *A* and *B* by a belt running in the direction indicated by the arrows. On the lower end of the governor shaft, *G*, is a small gear, which receives its motion from the gear *D*. When the belt is running in the center of the two pulleys *A* and *B*, the speed of both is the same, as their diameter in the center of face is the same. Consequently *C C* and *D D* run at the same speed, and have an equal action on the gear *E*; and hence the stud upon which the gear *E* revolves is held stationary. Now, upon the addition of a load, the speed will be checked, and the balls of the governor will fall. By this act, the belt on pulley *A* is, by proper connections, moved towards the larger end of the cone, thus causing the gears, *C C* and *D D*, to revolve with unequal velocity. This motion of the gears causes the gear *E* to be carried around on the gears *C C*, which, by means of connections with the shaft, opens the gate. Upon the decrease of the load, this operation is reversed, and the gate shut. The purpose of the lever *H* is to throw the governor out of gear by means of the flange *O*, and the clutch *I*. The flange is held out of gear by the latch marked *S*. The object of this arrangement is to enable one to hoist the gate, and when the proper speed is attained to throw the governor into gear by lifting the latch *S*.

Dif'fer-en'tial Move'ment. For the principles and illustrative instances of the transference of a movement at different rates in other directions, conversion of movements, etc., see "*Differential*," *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," Paris, 1877, vol. i.

Dif'fer-en'tial Press'ure Reg'u-la'tor. A contrivance to enable steam to be taken from a

Fig. 820.



Hand's Differential Pressure Regulator.

boiler or steam-pipe at any initial pressure and delivered equally at any pressure for which it is set

Steam is taken from pipe *A* and passes to the chamber where it acts equally upon the apposed surfaces of *B* and *C*, being so far balanced. The steam, however, passes by duct *D* beneath the piston *C* and exerts an upward pressure; this is balanced by the weight on the lever which tends to depress *C*. If the steam pressure should rise above that for which the lever ball is adjusted, the steam will raise *C* and partially close duct *D*, so that the *quantity* of steam passing to the object to be heated is diminished in proportion to its increased pressure and heat.

Fig. 821.

Differential Pulley Block.

Dif'fer-en'tial Pul'ley Block. Fig. 821 show the Moore's improved form of differential pulley block as manufactured by the Providence Tool Co. It has the following features: —

The lifted weight cannot run down of itself when suspended; both chains take an equal share of the load, so that the block hangs plumb; a hook can be attached to each end of the lifting chain so that when one load is raised the other hook is in position ready for work.

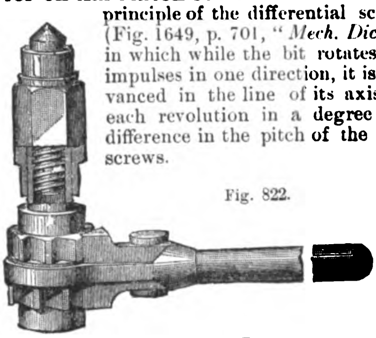
Weston . . . . . * "*Iron Age*," xxi., Jan. 17, p. 1.
Weston . . . . . * "*Scientific American*," xlii. 851.
Weston . . . . . * "*Min. & Scientific Press*," xxxvi. 225.
Cherry . . . . . * "*Engineer*," xlii. 88.

Dif'fer-en'tial Pump. In Davey's steam pump (Hathorn, Davis and Davey, Leeds, England), the slide valve derives its motion both from the main cross head and from a rod connected with a cataract piston moving with a uniform velocity, the two motions being so connected that the cut-off depends upon the velocity of motion of the main cross-head — in other words, upon the resistance encountered or work to be done by the piston. In the differential pumping engine the cataract piston is connected with a subsidiary steam piston working in a separate cylinder fitted with a small slide valve.

The invention is shown and described in
"*Scientific American Sup.*" . . * 2369.
Hathorn, Davis & Co., Br. . . * "*Engineering*," xxvi. 197.

Dif'fer-en'tial Ratch'et Brace. One on the principle of the differential screw (Fig. 1649, p. 701, "*Mech. Dict.*") in which while the bit rotates by impulses in one direction, it is advanced in the line of its axis at each revolution in a degree the difference in the pitch of the two screws.

Fig. 822.



Differential Rachet Brace.

See also RATCHET-BRACE, RATCHET-DRILL, p. 1882, "*Mech. Dict.*"

Dif'fer-en'tial Reg'u-la'tor. (*Electricity.*) A means of regulating an arc voltaic light, in a polyphote arrangement, by the differential action of the main current that produces the voltaic arc and of a highly resistant derivation established between the two carbons; thus, their distance apart depends both on the intensity of the current and on the difference of potential at the base of the two carbons; and equilibrium is established for each lamp, when the intensity and the difference of potential have reached the point requisite for the good working of the lamp. "*Electrician.*"

The *Siemens'* differential lamp has two solenoids that work on one rod. The *Brush* and the *Weston* have one electro-magnet on which are coiled two wires that act in inverse directions.

Dif'fer-en'tial Screw Pipe Joint. A pipe joint, the invention of M. Brurry, of St. Gallen, Switzerland. The ends of the pipes to be connected are threaded with screws of a different pitch and respectively right and left handed. A coupling, correspondingly threaded, screws on to them simultaneously and draws them together with great force.

Fig. 823.

Differential Screw Pipe Joint.

Bourry, Switz. . . . . * "*Engineering*," xxiii. 388.
* "*Scientific American Sup.*," 1272.

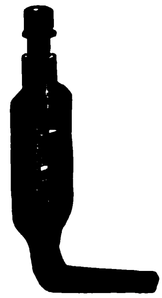
Dif'fer-en'tial Steth'o-scope. (*Surgical.*) A double stethoscope with elastic tubular branches and bells capable of being applied to different portions of the thorax so as to compare the indications at different points.

Allison, Fig. 268, p. 83, Part I., *Tiemann's* "*Armamentarium Chirurgicum.*"

Die Dog. A lathe dog adapted to hold a screw cutting die. Fig. 824.

Dif-fu'si-om'e-ter. (*Gas.*) An instrument invented by Graham to ascertain the rate at which diffusion of gases among one another takes place.

Fig. 824.



Die Dog.

A glass tube of 1″ caliber, 1′ in length, is stopped at one end with a porous plug of gypsum or graphite. The tube is filled with hydrogen, for instance, the open end plunged in a bath of mercury, and diffusion takes place through the plug. The law that the diffusibility of gas is in proportion to the square root of their densities is illustrated by the interchange of hydrogen and atmospheric air, at the expense of the latter, and the tube is eventually emptied.

Dif-fu'sion. (*Electricity.*) The power of a galvanic current to extend its influence in all directions, that influence being never limited to the two electrodes.

Dif-fu'ser. A portion of the apparatus in Clamond's thermo-electric battery, consisting of a series of plates of copper placed all round the battery, and which effect the removal and rapid dispersion of the heat of the solderings by means of the great surface which they present.

Described in "*La Nature*," 1880. Also in "*Manufacturer and Builder*," * xii. 86.

Dif-fu'sion Pro'cess. The Roberts diffusion process is mentioned and illustrated on p. 702, "*Mech. Dict.*" It has been very elaborately extended in some European sucreries. See

Roberts, Fr. . "*Dept. Agric. Sp. Rep.*," No. 28, Pl. XXIII.
Rotative, Ger. . "*Dept. Agric. Sp. Rep.*," No. 28, Pl. XXIV.
Continuous process.
* "*Scientific American Sup.*," 4109.

The question is admirably discussed, compared, and illustrated in Mr. Mallet's report on Group III. at the International Exhibition, Philadelphia, 1876. See vol. iv., Group III., * pp. 20-54.

The rotative diffusion apparatus was shown at the Paris Exposition of 1878 by Lecomte & Villette, Saint-Quentin (Aisne), France.

See also pamphlet on the subject by G. Bouscaren, Cincinnati, O.

Dig'ger. A spading machine.

Steam, *Darby*, Eng. . . * "*Scientific American Sup.*," 2458.
Knight, Br. . . . . * "*Engineer*," xli. 394.
* "*Scientific Amer.*," xxxviii. 83.
* "*Scientific American Sup.*," 455.

Dike. 1. A levee, bank, or dam.

In Japan the dike is formed thus: A kind of strong cylindrical bag, often eight yards and more in length, is made of split bamboo, with wide meshes, and is then filled up with big stones. A certain number of these bags, arranged on a wooden grating, form the foundation of the breakwaters or dikes. When the current is very strong, the ends of the bags are allowed to pass the gratings and to hang down into the sandy bed of the river; gradually they sink deeper and deeper, and finally, being entirely buried in the mud, form a solid mooring. The object of the bags is to keep the stones together, till all the interstices are filled up with sand and mud, when the construction is transformed into a solid mole. The bamboo is said to be of great durability; stems of this tree are also used for weirs and the temporary surroundings of breakwaters. The exterior parts of dikes are often covered with grass matting, so as to prevent their being washed away.

2. (*Mining.*) A wall-like mass of mineral matter filling fissures.

Di-la'tor. (*Surgical.*) An instrument for distending a natural or artificial opening. The term is specially applied to certain instruments, but really includes *speculi*. See Figs. 5360-5363, p. 2260, "*Mech. Dict.*"

See also list of DILATORS, p. 703, *Ibid.*, and ENDOSCOPE, *infra.*

The subject may be pursued by reference to the following figures in *Tiemann's* "*Armamentarium Chirurgicum*": —

Lithotrity	Page 43, Part III.
Meatus urinarius . .	Page 2, Part III.
Esophageal	Page 84, Part II.
Rectal	Page 118, Part III.
Sponge	Page 14, Part V.
Tracheal	Pages 93-94, Part II.
Tupelo	Page 11, Supplement.
Urethral	Page 23, Part III,
Uterine	Pages 77-79, Part III., 13, Supp.
Vaginal	Page 66, Part III.

Di-la'ting For'ceps. (*Surgical.*) Forceps the prongs of which are used to expand a passage or meatus. The *cervix uteri* dilator, for instance, Fig. 1220, p. 516, "*Mech. Dict.*," *et infra.*

Di-men'sion Saw'ing Ma-chine'. One adapted to sawing stuff to a given size for manufacturing purposes.

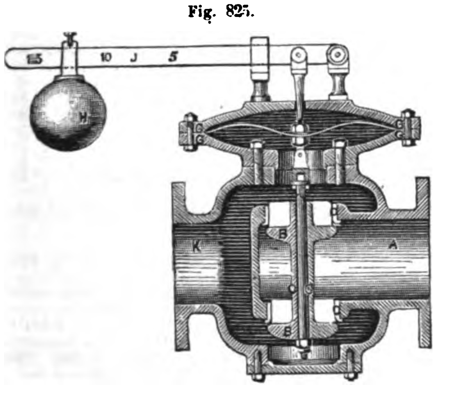
Richards' . . . . . * "*Engineering*," xxv. 151.
Preston's . . . . . * "*Scientific American*," xl. 403

Di-men'sion Stone Work. (*Masonry.*) Said of masonry when the dimensions of the stones entering into it are fixed by specification. See list under MASONRY.

Di-min'ish-ing Valve. A valve to regulate high pressure steam so as to give out a constant and uniform supply of low pressure steam.

The valve is shown by section in Fig. 825. Its operation is as follows: *A* is the inlet for high pressure steam; *BB* is

Fig. 825.



Diminishing Valve.

a double beat valve, with a hole through the stalk *C*, and which shuts against the brass seatings *BD*; *E* is a connecting rod, secured with nuts and washers to the bottom of the valve *BB*, and also to the circular corrugated metallic disk *F*, which is held in position betwixt *GG*. Suppose there is a pressure of 60 lbs. per square inch at the inlet *A*, and 10 lbs. per square inch is required at the outlet *K*, set the weight *H* on the lever *J* at 10 lbs., which pressure will raise the corrugated metallic disk *F*, thereby shutting off the excess of steam over and above the 10 lbs. required. The pressure at the outlet may be varied by moving the weight *H* on the lever *J*.

Din'gy. (*Fishery.*) A small fishing boat. See list under BOAT.

Berthon's duplex dingy, Br. . . * "*Engineer*," xlix. 438.

Di-o-nys'i-us' Ear. An aural instrument for the very deaf. It has a capacious pavilion swiveled on a stand which is planted on the floor, and an elastic tube with a nozzle to be applied to the ear.

Fig. 227, Part II., *Tiemann's* "*Armam. Chirurgicum.*"

Di-op'tric Ap'pa-ra'tus. The refraction system of lighting as distinguished from *catoptric.* See p. 704, "*Mech. Dict.*" See also following instances: —

Little-Basses, Ceylon . . . . * "*Sc. American Sup.*," 945.
For electric light, *Henderson*, Br. . . . . * "*Engineer*," xlix. 246.
Flashing apparatus, Little-Basses light . . . . . . * "*Engineering*," xxii. 355.
For light-ships, *Sautter, Lemonnier & Co.*, Fr. . . . . * "*Engineering*," xxvii. 211.
Revolving light, *Sautter, Lemonnier, & Co.*, Fr. . . * "*Engineering*," xxvii. 269.

Di-or-rex'ine. An explosive analyzed by M. Fels.

Consists of Picric acid,	1.5	Nitrate potassium . }	60
Wood charcoal . .	7	Nitrate sodium . . }	
Birch sawdust . .	10	Sulphur	12
		Water	9.5

Made principally at Brunn and Trieste.
"*Eng. & Mining Journal*," xxviii 263.

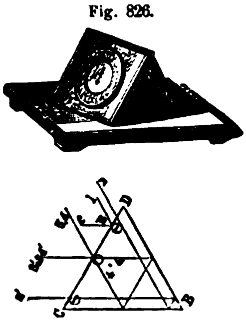
Another published recipe gives: —

Nitrate of potassium	50
Nitrate of sodium	25
Sulphur	12
Hard wood sawdust	13
	100

Di-plei'o-scope. An instrument invented by Bloxam to determine true meridian. *Dipleidoscope*, p. 704, "*Mech. Dict.*"

The instrument is represented in Fig. 826, the upper view showing it in position for observation, and the lower a diagram illustrating the principle of its operation, which is founded on the property of polished bodies, to reflect rays at an angle equal to that of their incidence.

Fig. 826.



Dipleioscope.

The instrument is on a horizontal base, and its anterior face is perpendicular to the meridian of the place. It is an equilateral glass prism with one face exposed, the others being opaque and constituting mirrors. *D C* represents the exterior face of the instrument, and *D B*, *B C* are mirror planes. Suppose that the ray 1 striking *D C* at *E* be reflected towards the eye in the direction 1', the image of the sun will appear, as time lapses, to advance in the direction from *D* towards *C*. The ray 2, traversing *D C*, is reflected by *C B* on to *D B*, and thence towards the eye in the direction 2', and the second image of the sun has an apparent motion in the direction from *C* to *D*, and as the sun culminates the two images mutually approach.

Supposing that the ray 1 shall arrive at 3 and the ray 2 impinge upon 4, it is evident that they will be each reflected in the common direction 3' and 4'; that is to say, that the two images will coincide at the instant of true meridian. The moment passed, the rays continuing to advance, the images again separate themselves, changing their relative positions and mutually recede.

Dip'lo-graph. A writing apparatus for the blind, invented by M. Recordon, of Geneva, Switzerland.

Speaking in general terms, it has lettered disks rotated by the blind writer so as to bring letter after letter in position to imprint upon a paper which moves along before the writer. It is simple but clumsy, far inferior to a type writer, which it would be easy to furnish with raised letters on its plungers: it is hardly worthy of the praise bestowed by "*La Nature.*" Shown in "*Scientific American*," * xxxvii. 210.

Dip'per. A form of dredging machine which has a large ladle on the end of a spar. This is plunged under water, scoops along the bottom, and then rises to the surface, and discharges its load into a lighter.

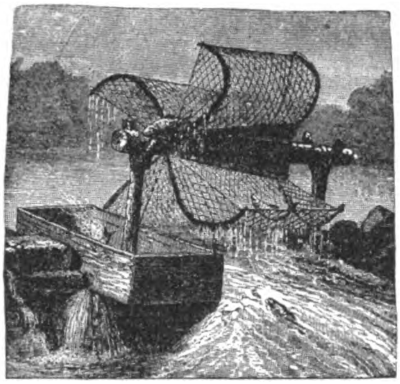
The principle is shown in Fig. 1896, vol. i., "*Mech. Dict.*," though the machine there shown is not aquatic.

Dip'per Ear'-trum'pet. An aural instrument with a dipper or cup-shaped pavilion. The sound waves entering the flaring mouth are reflected by the parabolic bottom towards a common center, and thence conducted by a tube to the ear.

Figs. 225, 226, Part II., *Tiemann's "Armamentarium Chirurgicum."*

Dip'ping Wheel. (*Fishing.*) A contrivance used in Southern rivers to meet local demand for fish.

Fig. 826.



Dipping Wheel.

It is set in the stream so as to be turned by the current, and has a number of dip-nets which raise the fish and tumble them out at the axis in the manner of the scoop-wheel. The inclination of the nets is toward the catching-box at the side.

Dip'ping Vat. (*Ceramics.*) The trough containing fine glazing slip in which biscuit ware is dipped to be covered with the material which, baked on, forms glaze.

Dip Reg'u-la'tor. (*Gas.*) A device used in gas works for regulating the seal of the dip-pipes in the hydraulic main, and for drawing off the heavy tar from the bottom of the main without disturbing the seal. See Fig. 1660, p. 705, "*Mech. Dict.*"

Di-rect'-coup'led Steam En'gine. A form of engine in which the piston-rods of two engines are coupled directly to the same crank.

The term is held to include the form shown in Fig. 713, in which the crank is rotated by the intervention of a triangular connecting-rod.

Di-rect' Fire. 1. (*Fire-arms.*) That kind of action in which the plungers lie and strike the ignition in a line parallel with the axis of the barrel.

2. (*Glass.*) A glass furnace with no artificial draft other than derived from the chimney or stack.

Di-rect' I'ron Pro'cess. A process for procuring directly from the ore an iron which is practically pure chemically, although mechanically mixed with certain impurities. The Catalan, the most ancient of processes, employed to produce charcoal blooms.

The modern direct methods are discussed in a report by A. L. Holley, Group I., "*Centennial Reports,*" vol iii., p. 40. Blair's and Siemens's processes are considered : —

"Blair's consists in deoxidizing the ores rapidly by gas and solid fuel, but without fusion, and then withdrawing the iron-sponge cold, without allowing it to oxidize again. The sponge is compressed and charged into the open-hearth furnace, or it is reheated or charged, or it is melted in a cupola and then treated in the open hearth. The best manner of using the sponge does not appear to be fully settled. Siemens's process consists in melting ore, together with coal and limestone enough to reduce it, in a rotating furnace, tapping off such slag as will run, squeezing the remaining slag out of the ball, and charging the ball hot into the open-hearth furnace. The radical trouble in all direct processes has been the waste of iron in getting it from the sponge into merchantable form. The addition of the open-hearth process greatly relieves this difficulty." — *Holley.*

See also ROTATOR ; SPONGE.

Di-rect'or. (*Surgical.*) A grooved instrument to serve as a guide to a knife, probe, scissors, bistoury, herniatome.

Exploring director	Fig. 135, p. 44, Part I.
Exploring director	Fig. 184, p. 61, Part I.
Allingham's anal scissors director	Fig. 589, p. 121, Part III.
Anal and rectal director	Fig. 591, p. 122, Part III.
Levis, hernia director	Fig. 629, p. 126, Part III.

Tiemann's "Armamentarium Chirurgicum."

Di-rect' Pro'cess. (*Metallurgy.*) One by which a metal is obtained in working condition by a single process from the ore. It is said of malleable iron obtained in loups for blooms by open-hearth process, in contradistinction to the double operation of obtaining pig iron by blast furnace and converting pig into malleable iron by puddling and hammering. See DIRECT IRON PROCESS.

Dis-gorg'er. (*Fishing.*) An implement used in discharging a gorged hook from the mouth or stomach of a fish. It is pushed down along the line, pushes back the barbed point, and thus assists in retracting the hook.

Dis'in-fect'ing Stove. A stove with adjacent drying chamber provided with bars on which to hang the clothes while exposing them to a heat of 159° C.

In the Chemical Department of Public Health of Dresden the following is given as the relative value of the articles stated, as disinfectants, — chloride of lime and sulphuric acid being 100 : —

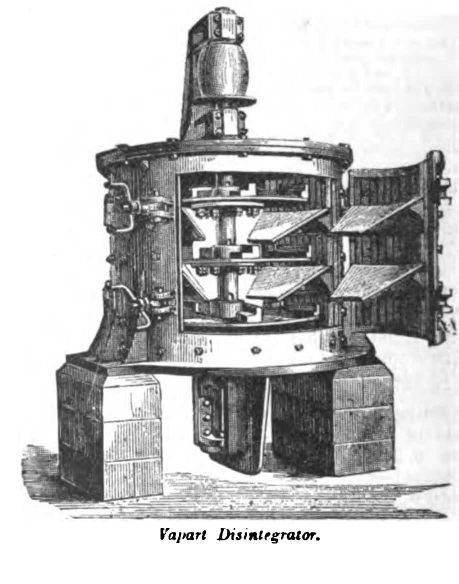
Chloride of lime, with sulphuric acid	100
Chloride of lime, with sulphate of iron	99
Luder and Liedloff's powder	92
Carbolic acid disinfecting powder	85.6
Slaked lime	84.6
Alum	80.4
Sulphate of iron	76.7
Chloralum	74.0
Sulphate of magnesia	57.1
Permanganate of potash, with sulphuric acid . .	51.3

Dis-in'te-gra'tor. A pulverizing machine operating by percussion.

The success of *Carr's* disintegrator, shown at Fig. 1665, p. 707, "*Mech. Dict.*," has been the incentive to the invention of a large class of machines which go by the name of disintegrators, the common feature of which consists in pulverizing by percussion, in the breaking by blows of rapidly revolving arms, spokes, or cages, as distinct from the grinding by attrition between surfaces.

The range of material to which the disintegrator has been

Fig. 828.



Vapart Disintegrator.

adapted has also been very much extended, and includes breaking and pulverizing —

Asphalt rock.	Grain of all kinds.
Bark.	Graphite.
Bones.	Guanos.
Cement.	Minerals.
Coal for patent fuel and coke making.	Mixing chemicals, clays, colors, fertilizers, sugars.
Coprolites.	Oil cake.
Fertilizers.	Ores.

The *Vapart* disintegrator consists of three horizontal platforms keyed to a vertical shaft. The platforms are fitted with vanes placed radially. The shaft is supported below by a footstep, and above by an ordinary bearing. The platforms are inclosed in a cast-iron cylindrical casing, fitted with two doors to give access to the interior. Between the platforms, and attached to the casing, hoppers are fixed to deliver the material to the center portion of the platforms, and opposite the platforms serrated segments of chilled cast iron or steel are attached.

The shaft and platforms are made to revolve rapidly, and the material is first delivered into the machine near the center of the first platform, where the velocity is low. It is then guided by the vane, and by centrifugal force is projected violently against the first series of segments. The broken material falls by its own weight down the first hopper to the center of the second platform, and is again thrown violently against the second series of segments, and afterwards against the third, when the material finally falls out of the machine in a thoroughly disintegrated state. Two arms fixed under the last platform serve to keep the machine clear. The pulverized material can then be led away on a belt or otherwise, as may be convenient.

Various forms of disintegrators are found in the columns of "*Engineering*," October 18, 1878; and proximate dates including: —

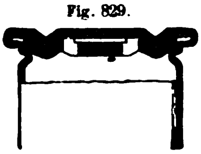
* *Carr's*,	* *Wilson's*,
* *Sherwin's*,	* *Vapart*.
* *Carter's*,	

The machines of *Hawksley* and of *Western & Co.*, of London, and *Bichou & Cie.*, of Paris, have been prominent at late expositions.

Carr	* "*Sc. Am. Sup.*," 2496.
	"*Com. Trade Jour.*," Br., June 8, 1878.
Carter	* "*Engineering*," xxi. 135.
	* "*Sc. Am. Sup.*, 240.
Sherwin, Br. . .	* "*Engineer*," xlv. 354.
Vapart, Fr. . . .	* "*Engineering*," xxiii. 448.
	"*Iron Age*," xxii., Aug. 1, p. 1.
	* "*Scientific American*, xxxvii. 67.

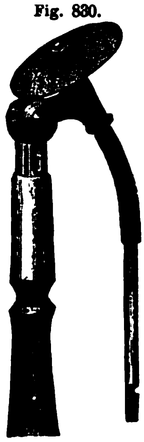
Disk An'vil. A strengthening plate or reinforce placed inside the head of a cartridge to support the impact of the striking pin which explodes the fulminate. See also CUP ANVIL.

Fig. 829.



Disk Anvil.

Fig. 830.



Dr. Hickman's Disk Carrier.

Disk Car'ri-er. (*Dentistry.*) A device for holding a cutting, grinding, or separating disk at the end of a handle while it is rotated by a flexible shaft driven by the dental engine. It is used in separating the teeth, cutting out lingual and buccal fissures, and finishing fillings and rough surfaces.

Disk Cut'ter. An instrument for cutting circles of thin glass for covers of microscopic objects on slides. A diamond is on the end of the arm, which is adjustable to suit the radius of glass cover required. See CIRCLE CUTTER.

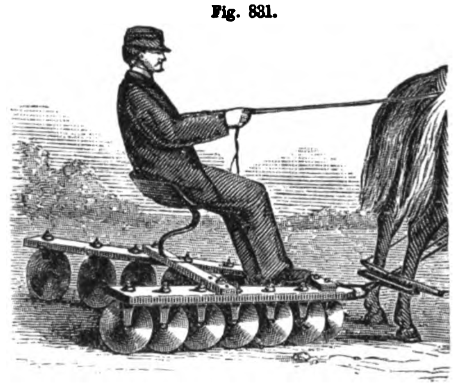
Disk E-lec'trode. (*Electricity.*) An electrode for telegraphic instruments in which the connection is secured by the contact of the peripheries of two disks, the axes of which are at right angles. The contact is a mere point or dot. The disks are of brass with platinum wires let into grooves on their peripheries, the densely-drawn hard wire permitting a fine and small contact. — *Cumming.* See TELEGRAPH KEY; also Fig. 847, p. 266, *infra*.

Disk En'gine. A form of steam engine invented by Dakeyne in 1830. Improved by Bishop, Ericsson, and others.

See *Bishop*, c, Fig. 1666, p. 708, "*Mech. Dict.*" (Wabbling).
Ericsson, A, B, same figure (revolving).
Taylor and Davis, 1836, 1838. (Br. patents.)
Gorsage, 1838.
Geiss, 1870.
See *Laboulaye's* "*Dictionnaire*," etc., tome iv., article "*Machines à Vapeur*," Figs. 3644–3646.
See also FOUR-CYLINDER ENGINE, SIX-CYLINDER ENGINE.

Disk Har'row. (*Agric.*) A harrow having a triangular frame, with a driver's seat mounted upon it, and carrying a number of sharp-edged and concave disks, set at such an angle in relation to the line of draft that in revolving they pulverize the soil, cutting, lifting, and turning it over in small furrows. A scraper is provided for each disk, so as to keep it constantly free from dirt.

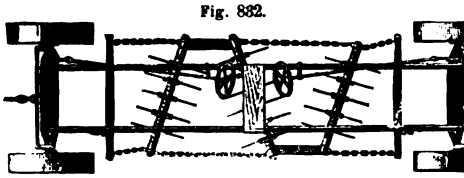
Fig. 831.



Nishwitz's Disk Harrow.

La Dow . . * "*American Manuf.*," July 16, 1880, p. 13.

Fig. 832.



Fowler's Disking Machine.

Disk'ing Ma-chine'. (*Agric.*) A steam-cultivating implement to be drawn by an engine over sod or plowed sod, to renew the ground, or to prepare for seeding. Circular steel disks are presented obliquely to the line of draft so as not merely to cut into the ground but make a slight furrow.

Dis-place'ment Ap'pa-ra'tus. Guerin's continual displacement apparatus consists of a vertical series of vessels; at bottom a flask in a sand bath, a percolator, receiver, and condenser, vertically in the order stated. The vapor of the lower member condenses in the upper one, is received in the next below it, and thence flows intermittingly into the percolator, from whence it reaches the flask at bottom.

"*Scientific American*" . . . . * xlii. 180.

Dis'lo-ca'tion Ap'pa-ra'tus. (*Surgical.*) This includes bandages, splints, apparatus for reducing, and for maintaining restored parts *in situ*, and for preventing recurrence.

The figures refer to *Tiemann's "Armamentarium Chirurgicum,"* Part IV.

Humerus	Figs. 55, 131.
Clavicle	Figs. 56, 150.
Hip	Figs. 87-89, 132, 133.
Knee	Figs. 93, 146.
Phalanges	Figs. 134-137.
Elbow	Fig. 148.
Radius and ulna	Fig. 151.

Dis-sect'ing Hook. A fine two-clawed hook used as a prehensor in making dissections.

Fig. 833.

Dissecting Hook.

Dis-sect'ing In'stru-ments. (*Surgical.*) The list embraces a variety of instruments, post-mortem and dissecting, the larger number of which may be found under their specific titles. See list under SURGICAL INSTRUMENTS, *infra* and "*Mech. Dict.*"

Among them are the following: the figures refer to *Tiemann's "Armamentarium Chirurgicum,"* Part I.

Anatomical syringe	Fig. 313.
Cartilage knife	Fig. 314.
Dissecting hook	Figs. 315, 316.
Grappling hook	Fig. 318.
Chain hook	Figs. 317, 319.
Reamer	Fig. 320.
Rachitome	Fig. 321.
Costotome	Figs. 322, 323, 333.
Scalpel	Fig. 325.
Brain knife	Fig. 326.
Enterotome	Fig. 327.
Calvarian hook	Fig. 328.
Saws	Figs. 329, 332, 333.
Hammer and chisel	Figs. 330, 331.
Scissors	Fig. 151.

Dis-sect'ing Ta'ble. One with arrangements devised for the convenient presentation of the subject, the disposition of the disjecta, etc.

A table with arrangements for disposition of effluvia is shown in *Laboulaye's "Dictionnaire des Arts et Manufact.,"* Figs. 3630-3632, article "*Insalubres*," tome iv., ed. 1877.

McIlroy's table, shown at the Philadelphia Exposition, 1876, is of convenient size and height, is supported on a stem connecting with a scale beam in the stand, affording the means of weighing the subject; it is dished to the center to collect the liquid of ablution or effusion; has means for the exhibition of disinfectants, etc.

Dis-sue'ing. (*Mining.*) Breaking away the rock from off the walls of a small and rich lode, in order that the ore may be moved without the accompanying worthless gangue.

Dis'tance Meas'ur-er. An angulometer, telemeter, etc. (which see): —

The instrument invented by Lieutenant Unge of the Swedish service is a stop watch to measure the interval between flash and sound. The pointer is placed at XII., and when the flash is observed a button is pressed, and the pointer begins to traverse. When the sound is heard the knob is released and the distance observed. The dial is divided into special peripheries according to the seasons.

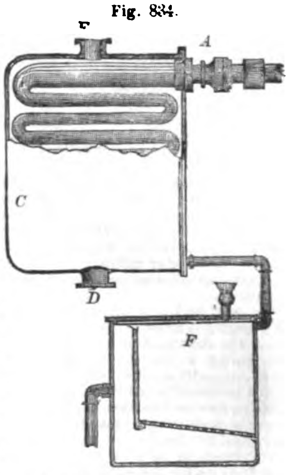
Distance indicator, *Watkin* . "*Scientific Amer.*," xxxvi. 22.

See also TELEMETER, Figs. 6255, 6256, pp. 2513, 2514, "*Mech. Dict.*"

Dis-til'ling Ap'pa-ra'tus. Baird's distilling apparatus for making potable water by condensation of steam from the boiler is used on board vessels of the United States Navy. Fig. 834.

It consists of an aërator, condenser, and filter. The aërator is at *A*; the steam passing towards the coil draws in air at a number of circumferential holes, and the air and steam pass together into the flat coil of copper twined inside. Sea water enters the condenser *C* at *D* and passes off at *E*. The water of condensation then passes by pipe to a filter, *F*, of purified granulated animal charcoal to deprive it of organic matter and oils which come over with the steam. See also STILL, "*Mech. Dict.*"

Fig. 834.



Baird's Distilling Apparatus.

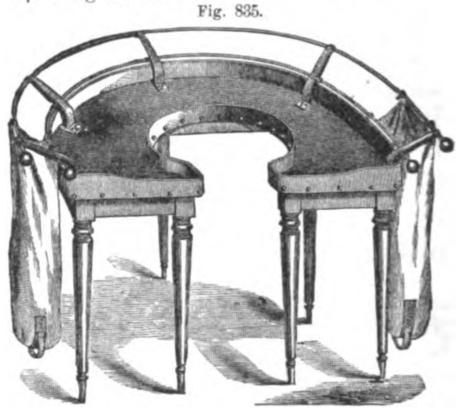
Dis-trib'u-ting Ta'ble. A table on which letters are collected and from which they are distributed into mail bags suspended around it in a horse-shoe form, the distributor standing in the middle. Fig. 835.

Ditch Clean'er. A square-ended scoop set at an angle with the handle to reach the bottom of a ditch while standing on the surface of the ground.

Two kinds are shown: one to push and the other to pull. Fig. 836.

Ditch'ing Ma-chine'. A machine for digging or plowing ditches.

Fig. 835.



Distributing Table.

The ditching machine of Theodore F. Randolph is shown in Fig. 837.

The digger share operates in the grooved periphery of a rotary flanged wheel, and has an adjusting attachment that regulates the depth of penetration. The flanged peripheries of the wheel penetrate and its rotation elevates the loosened soil, depositing it on the slide-way or apron that sheds it clear of the ditch on either side, optionally. A chisel-shaped cleaner attached to the slide-way works between the flanges of the wheel, cleansing it of its load, and guiding the dirt to the apron.

The large machine requires an eighteen horse-power engine to operate it; and it is calculated that it will dig eight cubic yards a minute in clay soil; equal to a man's work for a day, per minute.

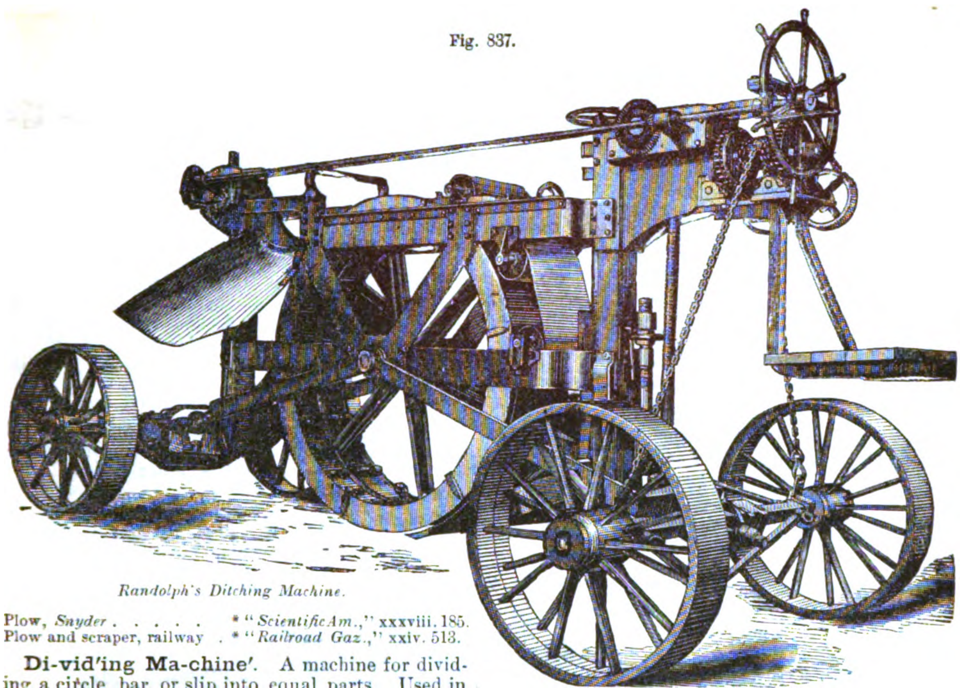
Fig. 836.

Ditch Cleaners.

The machine has adjustments for depth, and means for guiding under the control of the man who stands upon the platform. See also, —

Machine, *Gonellaz* . . . . * "*Scientific Amer.*," xxxv. 159.
Plow, locomotive, *Buchanan* * "*Engineering*," xxx. 166.

Fig. 837.



Randolph's Ditching Machine.

Plow, *Snyder* . . . . . * "*Scientific Am.*," xxxviii. 185.
Plow and scraper, railway . * "*Railroad Gaz.*," xxiv. 513.

Di-vid'ing Ma-chine'. A machine for dividing a circle, bar, or slip into equal parts. Used in graduating rules, scales, etc. See

Mass. Institute Technology * "*Scientific Am.*," xxxv. 195.
Linear, Stevens Institute . * "*Scientific Am. Sup.*," 704.
P. Dumoulin-Froment . . Wolcott Gibbs' report, "*Vienna Exposition* (1873) *Reports*," vol. ii., § F, p. 6
Perreaux . . . . . . *Ibid*, p. 6.
P. Dumoulin-Froment . . Prof. Barnard's report, "*Paris Exposition Report*," 1867, vol. iii., p. 613.
Perreaux . . . . . . *Ibid.*, p. 613.

Div'ing Ap'pa-ra'tus. Sub-aqueous appurtenances and machinery for the protection and assistance of divers. See

Signaling apparatus.
Protheroe, Br. . . . . . * "*Engineering*," xxiv. 127.
* "*Scientific Am. Sup.*," 1478.
Diving apparatus, *Richardson* * "*Scientific Am. Sup.*," 3848.
Improvised apparatus,
Magdalena River . . . * "*Scientific Am. Sup.*," 1952.

Bell, article "*Plongeur*," *Laboulaye's* "*Dict. des Arts et Manufactures*," iv., ed. 1877; describing apparatus of: —
Smeaton. *Cavé.*
Rennie. *Hallett & Williamson.**
Coulomb.

Dress, article "*Plongeur*," section "*Scaphandres*," *Ibid*, iv., ed. 1877; describing apparatus of: —
Leonardo da Vinci. *Rouquayrol-Denayrouze.**
Dean & Siebe. *Heinke.*
Bridge of Tarascon.
See also Figs. 4272, p. 1923; 6025, 6026, p 2437, "*Mech. Dict.*"; Figs. 359-361, pp. 155-157, *Ibid.*

Di-vis'ion Cath'e-ter. (*Surgical.*) A double current catheter, allowing liquid to be injected and withdrawn by distinct ducts in the same instrument and simultaneously.

Fig. 1190 *e*, p. 504, "*Mech. Dict.*"

Di-vis'ion Reg'u-la'tor. (*Electricity.*) A regulator adapted to allow several or many lights on one circuit. Usually called a *polyphote* or many-light regulator.

They are of three kinds: —
Differential.
Derivation.
Fixed interval (Regulators *à écart fixe*). See POLYPHOTE REGULATOR, and the above.

Di-vul'sor. (*Surgical.*) An instrument to rend asunder the walls of a constricted passage. The urethral divulsor for obliterating strictures is the most notable instance. See STRICTURE DILATORS, Fig. 5995, "*Mech. Dict.*"

The term *dilator* in one sense includes *divulsors* and in another direction *speculi*; the latter use being to expose, while in the former case it is to expand.

Thompson's, *Gouley's*, and *Holt's* stricture divulsors are shown at Figs. 64, 67, 66, Part III., *Tiemann's* "*Armamentarium Chirurgicum*," in company with other instruments called *dilators*, but the use of which is practically the same.
Anal divulsors and *dilators* on p. 119, Part III., *Ibid.*

Dob'by Ma-chine'. (*Weaving.*) A loom for weaving fantastic patterns; such a loom for instance may contain from 12 to 30 blades. The mechanical principle is similar to that of the Jacquard, of which it might be termed a simplification. In the dobby machine the pattern is obtained by means of little pegs, which according to the requirements are placed in the holes of the bars of a lath work. The bars correspond to the cards of the Jacquard.

Ainsworth's . . * "*Scientific American Supplement*," 3896.

Dock. (*Hydraulic Engineering.*) *a.* (*Wet.*) A basin to contain vessels for loading or discharge.

b. (*Dry.*) An excavation into which a vessel is admitted, inclosed, and exposed by pumping out the water contained in the dock. A *graving* dock, Fig. 2308, "*Mech. Dict.*"

c. A caisson which is sunk in position beneath a vessel and then floated therewith by pumping out the water contained in the caisson, Plate XIX., p. 884, "*Mech. Dict.*"

d. A depositing dock, which raises a vessel by means of sunken and subsequently floated caissons or camels and then shifts it to a staging which it may occupy for any required time, while the floating apparatus repeats the process on other vessels. See DEPOSITING DOCK, *supra*.

See the following references: —

Air cushion for dry dock . . .	* "*Sc. Amer. Sup.*," 1328.
Avonmouth, Bristol, Engl. . .	"*Van Nostr. Mag.*," xx. 179.
	* "*Sc. Amer. Sup.*," 1124.
Ayr, Scotland	* "*Engineering*," xxvii. 196, 242.
Bombay "Princes"	* "*Engineering*," xxiv. 266.
Clyde, (New)	"*Iron Age*," xxi., May 9, p. 5.
Dry Docks	"*Sc. Amer. Sup.*," 2070.
Holyhead	* "*Engineer*," l. 86.
Liverpool	* "*Sc. Amer.*," xxxvii. 150.
Nicolaieff, Russia	* "*Engineer*," xlvi. 64, 75.
	* "*Sc. Amer. Sup.*," 399, 661.
Philadelphia, *Crump*	"*Iron Age*," xvii., May 25, p. 15.
Portable dock-engine, *Mundy* .	* "*Iron Age*," xix., May 10, 1; xviii. Sept. 21, 9.
Thames, "Victoria Extension"	* "*Engineer*," xliv. 20; xlix. 457; l. 10.
	* "*Engineering*," xxv. 246
	* "*Sc. Amer. Sup.*," 1956.
Tubular	"*Man. & B.*," xviii. 180.
Woolwich, "Royal Albert" . .	* "*Sc. Amer. Sup.*," 3838.

Consult: "*The Dockyards, Shipyards, and Marine of France.*" *P. Barry*. London, 1869.

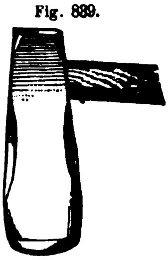
"*The Naval Dry Docks of the United States.* *Charles B. Stuart.* Illustrated with 24 fine steel engravings. New York, 1870.

Dock Block. A tackle-block secured on a

Fig. 838.

Dock Block.

Fig. 839.



Dog Head.

dock or wharf to change the direction of a rope passing to a cargo-lifting tackle. It has a universal ball-and-socket joint, to permit the block to swing in any direction.

Dog′-Head. A hammer used by saw makers in stretching the blade, that is, in removing a tension. The weight is about 3 pounds and the length $5\frac{1}{2}''$. The handle, $14''$ long, stands at an angle of 85° with the body of the hammer. Its face is rounding and of an even sweep. Fig. 839.

Do-mes′tic Mo′tor. One adapted for household use, to run sewing or knitting-machines, pump water, etc.

Many small forms of *steam engines* have been specially invented and offered for this purpose. *Gas*, *hot-air*, and *caloric engines* are specially well adapted. *Hydraulic motors*, operated by water from the mains, have an aptitude for this use. Also *spring* and *electro-magnetic* motors.

See under the various heads. Also p. 2123, "*Mech. Dict.*," and list of 72 patents of SEWING-MACHINE MOTORS, on p. 2115, *Ibid.*

See also —

"*Revue Scientifique*"	"*Van Nostrand's Mag.*," xxiii. 6.
Tyson	* "*Eng. & Min. Jour.*," xxvi. 365.
Ericsson	"*Eng. & Min. Jour.*," xxx. 91.
Domestic steam-engine.	
Landis	* "*Scientific American*," xxxvi. 22.

Dome′-top In′stru-ment. (*Surgical.*) Said of hollow instruments of introduction, such as a speculum or trocar, which has a rounded end.

Don′key Pump. A supplementary steam-pump, for use when the major engine is not in operation; or for specific purposes at any time; fire, bilge-water, washing decks, etc.

Bastin, Br.	* "*Engineer*," xliii. 328.
Gillett, Br.	* "*Engineer*," xliv. 50.
Leupold, Br.	* "*Engineer*," xliii. 441.
	* "*Sc. American*," xxxvii. 83.
Sulzer, Switz.	* "*Engineering*," xxvi. 162.

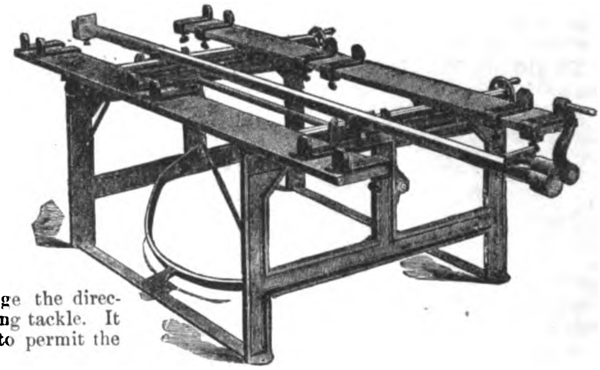
Door. See various references to doors and adjuncts, as follows: —

Door bolt, *Hoesly* . . .	* "*Scientific American*," xl. 198.
Double, *Brachmann* . .	* "*Scientific Amer.*," xliii. 310.
Door-check, *Collins* . . .	* "*Scientific Amer.*," xxxiv. 355.
Perkins	* "*Scientific Amer.*," xl. 131.
Door for fastening barn .	* "*Scientific Amer.*," xxxiv. 402.
Double-handle. Lock-nut.	
Harland, Br.	* "*Engineer*," xliv. 395.
Door-knob, Whipple . .	* "*Scientific Amer.*," xxxv. 153.
Door-knob screws . . .	* "*Scientific Amer.*," xxxvi. 275.
Door-spring, concealed.	
Barker	"*Iron Age*," xix., May 17, p. 18.
Door-spring, Torsion rod.	
Gray	"*Iron Age*," xxi., May 2, p. 42.

Door Clamp. (*Carpentry.*) A bench and frame on which the various parts of a door are assembled and then pushed together and held by clamps.

The bench shown in Fig. 840 is adapted for door, sash, or blind work; the action of the longitudinal clamp, and the two transverse clamps is evident. The pressure is given on

Fig. 840.

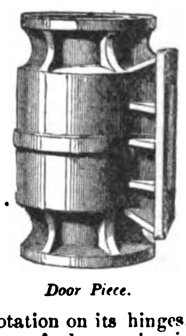


Door, Sash, and Blind Clamp.

each end of the tenon of each rail, the side-pressure being given by treadle while the end-pressure is given by hand.

Door Piece. The valve chamber of the stock of a Cornish pump-lift. A section containing a door or cover, which may be removed to admit examination of the valve and seal, or removal for repairs.

Fig. 841.



Door Piece.

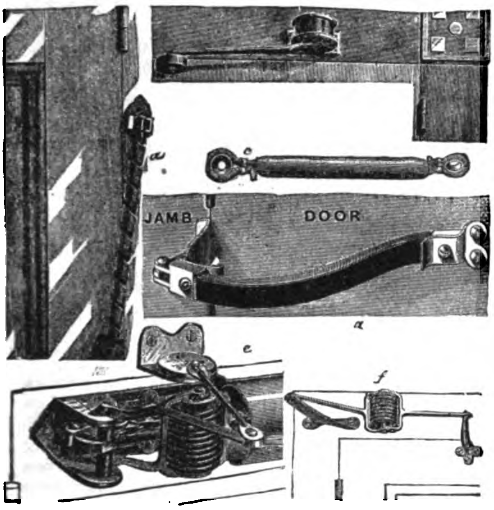
See Fig. 1467, page 626, "*Mech. Dict.*"

Door Rel′ish-ing Ma-chine′. (*Carpentry.*) A machine for trimming a tenon. See SASH RELISHING MACHINE.

Door Spring. An attachment to a door to close it. In some cases the spring operates to keep it open after it has passed 90° of rotation on its hinges. See BUTT HINGE. One form of door-spring is shown at Fig. 1688, p. 721, "*Mech. Dict.*"

Six other forms are shown in Fig. 842, pneumatic, spiral, and caoutchouc, arranged in various forms.

Fig. 842.



Door Spring.

a. " Boss " door-spring.
b. *Sabin's* lever door-spring, with a maximum when the door is closed.
c. " A. B. C.," india-rubber door-spring. *d.* "Centennial."
e. *Geer's* air-cushion door-spring ; the greatest pressure at the point of closure.
f. " Hercules " door-spring ; the same action as the previous one, but not pneumatic.

Dor'mant Scales. Warehouse scales, the platform of which is let in even with the floor, so as to roll a truck upon them.

Do'ry. (*Fishing.*) A small flat-bottomed fishing boat.

Do-sim'e-ter. An instrument for measuring prescribed quantities. The term is frequently applied to a drop-meter such as that of Prof. Thurston, which consists of a steel wire tapered to a point and affording a means of obtaining small drops of equal quantity.

Fig. 843.

Colmar's Dosimeter.

The dosimeter, Fig. 843, is a glass tube with a taper end and graduated to indicate drops, minims, and other measures according to the requirements of any given purpose or capacity. In the top is fixed a syringe with a rod which has an adjustable stop to limit the stroke of the piston to any required extent. By this means any desired quantity may be drawn into the syringe and the traverse of the piston is watched to observe the quantity ejected if it be less than the whole.
See Burette, Pipette, Drop Meter.

Dou'ble Act'ing Pump. One which is effective at each stroke, to and fro. See references : —

Amos & Smith, Br. * "*Engineering*," xxx. 462.
Carr . . . . * "*Manuf. & Builder*," xii. 148.

Dou'ble Bass. (*Music.*) A stringed musical instrument, the largest of its class.

It has three strings tuned in 5ths, or four strings tuned in 4ths. The compass is two octaves and a quarter. To this instrument belong the lowest sounds in the harmony.

Dou'ble Bas-soon'. (*Music.*) A wind musical instrument of lowest pitch in its class.

A double reed instrument which bears the same relation to the bassoon that the double-bass does to the violoncello.

Dou'ble Beam Bal'ance. One with two beams graduated in two systems; the *postal* balance, for instances, in grams and ounces: the *creamery* or *dairy* balance for weighing successive portions of cream or milk at a single draft; the *furnace* scale for weighing respective portions of ore, limestone, and coke at a single draft. See under the above heads.

Dou'ble Bell Pipe. One with a cup-shaped enlargement at each end to receive the ends of those in line with it. See *h* in Bend.

Dou'ble Blast Forge. One with two tuyères acting upon the same bed of coals. *Enfer*, Paris.

Dou'ble Bo'gie. One with a bogie at each end. A Double ender. See Back Truck Locomotive, Fig. 168, *supra.*

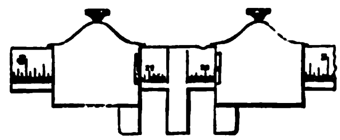
Car, Midland Railway, Br. * "*Engineering*," xxi. 533.
Locomotive, *Fairlee* . . . * "*Scientific American Sup.*," 72.
* *Anderson's* report, "*Paris Exposition* (1878) *Reports*," vol. iv., p. 452.

Dou'ble Bor'ing Ma-chine'. A machine with two augers, bits, drills, as the case may be.

Boring and facing, *Bede et Cie.*, Fr. . * "*Engineer*," xii. 5.
See also Double-traverse Drill, *infra* ; Multiple Drill, etc.

Dou'ble Cal'i-pers. Two calipers upon the same bar graduated respectively on each side of the central zero abutment.

Fig. 844.



Double Calipers.

Useful for making two separate measurements of an object, as the width and thickness of a quadrilateral steel bar.

Dou'ble Car'-axle Lathe. A lathe in which the axle is passed through the center-head and turns on dead centers at the respective ends. Each end of the axle is operated upon at the same time and finished without turning end for end. An equalizing driver attached to the side of the driving wheel distributes the driving force uniformly through the whole axle, overcoming the tendency to lateral strain. Changes of feed for roughing and finishing without changing wheels. Fig. 845.

Dou'ble Coil Gal'va-nom'e-ter. A refinement of the astatic galvanometer, invented by Sir William Thomson. It has two coils, one above the other, exactly alike in their effect upon the compass-needle, situated in the middle of each. A bar magnet above serves to give direction to the needles and may be moved up and down so as to nearly neutralize terrestial magnetism if desired. The connections at the base serve to keep the coils in combination, either as acting together or counteracting one another. Used in submarine telegraphing.

"*Manufacturer and Builder*" . . . . . . * xi. 276.

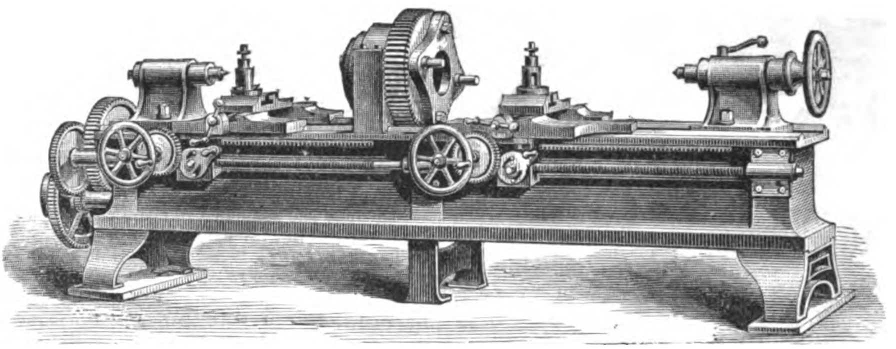
Dou'ble-cone Lamp. A lamp the glass of which consists of a cylindrical equatorial zone, and conico-frustal zones above and below.

Dou'ble-cone Re-flect'or. A form of ventilating reflector for the ceilings of auditoriums. Made in various sizes, diameter 25″ and upward, with from 6 to 150 burners. Fig. 846.

Dou'ble Con-nect'er. (*Electricity.*) A connecter with two binding screws for as many wires.

Dou'ble Cur'rent Cath'e-ter. (*Surgical.*) A catheter with two tubes or a divisional tube, so

Fig. 845.



Niles' Double Car-axle Lathe.

as to permit a current to be injected into the bladder through one duct, while the washing of the bladder passes out through the other duct. See *c*,

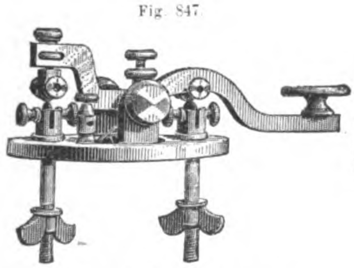
Fig. 846.

Double-cone Reflector.

Fig. 1190, p. 504, "*Mech. Dict.*" Also known as a *Division Catheter*. See also DEBRIS EVACUATOR.

Dou'ble Cur'rent Key. (*Electricity.*) A telegraph key with points or contacts at each end, the two legs being insulated and a third (middle) contact being connected with the base. For data see DISK ELECTRODE.

Fig. 847.



Cumming's Double Current Key.

Of the two points with which the ends of the key connect, one leads to a battery with its positive pole to the line and the other to the corresponding negative pole. The right hand of the key (as shown) being depressed, makes a contact with the point below, and the current passes (say from the positive of the battery) through these contacting points, the trunnions of the key and to the base. When the lever is raised, the reversed current from the negative of the battery flows through the other arm of the key to line by the middle connection.

The three points on the base are insulated from each other and are connected only by the depressing and raising of the key lever. The special device shown is that of Cummings, which has contacting disks for contact, the disks being on axes at right angles to each other and having fine platinum wire inserted in grooves on the peripheries.

Risch . . . . * "*Telegraph Journal*," vii. 93.

Dou'ble Cut Saw. A mill saw having one half the teeth turned towards one end of the saw and the other half the other way, each way from the center. Intended to cut equally up and down and discharge the saw-dust on top and bottom. The latter, of course, is not an object but an incident. — *Davis.*

Dou'ble Cut'ting-off Ma-chine'. 1. A two-headed lathe for railway axles and shafts up to 8″ diameter. Tool slides work at either end simultaneously, feeding together or separately.

2. A double cut-off saw, used by box-makers to square off both ends of dimension stuff at the same time.

Dou'ble Deck'er. Said of two-story or two-tier arrangements.

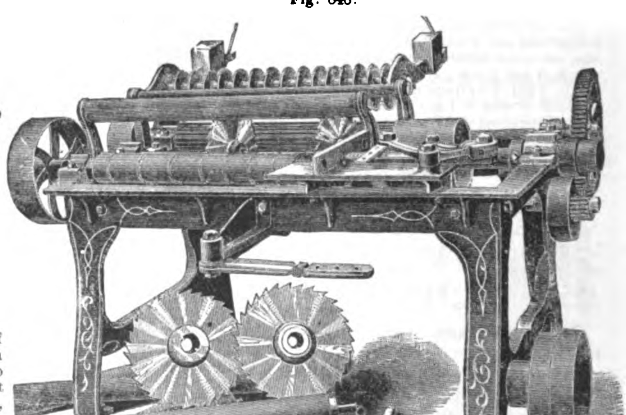
a. A ship with two decks above the water-line.

b. A railway car or street car with seats on the roof. Common in Europe.

c. A hog or sheep car with two decks.

d. A steam-boiler furnace with two tiers of firing chambers.

Fig. 848.



Nichols' Double Edger.

Dou'ble Door. *a.* A door in two portions, upper and lower, swinging or sliding independently :

used in express and mail cars. A pair of half doors in fact.

b. A pair of doors swinging or sliding, mutually approaching or receding, to close or open the doorway.

Dou'ble Edg'ing Ma-chine'. 1. (*Wood Working.*) A machine having a pair of circular rip saws at a regulatable distance apart, to dress both edges of a board at once.

The Nichols' double edger is particularly designed for edging boards in saw-mills, and sawing plank and boards from the mill into joists, scantling, flooring, battens, shingle-lath, etc. Fig. 848

It has a feed roll in front, composed of small saws and collars alternately, and has a fluted roll behind the saws, over which is a weighted flanged press-roll, which serves to keep the board straight. For edging, one saw is made stationary and the other saw adjusted to any width. For ripping, an adjustable gage is provided with a lever running to the operator and a screw on the front feed-roll, which keeps the stuff to the gage.

"*Iron Age*" . . . . . * xx., November 22, p. 1.

2. (*Sheet Metal Working.*) A machine for folding the edges of blanks for pieced tin-ware preparatory to seaming. It is arranged to fold the parallel edges of rectangular blanks to form cans from 6″ to 22″ in length.

Dou'ble End'er. 1. (*Wood Working.*) A cross-cut sawing machine, which has a pair of circular saws at a regulatable distance apart to cut off both ends of a board at once.

Staves are brought to a length in a similar manner by sawing both ends.

The box-board double cut-off saw machine of *Richardson, Merriam, & Co.* is for equalizing stuff, squaring off both ends of box stuff at the same time. It has a frame with a light sliding carriage on which the stuff is fed to the pair of circular saws which are upon the same arbor but regulatable as to distance apart.

2. A file with two points, either end capable of being placed in the handle.

3. (*Nautical.*) A ship capable of moving in either direction, having bow and rudder at each end. A frequent form in ferry-boats.

On double-ender ships . . . . . . "*Engineer,*" xli. 431.

4. (*Railway.*) A locomotive with pilot at each end. A switching locomotive. See BACK-TRUCK LOCOMOTIVE, Fig. 168, p. 65, *supra.*

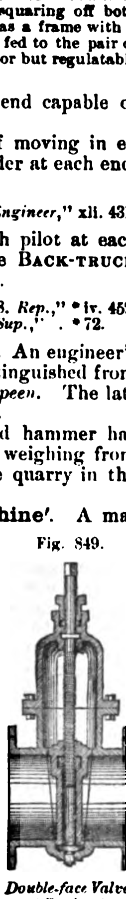
Anderson's report, "*Paris Exposition*, 1878. *Rep.*," * iv. 452.
"*Scientific American Sup.*," . * 72.

Dou'ble-faced Ham'mer. 1. An engineer's hammer, with two flat faces; as distinguished from the hammer with one face and one *peen*. The latter may be square, cross, or pointed.

2. The stonemason's double-faced hammer has two square faces; is a heavy tool, weighing from 20 to 30 pounds, and is used in the quarry in the roughest work.

Dou'ble-face Mil'ling Ma-chine'. A machine tool suitable for milling pieces that have pivots on opposite sides, such as main-spring stirrups or swivels for guns. A geared shaft, with cone pulley of three grades, drives a face-plate which revolves the piece to be finished. The feed is accomplished by means of rack, pinion, and levers, which move the foot-stock spindle, carrying one mill against the revolving piece, and press the piece against a mill held in the head-stock. — *Pratt & Whitney.*

Fig. 849.



Double-face Valve.
(*Section.*)

Dou'ble-face Valve. One coming fairly against a seat on each side of it. The valve jams between two faces, an element of security and support.

Dou'ble Fire'-cock. One having two connections, by Y-branch, for two hose, operated by a single screw valve.

Dou'ble Fluid Bat'te-ry. (*Electricity.*) One having the elements in different fluids to secure depolarization. A *constant* battery, which see.

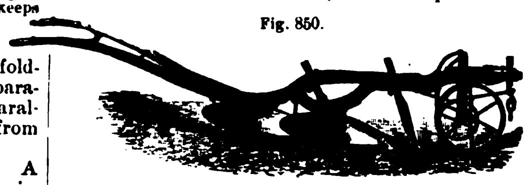
Becquerel's oxygen jar battery was the first to use two liquids, or a porous cell, and was the first constant battery. See BECQUEREL BATTERY.

Dou'ble Fur'nace Boil'er. One having two firing chambers, either double-tier, parallel, or at opposite ends.

Rowan, Br. . . . . * "*Engineer,*" xliv. 418.
Saltaire Mills, Br. . . . . . * "*Engineer,*" xli. 274.

Dou'ble-fur'row Plow. (*Agric.*) One for plowing two furrows at once. A GANG PLOW; the invention of Lord Somerville, the latter portion of

Fig. 850.



British Double-furrow Plow.

the last century, but much improved of late. The original form was of two plows locked in parallel position. That form is scarcely found now, except an implement made at Nancy, France.

Dou'ble-gate Valve. A valve for gas or water mains, having on each side a face which fits against its own seat. — *Isbell.*

See DOUBLE-FACE VALVE.

Dou'bled Glass. (*Glass.*) A glass made of several colors superposed. See FLASHED GLASS.

"It is worked in a different manner from plain glass. Colored glass when first made is generally drawn into sticks of a certain length and annealed. Suppose we now wish to blow an article made of white glass with a thin sheet of outside colored glass. A stick of colored glass is taken and heated gradually; the workman now takes up this stick on the end of his ponty and heats the glass in the glory-hole. When this is sufficiently plastic a quantity is cut off and attached to a blow-pipe also having a small lump of hot glass at its end. The colored lump is now heated again and blown in the usual way into a hollow ball. This ball is opened and formed into the shape of a cup. In the mean time another workman has gathered and blown another sphere of white glass of a suitable size. This sphere is now put into the cup-shaped colored glass, blown, and rubbed together while hot so as to make them adhere. We now have a ball of white glass inside and colored glass outside. This may be finished to any shape desired, in the usual way, with molds or tools." — *Colné.*

Dou'ble Har-poon' Fork. A hay-elevating fork having two harpoons forming a ∩-shaped implement with barbs on the points. A duplication of the harpoon fork, Fig. 2409, p. 1065, "*Mech. Dict.*"

Dou'ble Hook. (*Surgical.*) *a.* A tenaculum with two claws.

b. A two-clawed hook for fixing the eye during operation. *Double tenaculum*, Fig. 79, Part II., *Tiemann's "Armamentarium Chirurgicum."*

c. A prehensile two-armed instrument with two claws on each arm to grasp the eye in operation for extirpation. Fig. 78, *Ibid.*

d. See, also, Extirpation and Fixation Forceps, *Ibid.*, p. 25, Part II.

Dou'ble Im'age Prism. (*Optics.*) A prism of Iceland spar giving a double image of the object of complementary tints, and also used by revolving the images to measure the angle of crystals examined under the microscope.

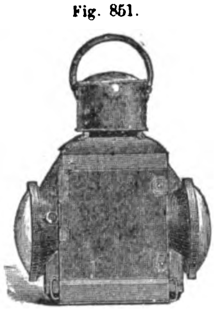
Dou'ble-jaw Vise. A vise having two pairs of jaws, either of which may be brought into play.

See ADJUSTABLE VISE, p. 5.

* "*Engineer*" . . . . xiii. 182.

Dou'ble-lens Lan'tern. One having a lens on opposite sides to throw rays in opposite directions. Used as a tail side-light for trains, throwing light forward and aft.

Fig. 851.



Double-lens Lantern.

Dou'ble-lip Safe'ty Valve. One with two circular concentric avenues of egress for the steam as the valve rises.

Dou'ble-nose Piece. (*Optics.*) A means for using two object-glasses without unscrewing, whereby either is brought into the optic axis of the instrument.

Dou'ble Pis'ton Bal'anced En'gine. A form of engine in which two pistons of equal area reciprocate in a cylinder, mutually advancing and retreating. See next article.

Dou'ble Pis'ton En'gine. One having a pair of pistons mutually advancing and retreating in the same cylinder, each traversing half the length of the cylinder, the steam being alternately admitted between the pistons, to force them apart; and at their ends to force them together. — *Wells.*

"*Manufacturer and Builder*" . . . . * xi. 49.

See also BALANCED ENGINE.

Dou'ble Pit'man Press. A heavy stamping press for sheet-metal work, the slide being operated by two pitmans having eccentric connection with the same shaft. A measure of strength and steadiness.

Dou'ble Plan'ing Ma-chine'. (*Metal Working.*) A large planing machine having two pairs of independent heads on opposite cross-slides movable to any position on the bed. The two slides swivel to any angle and have variable automatic feed in all directions. The movement of the table is by screw and gearing driven by two belts separately shifted.

Dou'ble Plate Wheel. (*Railway.*) A car wheel which has two plates connecting the hub and the rim. The plates are generally corrugated in cast car-wheels, but are flat in the compound wheels.

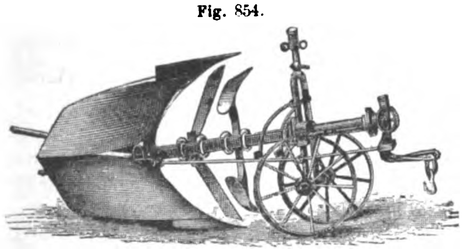
The Washburn wheel has a double corrugated plate next to the hub, about half way to the rim, and a single corrugated plate beyond it. *a a'* Fig. 1170, p. 493, "*Mech. Dict.*"

Dou'ble Plow. (*Agric.*) *a. A double furrow* plow, or one turning two furrows. See GANG PLOW.

b. A plow adjustable to turn a furrow to the right or to the left. A *side-hill* plow; a *turning mold-board* or *reversible* plow. There are four forms of this implement; see under the various heads.

The illustration is the Brabant double plow, which is perhaps the prime favorite in France at the present time. It has

Fig. 854.



Brabant Double Plow.

the skim share or jointer, and to reverse the plow and throw the furrow to the left, it is unlocked at the rear and revolved 180°.

Double plows, French and American, Knight's report, "*Paris Exposition* (1878) *Report*," * vol. v.

See also "*Scientific American*" * xxxix. 168.

Dou'ble Pur'chase. (*Nautical.*) A form of tackle also known as *gun-tackle purchase* with two single-sheave blocks. *c,* Fig. 6159, "*Mech. Dict.*"

The *reef tackle* is also a double purchase.

Dou'ble Rach'i-tome. (*Surgical.*) An instrument with two parallel saws for making an exsection of the spine.

Fig. 333, Part I., *Tiemann's* "*Armam. Chirurgicum.*"

Dou'ble Rud'der. A pair of rudders. Very common on our Western rivers, and on ferry-boats there and elsewhere, but not so much so on sea-going vessels. Twin screws and twin rudders are however, becoming more common in some classes of war vessels.

And movable propeller, *Sadler* . "*Sc. Amer. Sup.*," 1922.

Dou'ble Safe'ty Valve. A pair of safety valves on the same steam-pipe or dome. A measure of safety in case of one becoming rusted fast, or otherwise inoperative. Fig. 853.

Dou'ble Screw. Said of a vessel with two screw-propellers.

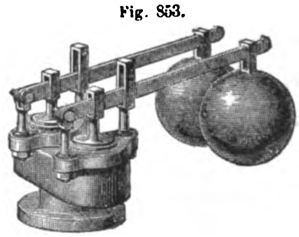
Tug-boat, *Howden*, Br. . * "*Engineering*," xxi. 253.
"*Scientific American Sup.*," 868.

See also TWIN SCREW.

Dou'ble Screw Up'right Vise. A parallel-leg vise. A screw above and one below being operatable by the same handle maintain a perfect parallelism of the jaw faces.

The upper screw is connected by chain to the lower one so as to make their motion simultaneous and equal.

Fig. 853.



Double Safety Valve.

Dou'ble Shap'ing Ma-chine'. A shaper, the heads in duplicate, so as to act upon two portions of an object dogged to a common table.

Wood, *Robinson*, Br. . . . . . * "*Engineer*," xlv. 276.

Dou'ble-shear Steel. (*Metallurgy.*) Blister steel, heated, rolled, and tilted to improve the quality, and the process repeated.

Dou'ble Steam-ket'tle. One kettle within another, the joint steam-tight, and steam occupying the interval.

Dou'ble Sur'fa-cing Ma-chine'. A wood-planing machine which acts upon the upper and lower surfaces of the board simultaneously.

Dou'ble Ten-ac'u-lum. (*Surgical.*) An instrument with two claws apposed by pivoting, in the manner of scissors.

Figs. 454, 461, 462, Part III., *Tiemann's* "*Armamentarium Chirurgicum.*"

The double-claw tenaculum, Fig. 21, Part I., *Ibid.*

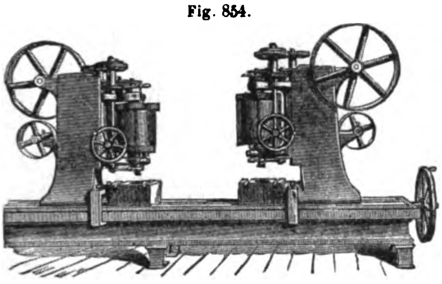
Dou'ble Trans-mis'sion Tel'e-graph. (*Electricity.*) A form of duplex telegraph.

Sieur . . . * "*Telegraphic Journal*," vi. 375.

Dou'ble-trav'erse Drill. A machine-tool for boring holes simultaneously, at both ends of a bridge-link, for instance, to insure exactness where many pieces of precisely the same size and proportions are required. The double-traverse drill has right and left-hand boring machines, sliding on a solid bed, and adjustable to or from each other to suit the required length of links.

The boring machines are so placed as to permit the links to be put in place from one side, and, when done, passed out

Fig. 854.



Sellers' Double Traverse Drill.

on the other side of the machine. The driving is effected by horizontal belts passing over guide-pulleys, and around a drum on the spindles. The cutters are kept cool by water fed to them through the center of the spindle. The two heads are united by bars of wrought-iron, and can slide freely on the cast-iron bed. The expansion of the wrought-iron bars being the same as the expansion of the link being bored, insures uniformity in the length of the finished work.

Dou'ble-truck Lo-co-mo'tive. (*Railway.*) A form of locomotive in which a leading pony truck is added to the driving. See instance in "*Railroad Gazette,*" * vol. xxiv., p. 8, and full-page plate; a locomotive of the Denver, South Park, and Pacific Railroad. The pony truck in this case is to carry the overhanging weight of the cylinder and to protect the front driving-wheels from wear.

Dou'ble-tub Press. A cider or wine press which has two concentric cylinders, the pomace or marc occupying the space between the two, the piston or follower of the press being annular. A French press is shown in Dr. Knight's report, "*Paris Exposition* (1878) *Reports,*" * vol. v., p. 232. The double tub gives two surfaces at which the liquid may exude, and the arrangement is very effective, inasmuch as it is especially difficult to drain the interior of the mass of pomace.

In the instance shown the power is applied by means of a toggle which is particularly suitable, the force increasing as the knees become more and more extended. To put the press in action the platen is depressed by means of a small hand-wheel placed at the end of the screw. When the pressure thus obtained is not sufficient, a stronger force may be obtained by the lever and ratchet-wheel.

See also Fig. 618, p. 196, *supra*.

Dou'ble Tur'bine. *a.* A pair of turbine wheels on the same shaft, one receiving the water from the other. A doubtful expedient.

b. A pair of turbines on the same shaft, receiving the water between them and each discharging outwardly. A *double-head wheel.*

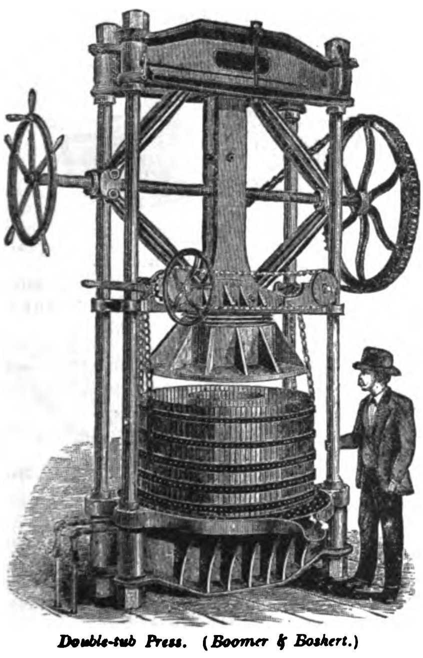
c. A turbine with a partition in the middle of the tier of buckets, dividing the wheel. More curious than useful, and the name a misnomer.

d. A combination of two kinds of turbine on the same shaft, — one a *vertical* and the other a *central* discharge. Leffel. Each receives its water from the same set of guides at the same time, half the water passing to each wheel. This is believed to afford a freer escape for a large volume of water than if the same area of opening were employed in a single wheel on either the vertical or central system of discharge.

Dou'ble Turn'ing-mold'-board Plow. (*Agric.*) A double-furrow plow, having the additional capacity for turning the furrows either to the right or to the left. A gang-plow adapted for hill-side work.

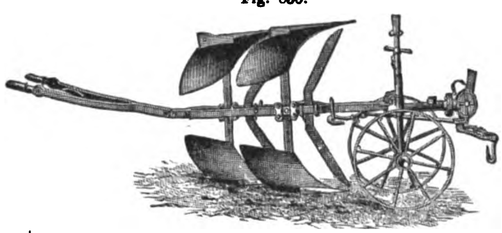
The instance shown is the *Brabant double bisoc,* — a favorite French form. It may be mentioned that the adaptability for mold-board turning is not (in France) for the purpose of plowing side-hills, but to enable the plowman to begin at the side of a field and plow furrow by furrow clear across, reversing the plow at the end of each furrow, — the ancient mode of plowing still common in the Orient. See BOUSTROPHEDON, *k.* Fig. 1613, p. 1655, "*Mech. Dict.*"

Fig. 855.



Double-tub Press. (*Boomer & Boshert.*)

Fig. 856.

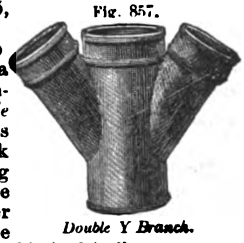


Brabant Double Turning-mold-board Plow.

Dou'ble Wheel'-lathe. A lathe adapted to receive a pair of wheels while on their axle, as in the wheel-lathe, Fig. 7185, p. 2767, "*Mech. Dict.*"

Dou'ble Whip. (*Nautical.*) A *whip* is a rope wove through a single block; in a *double whip* the rope passes through a lower or hook block, and the standing end is secured to the upper block or other point of attachment. See also Fig. 6159, p. 2480, "*Mech. Dict.*"

Fig. 857.



Double Y Branch.

Dou'ble Y Branch. A triple pipe connection, one central and two branching, from a single main.

Dou'bling Wind'ing Ma-chine'. A machine used in thread manufacture to double and at the same time wind the doubled yarn, ingenuity being displayed in securing uniform winding speed notwithstanding the increasing diameter of the wound yarn.

Boyd's doubling winder, * "*Textile Manufacturer*," 1878; reproduced in "*Scientific American Supplement*," * 2179.

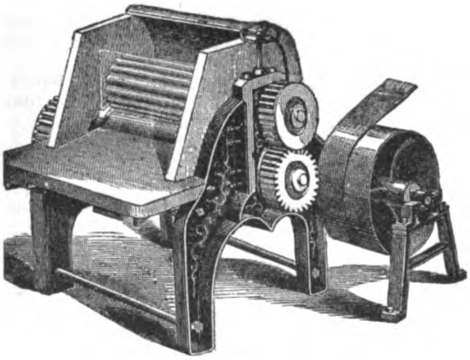
Douche. (*Surgical.*) A syringe constructed for special applications and deriving its name therefrom, as, —

Catarrhal.	Uterine.
Eye.	Vaginal.
Ear.	Hemorrhoidal.
Nasal.	Rectal, etc.

See Fig. 1727, p. 782, "*Mech. Dict.*"

Dough Brake. A bakery machine for kneading dough. It takes the material from the mixing machine, and makes it ready for the cracker machine. Dough brakes are *simple* or *return*. In the former case the dough is laid upon a table, passed between rollers, and discharged on to a lower shelf whence it is picked up and laid on the upper table for the repetition of the process. In the *return* dough brake the labor of lifting the dough is saved.

Fig. 858.



Dough Brake.

The dough is placed on the table, taken by the rollers, passed between the rollers, and carried over the upper one back to the table ready to be doubled and passed through again.

Dough Cut'ter. A circular cutter for stamping out cakes from a sheet of dough. A spring piston ejects the cake from the cutter.

Collins * "*Scientific American*," xxxiv. 355.

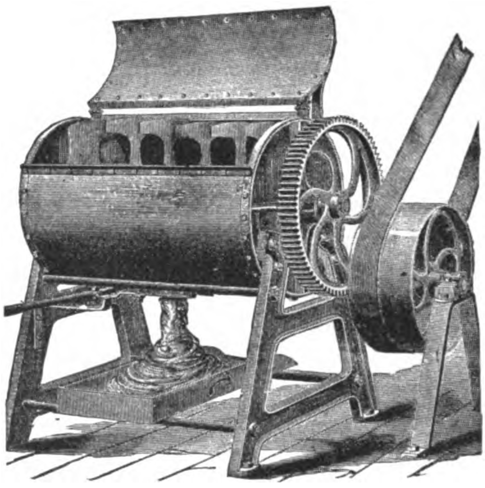
Dough Knead'er. A machine for incorporating dough: violent and repeated pressure is necessary. See Dough Brake. The name of the *brake* is from the pivoted lever upon which the weight of the man was formerly swung in the old method of preparing cracker dough.

The Durand dough kneader is an annular trough driven by steam, and with stirring devices which revolve in the trough while the latter revolves.

Pfleiderer, Br. . . . * "*Engineering*," xxviii. 483.
"*Scientific American*," xl. 246.

Dough Mix'er. A bakery machine for compounding the ingredients of bread, cake, crackers, as the case may be. The machine illustrated is for mixing soft cake dough, beating eggs, and preparing the dough for the machine which rolls

Fig. 859.



Ruger's Dough Mixer.

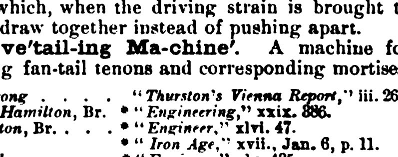
the paste, and cuts and pans the cakes. See Cracker Machine. The dough mixer is a horizontal cylinder with an axis provided with arms which cut, stir, and intimately incorporate the materials. It is discharged below when the gate is opened.

The hard dough-machine is on the same principle, but the discharge of the much more solid dough is by a spout in the manner of a sausage-stuffer.

Doul'ton Ware. (*Ceramics.*) A ware with an ordinary clay body and the salt glaze of stone ware, made by Doulton, of London.

The pieces are thrown, not molded, and are highly artistic, being cut, carved, and incised, with small ornaments in body of another color, added in lines or bands. Some colored slips are used, and a few metallic oxides contribute to the richness of coloring which the final glazing in the open salt-glaze kiln imparts.

Fig. 860.



Dovetail Clutch-coupling.

Dove'tail Clutch'-coup-ling. A device in which the interlocking parts are formed of dovetails which, when the driving strain is brought to bear, draw together instead of pushing apart.

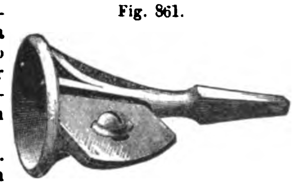
Dove'tail-ing Ma-chine'. A machine for cutting fan-tail tenons and corresponding mortises.

Armstrong . . . . "*Thurston's Vienna Report*," iii. 265.
Tighe-Hamilton, Br. * "*Engineering*," xxix. 886.
Hamilton, Br. . . . * "*Engineer*," xlvi. 47.
* "*Iron Age*," xvii., Jan. 6, p. 11.
Stengel . . . . . * "*Engineer*," xlv. 435.
* "*Scientific American*," xxxviii. 246.

Dow'el Ma-chine'. A machine for turning dowels; the small cylindrical pegs wherewith jointed boards, table-leaves, or staves are connected. It is like a rod lathe, the stuff passing through the hollow head and turned by a chisel or by a special tool, a sort of hollow auger. A *rod, pin, and dowel machine*, Fig. 4394, p. 1961, "*Mech. Dict.*"

Dow'el Point'er. A hollow cone with a bit projecting inwardly, into which a dowel is thrust to point or chamfer the end to facilitate its entrance in driving.

Fig. 861.



Dowel Pointer.

Draft Chain. A chain by which the draft of a plow-team is thrown back on to the part of the beam near the standard, instead of hitching direct to the forward end of the beam.

A draft rod answers the same purpose, and is shown in Fig. 3825, p. 1746, "*Mech. Dict.*"

Draft'ed Stone. (*Stone Cutting.*) Ashlar stone the face on which is surrounded by a chisel draft, the space inside the draft being left rough.

Draft'ing In'stru-ments. See list on p. 736, "*Mech. Dict.*," also the following references: —

Templet, *Davis*	* "*Sc. Am. Sup.*," 3757.
Easel, *Boudriot*, Ger.	* "*Sc. Am.*," xlii. 338.
Table	* "*Sc. Am.*," xxxviii. 114.
Instruments and pens	* "*Engineer*," xlvii. 458.
Pen, *Faber*	* "*Engineering*," xxx. 168.

See also list of Drawing, Writing, Copying Instruments and Processes on pp. 272, 273 *infra*. Also list under Graph, p. 1009, "*Mech. Dict.*"

Draft Reg'u-la'tor. A means of governing the energy of a fire by means of limiting the access of air thereto, or the egress of air therefrom: by devices, that is to say, which control the admission of air to the fire, or govern the sectional area of the chimney. Such is a *damper*. The subject is considered under Damper Regulator, which see.

Woodruff's draft regulator acts by pressure of steam on a diaphragm, excess of pressure closing a damper in the chimney to a regulated extent.

The "acme" draft regulator acts by displacement of water by steam. Patent, October 11, 1875.

For stoves, *Andrews*	* "*Scientific Amer.*," xxxviii. 339.
"Acme"	* "*Scientific Amer.*," xxxv. 179.
Franklin	* "*Scientific Amer.*," xlii. 231.
Turl	* "*Manuf. & Builder*," xii. 76.

Draft Tug. (*Harness.*) *a.* A trace.

b. A short section attached to the draft eye of the hame, and to which the trace proper is buckled.

c. A spring section in a trace to relieve the horse from sudden jerks.

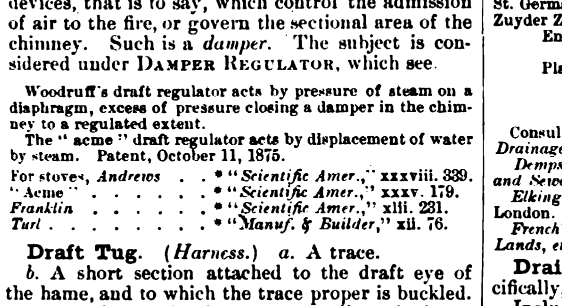
Smalley's	* "*Scientific American*," xlii. 100.

Drag. (*Spinning.*) A device to act as a gentle brake upon the rotation of a bobbin in throstle spinning and doubling frames. — "*Textile Manufacturer.*"

"*Scientific American Supplement*" . . . . . * 2705.

Drag Chain. A chain dragged by a plow in such a position as to gather and turn weeds and trash over into the furrow to be covered by the plow. Fig. 862 shows the mode of attachment.

Fig. 862.



Right Hand Plow with Rolling Colter and Drag Chain.

Not to be confounded with *draft chain*, which is a means of drawing the plow without hitching to the nose of the beam.

Drag Mill. (*Metallurgy.*) Another name for the arrastra. Blocks of porphyry are dragged around in the pan. See Figs. 367–371, pp. 159, 160, "*Mech. Dict.*" See also Amalgamator, *Ibid.*

Drag Saw. A cross-cutting saw for logs. The fact that the cut is upon the *draw* and not upon the *thrust* motion is the occasion of the name. See Fig. 1522, p. 649, "*Mech. Dict.*"

Alters & Basington	* "*Scientific American*," xli. 21.
Giles	* "*Scientific American*," xli. 230.

Drail'ing Tack'le. (*Fishing.*) A trawling tackle, the line with bait, real or artificial, being towed over the surface by the moving boat.

Drails. A jig or artificially-baited hook, used in trawling.

Drain'age. See notices under the following: —

Haarlem Mere	* "*Mech. Dict.*," pp. 116, 789.
House,	* "*Scientific Am. Sup.*," 2850.
Willett	* "*Scientific Am. Sup.*," 509.
Lac Fetzara, Italy, *Bure*	"*Technologiste*," xli. 802.
Lac Fucino, *Durant-Claye*	"*Technologiste*," xl. 32–38.
	* "*Engineering*," xxi. 17, 33; xxii. 517; * xxvii. 249.
	"*Van Nostrand's Mag.*," xviii. 437.
	"*Sc. American*," xl. 10.
Mines, 16 figures, Br.	* "*Engineer*," xliv. 332.
Pipe machine	* "*Eng. and Min. Jour.*," xxvi. 419.
Pipe making	* "*Sc Amer.*," xxxviii. 31.
	* "*Sc. Amer. Sup.*," 1048.
St. Germain sluice	* "*Engineer*," xlvi. 127–130.
Zuyder Zee	* "*Engineer*," xli. 2.
Engines	"*Sc. Am. Sup.*," 126, 127, 136, 137.
Plat	* "*Eng. & Min. J.*," xxvi. 133, 151.
	"*Sc. American*," xxxiv. 193
	"*Sc. Am. Sup.*, 1232.

Consult: *Klippart's* "*The Principles and Practice of Land Drainage.*" Cincinnati, 1868.

Dempsey's "*Draining Districts and Lands.*" "*Drainage and Sewerage of Towns and Buildings.*"

Elkington's "*A Systematic Treatise on Draining Land,*" London.

French's "*The Principles, Process, and Effects of Draining Lands, etc.*"

Drain'age In'stru-ments. (*Surgical.*) Specifically, tubes placed in a wound to withdraw pus.

Inclusive also of trocars, canulæ, and aspirators in one of their functions. See Fig. 6665, p. 2629, "*Mech. Dict.*"; and Figs. 120, 121, p. 52, *supra*.

Instruments for *paracentesis abdominis* are given on p. 162, Part III., *Tiemann's* "*Armam. Chirurgicum*," including: —

Drainage trocar.	Clamp Forceps.
Drainage tubing.	Trocars.
Drainage spiral.	Aspirator needles, etc.

Instruments for *paracentesis corneæ*, *Ibid.*, p. 29, Part II.
Instruments for *paracentesis thoracis*, *Ibid.*, p. 131, Part I.

Drain'age Tent. A dilating instrument introduced into the cervix uteri.

The uses and value of sponge, sea-tangle (*laminaria*), tupelo, and solid and tubulous tents, discussed by *Dr Sussdorf*, "*Richmond & Louisville Medical Journal*," May, 1879.

Drain'age Tube. A tube introduced into a wound to form a means of discharge of matter.

Dr. J. B. Hamilton's drainage-tube carrier consists of a stylet, with a hook at the end within a canula; the stylet is moved by a button over a side slot in the canula.

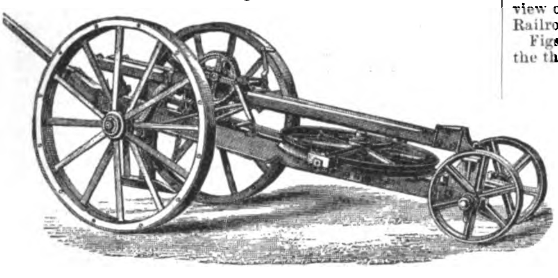
Drain Cock. A faucet attached to a cylinder to draw off water of condensed steam.

Drain Clean'er. A long-handled spade, the blade set on at an angle in order to be able to reach the bottom of a ditch when standing on the surface of the ground. See Ditch Cleaner.

Drain Gage. A device to measure the percolation of moisture — rain, liquid manure, etc. — through soil, and involving elaborate apparatus, is erected at Rothamstead, England, and a description is given in "*Scientific American Supplement*," * 1607.

Drain Grate. A grid at the entrance of a sewer in a yard or street.

Fig. 863.



Steam Draining Plow. (*Fowler & Co.*)

Drain'ing Plow. (*Steam Culture.*) A plow for opening furrows or drains for water. Fig. 863 shows the Fowler draining plow, adapted to be drawn by the plow-engine, which is applicable to various duties of steam husbandry.

It is drawn by the winding engine and rope; see Fig. 5706, p. 2354, "*Mech. Dict.*" It is used either as a mole plow, or to put in drain tile, and is worked to a depth of 42″. The wire rope passes over the sheave, and so draws the plow at but half the rate that it would were it hitched directly to the front of the implement.

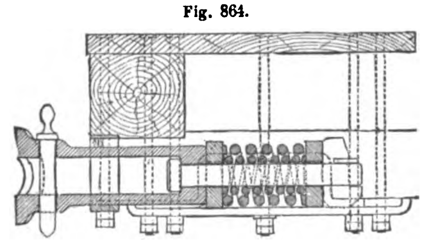
See also DITCHING MACHINE, and items in lists of AGRICULTURAL IMPLEMENTS, "*Mech. Dict.*," and *supra*.

Drain Tile Lay'er. *a.* A long handle with a piece projecting at right angles from the lower end, to place in position drain tile at the bottom of a trench.

b. Some forms of draining machines also lay tile. Some are noticed on p. 741, "*Mech. Dict.*"

Drain Tile Ma-chine'. See TILE MACHINE.

Fig. 864.

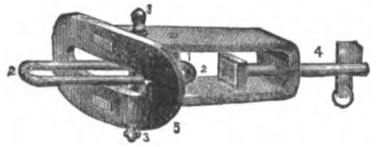


Draw Gear for Freight Cars. (*Pennsylvania Railroad.*)

Drain Trap. A device at the opening of a drain or sewer to allow passage to liquids by preventing emission of gases.

Banner, Br.	* "*Engineer*," xli. 51.

Fig. 865.



Bolt Draw Bar.

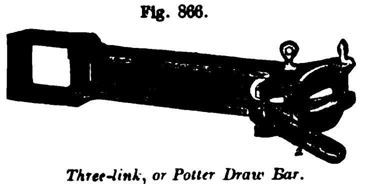
1. Coupling-link Rivet.
2. Fast Coupling-link.
3. Fast Coupling-pin.
4. Draw-bar Bolt.
5. Draw-bar Face-plate.

Draw Bar. (*Railway.*) An open-mouthed bar at the end of a car to which the coupling-links are attached, and with which the car is drawn. The draw-bars are usually provided with springs to give elasticity to the connection between the cars, and arranged so as to resist both the tension and compression to which the draw-bar is subjected. — *Forney.*

These springs are shown in the longitudinal sectional view of the draw gear for freight cars of the Pennsylvania Railroad, Fig. 864.

Figs. 865 and 866 are respectively the bolt draw bar, and the three-link, or *Potter* draw bar.

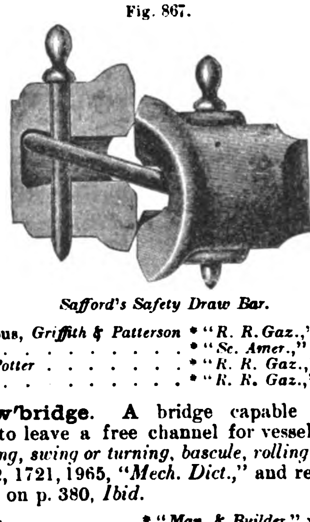
Fig. 866.



Three-link, or Potter Draw Bar.

Fig. 867 is a safety draw bar, which accommodates itself to draw heads of varying height.

Fig. 867.



Safford's Safety Draw Bar.

Continuous, *Griffith & Patterson*	* "*R. R. Gaz.*," xxi. 559.
Hibbert	* "*Sc. Amer.*," xliii. 226.
Safety, *Potter*	* "*R. R. Gaz.*," xxii. 315.
Safford	* "*R. R. Gaz.*," viii. 164.

Draw'bridge. A bridge capable of being moved to leave a free channel for vessels. They are *lifting, swing or turning, bascule, rolling.* See pp. 241, 742, 1721, 1965, "*Mech. Dict.*," and references; also list on p. 380, *Ibid.*

Harlem	* "*Man. & Builder*," xi. 6.
Lifting	* "*Man. & Builder*," xi. 29.
Thames, proposed	* "*Scientific Amer. Sup.*," 290.

Draw'ing. (*Add.*) 5. (*Glass.*) Glass is drawn into tubes or sticks by attaching a ponty to the end of a bulb held on the blowing tube, and running away with it; so that the glass is elongated between the ponties held by the respective men.

In drawing tubes, the glass is blown to a globe, so that as the workman runs off the stick is hollow; the thickness of the glass and bore of the tube are regulated by the quantity of metal in the globe, the size of the latter, and the rate of the motion of the retreating workman.

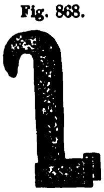
The stick or tube is constantly rotated, and when the workman has attained his distance the glass is laid on the floor to cool straight. It is divided into lengths by cold tongs. Such tubes furnish the material for beads.

Draw'ing, Writ'ing, Cop'y-ing In'stru-ments and Pro'ces-ses. See under the following heads: —

Albertype.	Blind ink.
Autographic process.	Blue process, for copying.
Autopolygraph.	Brush.
Bank note engraving.	Camera lucida.
Beam compass.	Camera obscura.
Bevel protractor.	Carbon printing.

Carbon process.
Charcoal pencil.
Chromophotograph.
Composite portraits.
Copygram.
Copygraph.
Copying devices.
Copying ink.
Copying pad.
Copying paper.
Copying pencil.
Copying press.
Copying processes.
Crayon cutter.
Crayon mold.
Curve delineator.
Curve instrument.
Curve scribe.
Curvograph.
Cyclograph.
Cycloidograph.
Diagraph.
Dividers.
Easel.
Electric pen.
Ellipsograph.
Engraving.
Engraving, Electric
Engraving and chasing machine.
Engraving machine.
Etching liquids.
Fountain pen.
Galvanoplastic process.
Gelatine process.
Hectograph.
Heliogravure.
Horograph.
India ink.
Ink.
Ink eraser.
Ink marks, Removing.
Ink pencil.
Ink powder.
Ink, Restoring faded.
Inkstand.
Ink, Sympathetic.
Lithogram.
Lithographic crayon.
Lithographic ink.
Manigraph.
Microscopic-drawing apparatus.
Mucilage brush.
Odograph.
Pantograph.
Papyrograph.
Pen.
Pencil.
Pencil, Indelible.
Perspective.
Perspective linead.
Perspective ruler.
Perspectograph.
Photo-collograph.
Photo-collotype process.
Photo-engraving.
Photographic printing surface.
Photographic relief process.
Photolithography.
Photo-mezzotint engraving.
Photo-printing process.
Phototype.
Photozincotype.
Planigraph.
Pneumatic pen.
Point finder.
Polar pantograph.
Polytype.
Porotype.
Profilograph.
Proportional dividers.
Protractor.
Pyrostereotype.
Quill.
Quill manufacture.
Radiograph.
Reducing squares.
Reflecting drawing board.
Relief process.
Shading pen.
Short-hand writing machine.
Sketching frame.
Slate pencil.
Steel pen.
Stencil paste.
Stencil pen.
Stenochrome.
Stylographic pen.
Sun engraving.
Tablet.
Tracing apparatus.
Tracing copying.
Tracing table.
Voltaic pencil.
Woodburytype.
Writing multiplier.
Writing, Restoring faded.
Zincography.

Fig. 868.



Drawing Hook.

Draw'ing Hook. A clutch-hook used in lifting well-rods.

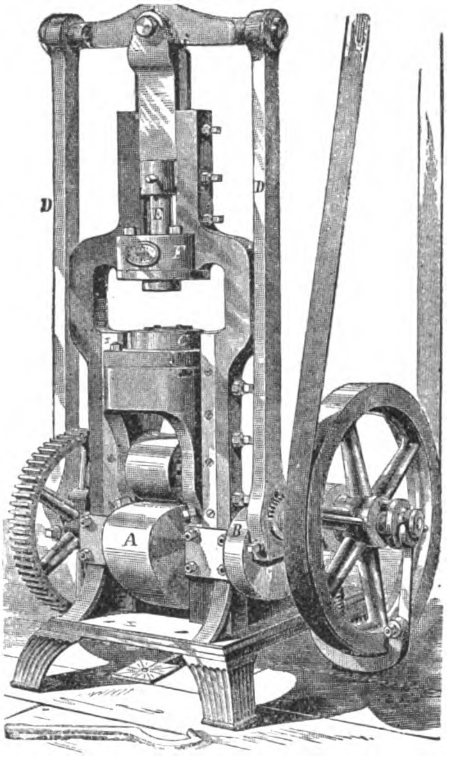
Draw'ing Ma-chine'. (*Add.*) 4. (*Cartridge Making.*) In making fixed ammunition in the United States factories there are five draws to the shell, coming in consecutive course. These machines elongate the shell and lessen its diameter by means of vertical dies descending into depressions beneath. The shells are fed into each machine on a horizontal wheel.

Drawing machine for cutters, Figs. 1-5, "*Engineering*," xxx. 484.

Draw'ing Press. A machine for cutting and drawing sheet metal into hollow ware. In making articles of moderate size it cuts the blank and forms the article at one operation. The work ranges from lantern bottoms, rim-covers, patty-pans, pie-plates, etc., up to 30-quart dish-pans and equally large work of other descriptions.

Power is communicated to the large pulley on the right, which, by means of a simple clutch, operated by the treadle shown under the bed, is thrown into or out of gear at will. From this pulley power is transmitted to a horizontal shaft passing through the lower portion of the frame, on which shaft is a heavy cam, *A*, and also two cranks *B*. The cam, in its revolution, acts upon a roll above it, and so elevates the carrier *C*, of the cutting and drawing dies, which carrier travels in slides in the frame. To the cranks are connected pitmen, *D D*, which connect with a wrought-iron yoke, to which is secured the drawing punch-rod, *E*. At *F* is a cross-

Fig. 869.



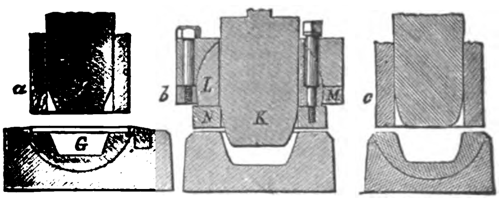
Double-acting Drawing Press.

piece between the two sides of the frame, through which piece operates the cutting-punch.

When the cam-shaft is rotated, the cam raises the die carrier, and the cranks, pulling down the pitman, force the cutting-punch against the metal and into the die below. This will be more clearly understood from the section *a*, Fig. 870, in which *G* is the drawing die, *H* the cutting die, *I* the cutting-punch (stationary), and *J* the drawing-punch. As the die carrier rises, the metal is first pressed against the cutting-punch *I*, between the outer edge of which and the cutting die *H* it is quickly cut, and the punch *I*, entering the die, then holds the edges so cut out as in a vise. At this point the drawing-punch *J* comes down and forces the metal into the drawing die *G*, thus completing the operation.

To obviate the difficulty incident to working in sheet metal not of uniform thickness, in which case the metal will be imperfectly held between the rising die and the stationary cylin-

Fig. 870.



Sectional Views of Drawing-press Dies.

der *I*, the lower portion of the drawing die *G* is made hemispherical so as to form a ball-and-socket joint, which enables the upper face to correspond with the face of the cutting-punch *I*, notwithstanding some slight difference in the thickness of the intervening sheet-metal. The device shown in section *a*, Fig. 870, is especially intended for small ware.

The arrangement shown at *b*, the same figure, is intended for large pans and like objects. In this there is no cutting of the metal by the machine, this having been previously done; there is, therefore, no cutting-die nor punch in this style of machine. The drawing die is a simple concavity without peculiar features, the essential points of the device being found in another means of holding the edge of the blank. The punch *K* passes directly through the ball portion, *L*, which is confined by a ring, *M*, held by the screw bolts, one of which is shown on the left. The edges of the blank are compressed and held between the surface of the die and a lower ring, *N*, which is upheld by another set of screw bolts, one of which is shown on the right. These bolts pass through a large bore in the ball portion, *L*, thus allowing the latter its free play and shoulder in said ball, as shown, so that the latter and the ring are closely united. The ring *N*, therefore, follows the play of the spherical portion, and consequently automatically adapts itself to the thickness of the metal. The punch then descends in manner similar to that already described.

c, Fig. 870 is a section of a simpler form of drawing press without cutter, but possessing the adjustable feature of *a*.

Referring to Fig. 869, it will be observed that the lower slide *C* is carried up by the cam *A* on the main shaft, and the shape of the cam is such that the slide dwells after cutting the blank, while the die on the lower end of the plunger *E* forces the sheet-metal into shape. The upper slide is brought down by the yoke *G*, operated by the pitmen *D D*, from cranks *B* on the main shaft. Thus it will be seen that the strain at the critical moment comes on the main shaft, pitmen, and yoke, — all of steel or wrought iron, — relieving the cast-metal frame. The frame bows at the point where the drawing takes place, thus affording a slight spring and a wider space in which to manipulate the blanks and the ware. See the following references: —

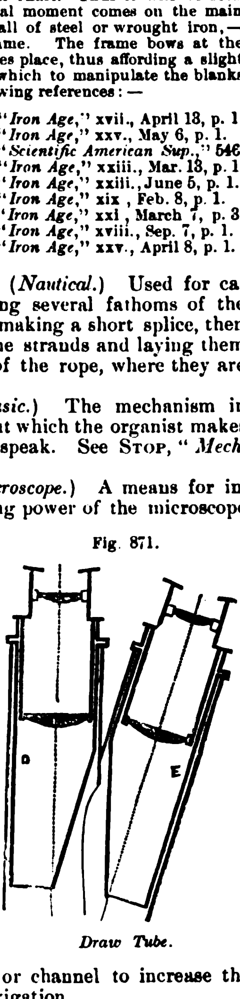
Bliss & Williams	* "*Iron Age*," xvii., April 13, p. 1.
	* "*Iron Age*," xxv., May 6, p. 1.
	* "*Scientific American Sup.*," 546.
Deep work	* "*Iron Age*," xxiii., Mar. 13, p. 1.
	* "*Iron Age*," xxiii., June 5, p. 1.
Double-crank	* "*Iron Age*," xix, Feb. 8, p. 1.
Inclined	* "*Iron Age*," xxi, March 7, p. 3.
Ferracute Machine Co.	* "*Iron Age*," xviii., Sep. 7, p. 1.
	* "*Iron Age*," xxv., April 8, p. 1.

Draw'ing Splice. (*Nautical.*) Used for cables. Made by unlaying several fathoms of the two ropes to be joined, making a short splice, then tapering the ends of the strands and laying them along in the contlines of the rope, where they are secured by seizing.

Draw Stop. (*Music.*) The mechanism in an organ, by drawing out which the organist makes such and such a stop speak. See Stop, "*Mech. Dict.*"

Draw Tube. (*Microscope.*) A means for increasing the magnifying power of the microscope by lengthening the distance between the object-glass and eye-piece without changing for lenses of different power.

Fig. 871.



Draw Tube.

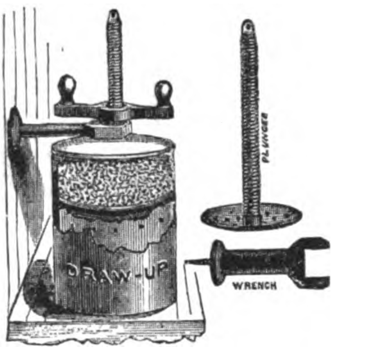
Fig. 871 shows the draw-tubes *D E* of a binocular microscope.

Draw'-up Press. A small domestic press for jelly, fruit, or what not, in which the platen is drawn up by a screw, and presses the material against the lid, leaving a space beneath in which the liquid expressed may collect. Fig. 872.

Dredge. A machine for excavating the bottom of a river or channel to increase the depth and facilitate navigation.

The Eads dredging machine is a sort of plow with a throat, comparable to a carpenter's plane, 4′ in width, and with arrangements for limiting the depth of its cut on the silt of the river-bottom, so that the silt and water shall bear a quantitative relation, the silt occupying so much of the 16″ of throat as the nature of the plowed-up material shall

Fig. 872.



Draw-up Press.

warrant. An Andrews cataract pump of 27″ diameter suction is the lifting apparatus, and the discharge is into tanks of 1,000 tons capacity, with overflows for water as the silt settles to the bottom.

The dredge-boat is 200′ in length, propelled by horizontal high-pressure engines, each 7′ stroke and 21″ diameter, turning paddle-wheels 28′ diameter. It is designed to move at the rate of from 10,000′ to 15,000′ per hour.

Adelaide, Australia.	
Simons	* "*Engineer*," xli. 460.
	"*Scientific American*," xxxv. 146.
	"*Scientific Amer. Sup.*," 2688.
Antwerp	* "*Engineering*," xxviii. 389.
"Atlanta Dredging Co."	"*Trans. Am. Soc. Civ. Engineers*," vii., No clxxiv.
Buckets, *Kinipple*, Br.	* "*Engineer*," xliv. 273.
	* "*Scientific Amer. Sup.*," 1583.
Simons, Br.	* "*Scientific Amer. Sup.*," 2688.
Calcutta, dredge and fire-engine boat	* "*Engineering*," xxviii. 265.
Carr	* "*Scientific Amer.*," xxviii. 390.
Danube improvements	* "*Engineering*," xxvi. 147, 235.
Davis	* "*Scientific American*," xxxvi. 50.
Dennison, "Ingurgitator" (suction)	* "*Min. & Sc. Press*," xxxv. 121.
	* "*Scientific American Sup.*," 1488.
Eads, Mississippi	"*Manuf. & Builder*," x. 35.
	* "*Iron Age*," xx., Aug. 9, p. 1.
Holland, *Reitscholen et al.*	* "*Scientific Amer.*," xxxvii. 259.
Kurrachee, India	* "*Engineering*," xxix. 341.
Lake Fucino	* "*Engineering*," xxi. 17.
	* "*Scientific Amer. Sup.*," 120.
Newton (suction)	* "*Min. & Sc. Press*," xxxv. 241.
	* "*Scientific Amer. Sup.*," 1583.
Patna Canal, India.	
Fouracres	* "*Engineer*," xlviii. 199, 202.
Pneumatic	* "*Scientific American*," xxxvii. 371; xxxiv. 179.
Pneumatic, Millwall, Br.	"*Iron Age*," xvii., April 6, p. 23.
Roy Stone	* "*Eng. & Min. Jour.*," xxviii. 454.
Toulon, graving dock	* "*Engineering*," xxvii. 136, 376, 432.

See also Excavator, *infra*, and figures on pp. 747–749, and 814, "*Mech. Dict.*"

(*Add.*) 2. (*Fishing*). A rake or scoop, with a net attached, drawn with open mouth in the wake of a vessel to gather oysters or flat-fish, coral, or other objects. See Trawl Net.

Fig. 873 shows the *dredge* and *tangles* of the expedition ship "Challenger."

Dredg'ing Tube. A tube which is lowered from a vessel or scow and burrowing in the silt removes it by means of a connected steam-pump which draws up the solid portions together with water.

This is a feature common in pneumatic dredgers; see list of references under Dredge. See also Figs. 1762, 1763, p. 749, "*Mech. Dict.*"

One form is a closed tube which is lowered into position and then filled by exhausting the air by pump; after which the tube is lifted and discharged, shown in * "*Scientific American*," xxxvii. 371.

Fig. 873.

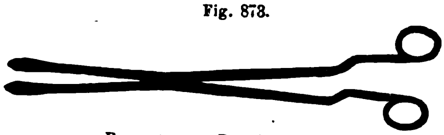
Dredge and Tangles of the "Challenger."

Dres'ser. 1. (*Mining.*) A heavy pick used for preparing the large bunches of ore for loading on the skips.

2. A plumber's wooden mallet, or rather paddle, for closing sheet-lead joints.

Dres'sing For'ceps. (*Surgical.*) An instrument used in applying and removing dressings.

Fig. 873.



Bayonet-curve Dressing Forceps.

Dress'ing Ta'ble. 1. (*Stereotyping.*) A machine for straightening and trueing the edges of stereotype plates; and for beveling and cutting off curved plates for newspaper work and for perfecting presses. See figures on pp. 2378–2381, "*Mech. Dict.*"

2. A brickmaker's table on which bricks are dressed, to make them symmetrical for house-front courses. Fig. 1764, p. 749, "*Mech. Dict.*"

3. A bench on which copper or other ores are hammered, and sorted into qualities.

Drift Net. (*Fishing.*) A gill net suspended from a cork line and having leads at its lower edge. A float at each end carries a lantern and it floats with the tide or current. Such a net is usually 300 yards long, and a number of such are cast parallel with an intervening space of 50 to 80 feet. The gilling ground of the Chesapeake Bay is famous.

Drill. 1. (*Surgical.*) A boring instrument in operations in osteotomy.

Brainard's, Tiemann's, Hamilton's, Howard's, and *Buck's* drills are shown on p. 8, Part I., *Tiemann's "Armamentarium Chirurgicum."*

See list under Surgical Instruments, "*Mech. Dict.*" *et infra.*

Drill for ununited and oblique fractures, *Ibid.*, Fig. 61, Part I.

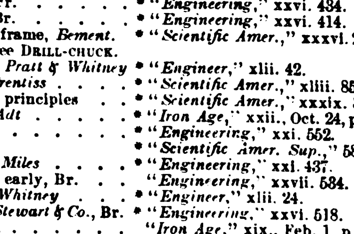
2. (*Dentistry.*) A boring tool used in mechanical or operative dentistry. See Dental Drill, *supra*, and Fig. 1609, p. 685, "*Mech. Dict.*"

3. (*Machinery.*) A boring tool for metals. See pp. 750–752, "*Mech. Dict.*," and the following references: —

Boiler work, *Adamson*, Br.	* "*Engineering*," xxvi. 434.
Allan, Br	* "*Engineering*," xxvi. 434.
Brown, Br.	* "*Engineering*," xxvi. 434.
Buckton & Co., Br. . .	* "*Engineering*," xxvi. 414.
Buckton & Wickstead, Br.	* "*Engineering*," xxvi. 414.
Dickenson, Br.	* "*Engineering*," xxvi. 434.
Hall, Br.	* "*Engineering*," xxvi. 434.
Hutchinson, Br.	* "*Engineering*," xxvi. 414.
Jordan, Br.	* "*Engineering*," xxvi. 414, 434.
Kennedy, Br.	* "*Engineering*," xxvi. 434.
McKay, Br.	* "*Engineering*," xxvi. 414.
Thorn, Br.	* "*Engineering*," xxvi. 434.
Welch, Br.	* "*Engineering*," xxvi. 414.
Car truck frame, *Bement*.	* "*Scientific Amer.*," xxxvi. 226.
Chuck. See Drill-chuck.	
Chucking, *Pratt & Whitney*	* "*Engineer*," xlii. 42.
Cleaner, *Prentiss*	* "*Scientific Amer.*," xliii. 85.
Forms and principles . .	* "*Scientific Amer.*," xxxix. 387.
Machine, *Adt*	* "*Iron Age*," xxii., Oct. 24, p. 1
Bement	* "*Engineering*," xxi. 552.
	* "*Scientific Amer. Sup.*," 582.
Ferris & Miles	* "*Engineering*," xxi. 437.
Notes on early, Br. . .	"*Engineering*," xxvii. 584.
Pratt & Whitney . . .	* "*Engineer*," xlii. 24.
Sharpe, Stewart & Co., Br.	* "*Engineering*," xxvi. 518.
Treatise on	"*Iron Age*," xix., Feb. 1, p. 7.
Hall	* "*Engineering*," xxvi. 414.
Multiple, Br.	* "*Scientific Amer.*," xxxiv. 191.
Oil wells	* "*Scientific Amer. Sup.*," 1644.
Power, *Pratt & Whitney* .	* "*Manuf. & Builder*," xii. 16.
Press, *Ferris & Miles* . . .	* "*R. R. Gazette*," xxi. 119.
Recessing mach., and, duplex, *Kershaw*, Br. . .	* "*Engineer*," xlii. 429.
Self-feeding, *Combs & Bawden*.	
Pratt & Whitney . . .	* "*Scientific Am.*," xxxvii. 278.
	* "*Iron Age*," xx., July 12, p. 11.
Slotting mach., and, *Lowry*	* "*Engineer*," xli. 122.
	* "*Scientific Amer. Sup.*," 248.
Square hole, *Hall* . . .	"*M. & Sci. Press*," xxxvii. 291.
	* "*Scientific Amer.*," xxxix. 311.
Stone working	* "*Sci. Amer. Sup.*," 1796, Fig 18.

Drill Bench. See Bench Drill.

Fig. 874.



Cushman's Drill Chuck.

Drill Chuck. A lathe-drill holder. Figs. 874, 875, 876, show various drill-chucks.

Almond	* "*Sc. American*," xxxv. 6.
Brown & Sharpe . . .	* "*Polytech. Rev.*," Jan. 27, 1877.
Chucking, On	* "*Scientific American*," xl. 52.
Horton	* "*Polytech. Rev.*," Jan. 27, 1877.
	* "*Scientific American*," xlii. 383.
Planer chuck	* "*Sc. American*," xxxviii. 245.
Pratt, "Victor" . . .	* "*Iron Age*," xxi., Feb. 28, p. 1.
	* "*Sc. American*," xxxv. 210.
Self-centering	* "*Sc. American*," xxxvi. 406.
Sweetland & Horton . .	* "*Iron Age*," xxiv., Nov. 6, p. 1.

Drill Hold'er. A lathe rest or fork-attachment, or both, to hold a drill in position, or steady it, while held up to its work by the tail center.

"*Scientific American*" . . . . . . * xl. 164, Fig. 22.

Drill'ing Clip. A vise or clamp to clasp a gas or water main, and having an arm on its upright shaft to form the upper bearing for a brace or ratchet drill. Fig. 877.

Drill'ing Scow. A vessel fitted up with apparatus for subaqueous drilling.

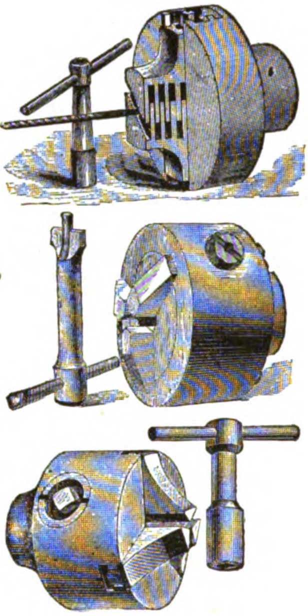
The drilling scow, built for excavating the channel for the improvement of the Des Moines Rapids, is shown in the

Fig. 875.

a

b

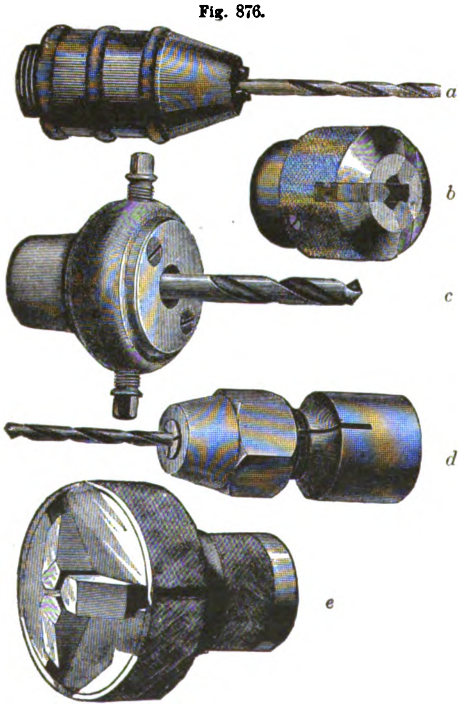
c



Drill Chucks.

a. "Oneida" chuck. *c. Whiton* chuck.
b. "Danbury" chuck.

Fig. 876.



Drill Chucks.

a. Beach chuck. *d.* Center drill chuck.
b. Adjustable drill chuck. *e.* "Acme" chuck.
c. "1876" chuck.

"*Report of the Chief of Engineers, U. S. Army,*" 1880, * ii. 1556.

See also drilling platform and scow, Ahnepee Harbor, Wis.; "*Report of Chief of Engineers,*" 1879, * i. 1510.

The United States drilling scow, East River, N. Y., is shown in "*Scientific American,*" * xli. 131.

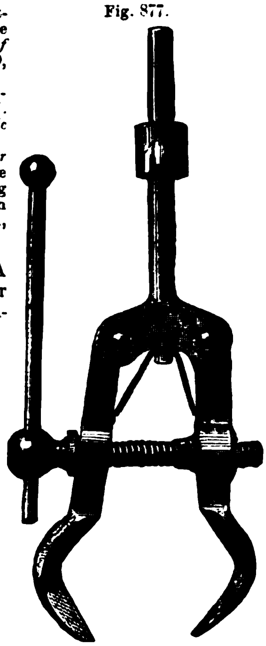
See also Report by *Sir John Hawkshaw* on the Hydraulic Engineering Group, British Reports on the Centennial Exhibition, 1876.

Drip Pump. A plumber's pump for removing drip or collections of water incident to accidents to pipes or in clearing up after work.

Fig. 878.

Evarts' Drive Chain.

Fig. 877.



Drilling Clip.

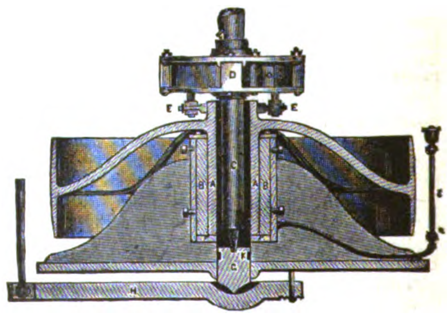
Drive Chain. A detachable link chain used in connection with sprocket wheels, to drive machinery. Each link has a hook and bar at its respective ends, and these may be connected in certain relative position, but cannot be detached when stretched. Fig. 878.

Drive Well. A tube driven into an aqueous stratum, and forming the stock for a pump attached to its upper end.

See notices. * "*Iron Age,*" xxi., Jan. 31, p. 3; Feb. 7, p. 3.
"*Scientific American,*" xxxv. 17.
In England . * "*Scientific American Sup.,*" 1697.
Paper by *Palmer,* "*Scientific American,*" xxxix. 408.

Dri'ving Pul'ley. One receiving motion from a belt, and concerned in driving machinery: as distinguished from a *loose* pulley, which runs free on the shaft, and does not communicate motion. The belt is shifted from the *loose* to the *driving* pulley when the machine is to be started, and *vice versa.*

Fig. 879.



Hafner's Equilibrium Driving Pulley, for Millstones.

Hafner's equilibrium driving pulley, designed for driving mill-stones, is intended to prevent the side draft of the belt on the pulley from putting the stone out of tram. The hub *A* of the pulley works in the bearing *B*, which rests on the bridge-tree *H*, by means of the step *G*. *C* is the spindle of the stone resting on *G*, and *E E* are drivers on the hub, which project upward into the jaws *D* of the coil spring. The arms of the pulley are curved down, so that the strain of the belt is on the center of the bearing *B*, and the side strain does not communicate to the spindle, as the drivers *E* have a freedom of motion in the jaws of the spring.

Dri'ving-wheel Brake. (*Railway.*) One applied directly to, usually between, the driving-wheels of a locomotive. Fig. 749. *Forney's "Car-builder's Dictionary,"* p. 475.

Drogue. A drag-anchor, thrown overboard from a vessel to keep a ship's head to the wind when drifting. See Drag Anchor, * p. 737, "*Mech. Dict.*"

Drop and Trans'fer Ta'ble. (*Railway.*) An arrangement for taking out the wheels of car trucks without removing the trucks from under the car.

Kirby's arrangement is shown in Fig. 880, which gives a side elevation of the truck and a section of the pit, which is transverse to and below the line of rails. The drop table is a truck, *C*, which runs on wheels on a rail under and transverse to the main line of rails, *A*, and has a screw-jack, *E*, which is brought beneath the axle of the pair of wheels, *F*, to be removed. These being lifted, a hinged section, *B*, of the rail is swung open, and the pair (*E*) of wheels lowered into the pit, as shown by dotted lines, the transfer moved off, and a new pair introduced in a corresponding manner.

Drop Bot'tle. One for using in small quantities iodine, creosote, acids, etc., in the laboratory.

Fig. 881.

Drop Bottle.

Warm the bulb over the flame of a spirit-lamp, or in warm water, to expel the air, immerse the point of the pipette in the liquid, and the latter will ascend as the air condenses. When cool, place in the bottle, which should have enough of the liquid to cover the point of the pipette.

When required to be used take it from the bottle, and the warmth of the hand on the bulb will force the liquid out a drop at a time.

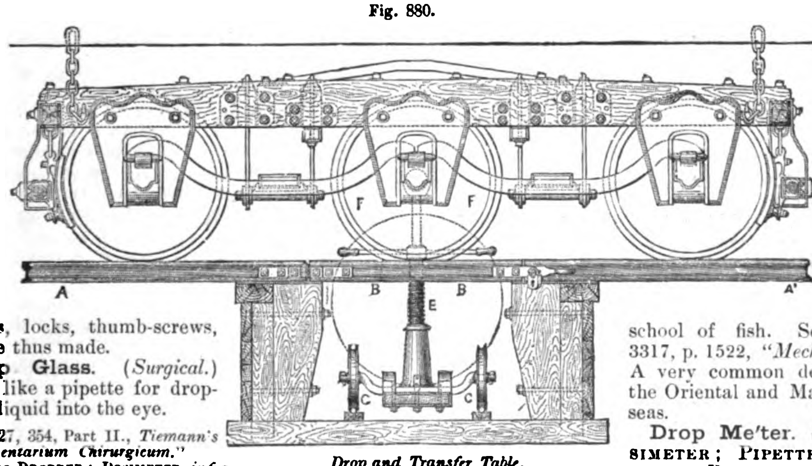
See also Dosimeter; Burette; Pipette, etc.

Drop Cut'-off. (*Steam.*) That form of cut-off in which a weighted bar is released at a regulatable point, and by its fall closes the valve. The Corliss arrangement is a familiar instance.

Drop For'ging. One made in that form of press in which the blow is by impact instead of by mere pressure. A forging made by a drop hammer.

Parts of sewing machines, watches, guns, pistols, drill-chucks, spinning rings, wrenches, clinch rings, shuttles, locks, thumb-screws, etc., are thus made.

Fig. 880.



Drop and Transfer Table.

Drop Glass. (*Surgical.*) A tube like a pipette for dropping a liquid into the eye.

Figs. 27, 354, Part II., *Tiemann's "Armamentarium Chirurgicum."*
See also Dropper; Dosimeter, *infra.*

Drop Ham'mer. A swaging hammer having a vertical motion in guides, or suspended by spring connection from a reciprocating portion. See Dead Stroke Hammer, Drop Press, "*Mech. Dict.*"

See following references: —

Hasse, Br.	* "*Engineering*," xxviii. 396.
Hill	* "*Scientific American*," xxxv. 67.
Hotchkiss & Stiles .	* "*Thurston's Vienna Report*," ii. 237.
Peek	* "*Iron Age*," xxi., May 2, p. 41; xxii., Dec. 5, pp. 24, 29.
Pratt & Whitney . .	* "*Eng. & Mining Jour.*," xxi. 298.

Drop-lev'er Scales. A weighing scales with a lever to raise the platform entirely off the working parts of the scale while it is being loaded.

Drop Light. A gas-light vertically adjustable to bring it from a chandelier to convenient table-height.

Taylor . . . . . * "*Scientific American Sup.*," 1363.

Drop Net. (*Fishing.*) A net suspended over the water, and dropped vertically over a passing school of fish. See Fig. 3317, p. 1522, "*Mech. Dict.*" A very common device in the Oriental and Malaysian seas.

Drop Me'ter. See Dosimeter; Pipette; Burette; Dropper, etc.

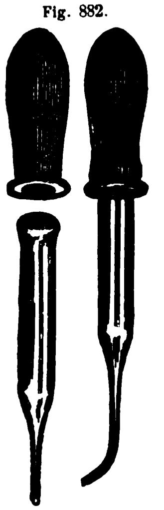
Drop'per. 1. (*Agric.*) A form of reaper in which the grain falls backward from the knife on to a slatted frame which is *dropped* at intervals to discharge the gavel. As the rear-end of the frame drops to the ground the heads of the cut grain catch in the stubble, and the gavel is pulled off in a compact bunch of a width equal to the length of the knife-bar. The dropping is done automatically at regulated intervals, or can be operated at the will of the driver. When the dropper falls, a horizontal rod descends temporarily to arrest the falling grain so that it shall not trail off at the rear of the gavel. When the dropper rises the rod also ascends and allows the grain to fall freely and collect on the dropper. See middle figure, Plate XLVI., p. 1892, "*Mech. Dict.*"

2. A pipette. A tube with a small aperture at its lower and an elastic bulb at its upper end. Fig. 882. By compressing the bulb, and plunging the lower end into a liquid, the tube is filled, and the liquid ejected in drops by gentle compression of the bulb.

Drop'ping Tube. A *pipette, burette,* or *dosimeter.* See DROPPER.

Drop Shut'ter. (*Photography.*) An arrangement for giving a very rapid exposure to a plate in instantaneous photography.

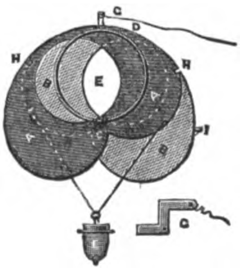
Fig. 882.



Dropper.

It is essentially constructed of two heart-shaped disks, *A A*, revolving on one axis, which is attached to the lower part of the mount of the lens. These two plates, when released by the trigger, have a reciprocal motion imparted to them by means of the weight *F*, which hangs suspended from the upper part of each. The apertures in each plate are thus simultaneously brought in front of the lens, and the exposure rapidly effected. The exposure commences and terminates at the lower side of the center, *E*, of the lens, so that the foreground will get slightly more light than the upper portion of the picture, an advantage which will be readily appreciated by photographers.

Fig. 883.



Duplex Drop Shutter.

D is a ring adapter fitted to the mount of the lens. *G* is a trigger with cord attached, fitting into notches *H*. When the exposure is completed the stop at *I* comes in contact with an overhanging hook near the trigger *G*.

Drop Tube. A PIPETTE. See DROPPER; DOSIMETER.

Drum. (*Add.*) (*Surgical.*) A circular frame over which a membrane is stretched as an object on which are tested the delicate edges of eye instruments.

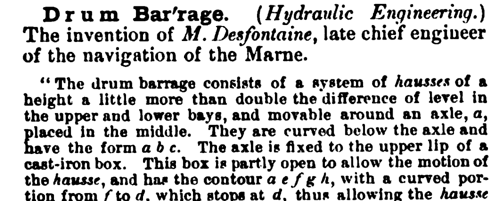
See Fig. 35 *b*, Part II., *Tiemann's* "*Armam. Chirurgicum.*"

Drum Bar'rage. (*Hydraulic Engineering.*) The invention of *M. Desfontaine*, late chief engineer of the navigation of the Marne.

"The drum barrage consists of a system of *hausses* of a height a little more than double the difference of level in the upper and lower bays, and movable around an axle, *a*, placed in the middle. They are curved below the axle and have the form *a b c*. The axle is fixed to the upper lip of a cast-iron box. This box is partly open to allow the motion of the *hausse*, and has the contour *a e f g h*, with a curved portion from *f* to *d*, which stops at *d*, thus allowing the *hausse* to move from the position *b a c d* to the position *b' a' c' d'*, leaving the two orifices *l* and *k*, outside of its path. The upper part of the box is flat, one portion below the other, so that the *hausse*, when lowered into the position *a b'*, is a little below the level *a e*, and thus hidden by it.

"Each *hausse* is fitted to a special box or drum, but all the boxes are pierced with oblong holes, *l* and *k*, so that they communicate when arranged side by side. The drums are fitted together by flanges around these holes, thus affording a communication along the whole line of the *barrage*, both before and behind the *hausses*, with the water in the upper bay.

Fig. 884.



Desfontaine's Drum Barrage.

"It is now evident that if, by means of sluice-gates or valves, the tube *l* is put in communication with the upper bay and the tube *k* with the lower bay, the difference of pressure on the face of the *hausse* will cause it to rise and take the position *b a c d*. If, on the other hand, the tube *k* is by a second system of sluice-gates put in communication with the upper bay and *l* with the lower bay, the system is reversed and the pressure forces the *hausse* to take the position *b' a' c' d'*; *i. e.*, lowers the *hausse*.

The simple turning of a valve thus opens the whole *barrage*. The time for opening is one and a half minutes; the time for closing four and a half minutes." — *Prof. Watson*, in "*Vienna Exposition Reports.*"

See also "*Van Nostrand's Engineering Mag.*," * xvii. 253.

Drum Guard. (*Agric.*) A British invention, to prevent a man while feeding a threshing machine from falling into the throat, and being mutilated by the cylinder. In the British practice the feeder is on top of the machine. Fig. 6395, p. 2557, "*Mech. Dict.*" In the American practice, no such attachment is used.

Clayton & Shuttleworth, Br.	* "*Engineer*," xlix. 235. * "*Engineering*," xxviii. 477.
Fison, Br.	* "*Engineering*," xxviii. 36.
Hunt *Fison* *Ruston & Proctor* *Gibbon* *Robey*	* "*Engineering*," xlviii. 81, 100.
Marshall, Br.	* "*Engineer*," xxvii. 580.
Nalder, Br. *Ransome*, Br.	* "*Engineer*," xlvi. 424.
Robey, Br.	* "*Engineering*," xxvi. 471.
Ruston & Proctor, Br.	* "*Engineering*," xxviii. 446.
Wallis & Stevens, Br.	* "*Engineering*," xxvi. 27.

Drum Weir. The drum barrage of M. Desfontaine. See DRUM BARRAGE.

Dry Cup'ping Ap'pa-ra'tus. (*Surgical.*) An apparatus in which a limb is placed while the pressure of the surrounding air is withdrawn.

For *Junod's* apparatus see ARM; BOOT. See also DEPURATOR, "*Mech. Dict.*," and AËROTHERAPY APPARATUS, *supra.*

Dry Dock. (*Hydraulic Engineering.*) A basin, structure, caisson, etc., in or by which a vessel is exposed clear of the water, for examination, cleaning, or repairs.

See list on p. 715, "*Mech. Dict.*," and DEPOSITING DOCK, *supra.* Also GRAVING DOCK, FLOATING DOCK, "*Mech. Dict.*," *et infra.*

Dry E-lec'tric Pile. A name applied to a hermetically sealed pile; not that there is no exciting liquid, but it is inclosed in insulated and air and water-tight envelope.

C. L. Van Tenac, Paris, * "*Scientific Amer. Sup.*," 913

Dry'er. One form of dryer is that operating by centrifugal action in a wire cage, and is largely used with sugar, wringing clothes, etc. It has various names: *centrifugal machine, centrifugal filter, hydro-extractor, or sugar dryer, wringer,* etc., under some or all of which heads it is noticed in the "*Mech. Dict.*" See the various heads *supra et infra.*

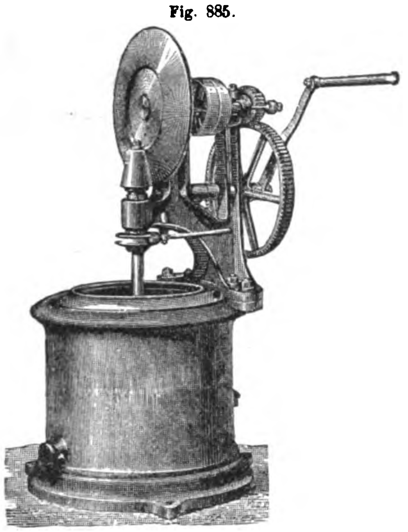
Fig. 883 shows a drying machine of a size to be driven by hand, and such as is used in French laundries. See also list of DRYERS, page 758, "*Mech. Dict.*"

Dry'ing Ap'pa-ra'tus. See the following: —

Centrifugal, *Stevenson*, Br.	* "*Engineer*," xlix. 323.
Crystals, for,	* "*Sc. American Sup.*," 1216.
Fabrics, for, *Butterworth*,	* "*Sc. American*," xli. 162.
Gunpowder stove	* "*Engineering*," xxv. 198.
Hot air, *Redfern*, Br.	* "*Sc. American Sup.*," 1014.
Oven, *Rohrbeck*	* "*Sc. American*," xlii. 180.

Dry'ing Case. (*Optics.*) A copper case surrounded with a chamber containing hot water, for drying tissues and hardening balsam preparations for the microscope.

Fig. 885.

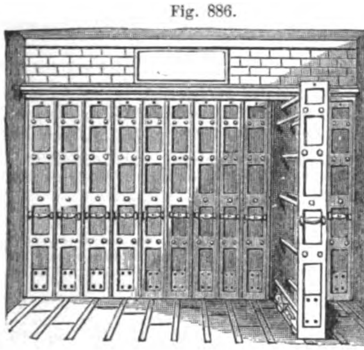


French Laundry Dryer.

Dry'ing Cham'ber. The closet in which printed stuffs are artificially dried; the tissue, accompanied by its *doublier,* passes in a zigzag manner over a large series of rollers near the ceiling and floor respectively of the room. After a certain course the *doublier* parts and goes to its own roller, while the tissue proceeds to the folding-room.

Dry'ing Clos'et An apartment made up of

Fig. 886.



Drying Closet.

a series of "draw-out horses" for the suspension of clothes to dry. It is heated in any suitable way, and is used in asylums and public laundries.

Dry'ing House. 1. (*Powder Making.*) A building remote from those in which the mechanical operations of powder-making are carried forward, and heated by steam from a distant boiler-house.

The steam pipes are laid along the floor, and have expansion joints. The temperature by thermometer is visible through a pane of glass, and the ventilators operable from the exterior. Wooden racks hold trays of sheet copper, or wooden frames with canvas bottoms to contain the powder. The maximum temperature is 130° F., and the time employed 18 hours, with an additional 6 hours for cooling. Pebble powder requires 135° F., and 36 hours exposure.

Russian dry house, Fig. 22, accompanying appendix to "*Ordnance Report,*" 1877.

2. (*Fruit.*) A structure, usually a tall wooden one-story out-house in which trays of fruit are exposed in an ascending column of heated air. See FRUIT DRYER.

Dry'ing Ma-chine'. (*Add.*) 2. The centrifugal machine is also used for drying fabrics, sugar, and other material. See DRYER.

3. A machine used in England for drying calicoes and printed cloths, consists of a furnace heating a column of air in a flat or slightly inclined trunk, through which the cloth passes on an endless apron. See Fig. 2262, article "*Lechoir,*" *Laboulaye's "Dictionnaire des Arts et Manufactures,"* tome iii. The French machine, article "*Impression sur Étoffes,*" Figs. 45, 46, *Ibid.*, tome ii.

Dry'ing Room. 1. (*Ceramics.*) The room in which green ware is dried previous to baking or burning, as the case may be. Some wares are baked to the biscuit condition, then ornamented and glazed; subsequently burned.

2. (*Linen.*) See DRYING CLOSET.

3. (*Calicoes.*) See DRYING MACHINE.

Dry'ing Stove. 1. (*Gunpowder.*) A close chamber in which powder is dried. A *drying house,* which see.

See also "*Ordnance Report,*" 1879, pp. 108, 109; and Plate V., Fig. 10.
Drying stove, for testing samples, *Ibid.*, Plate X. *b.*

2. (*Founding.*) A large fire-proof room usually heated by an open fire, used for drying cores, dry sand, and loam molds. It is furnished with racks and shelves inside, and is usually provided with a flat carriage traveling on rails extending to the crane, and has large iron doors.

Dry Pile. (*Electricity.*) A voltaic battery in which the positive and negative plates are disposed alternately with an intervening fibrous disk, combined with a deliquescent salt.

Zamboni's, Ganot's "Physics," 693, N. Y., 1877.
Prescott's "*Electricity,*" 1879, p. 83.
For the ordinary voltaic pile, Ganot, * 682.
Prescott's "*Electricity,*" * 42; N. Y. 1879.
Dissertation, Niaudet's "*Electric Batteries,*" pp. 235-237, American translation.
"*Scientific American Supplement,*" * 2489.

Dry Screen. (*Mining.*) A machine in which crushed dry mineral is sifted into sizes in order to treat it farther by processes which tend to separate different qualities by differences in speed, centrifugal or otherwise, principally due to differences in specific gravity.

Revolving dry screen . "*Min. & Sc. Press,*" * xxxiv. 33.

Dry Wash'er. A machine for sorting minerals by means of agitation, impulse, or air-blast, without the use of water, and so arranged that metals — gold or tin especially — are selected from the gravel, etc., by virtue of their greater specific gravity.

There are many devices which come under this definition. *Krom's* ore concentrator, for instance, Plate XXXIV., p. 1567, "*Mech. Dict.,*" and Figs. 3415, 3416, *Ibid.* Also ORE SEPARATOR, p. 157, and Figs. 3421, 3422, *Ibid.*

Du'al Burn'er. A lamp burner with two wicks: flat or argand.

Fig. 887.

Dual Burner.

Du'al Tel'e-phone. Invented by Pritchett. One end of a hinged and covered magnetized bar is fitted with a padded receiving ear-piece, and its other end is fitted with a transmitting mouth-piece. It is held by one hand, and adjusted to the ear and mouth by one motion; obviating the use of two instruments.

* "*Telegraphic Journal*" . vi. 471.

Dub'bing. (*Leather.*) *Daubing.* A mixture of tallow and either neats-foot or sperm oil. The dampened leather is coated therewith and rendered supple thereby. *Stuffing.*

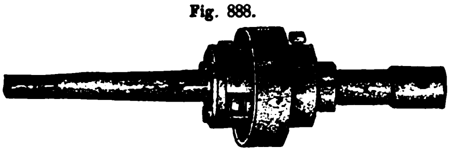
Duck'ing Boat. A low-sided boat with a well in the center for the fowler, and sharp at both ends, so as to be readily paddled either end forward. *A double-ender.*

A cedar duck-boat of some celebrity, "Central Republic," is 12' long, 3' 11" beam, depth 12". This boat was navigated by Mr. Bishop, of Lake George, from Pittsburg, Pa., via the Ohio and Mississippi Rivers and Gulf of Mexico to Cedar Keys, Florida, during 1875, 1876.

Duck's'-foot Cul'ti-va'tor. A cultivator with wide flanged shares, resembling the splayed foot of a duck. Such a cultivator has usually an expanding frame held to the width desired by perforated connecting rods and set screws. See shape of hoes in Fig. 2521, *b*, p. 1107, "*Mech. Dict.*"

Dudg'eon Ex-pand'er. (*Plumbing.*) A tool

Fig. 888.



Dudgeon Expander.

for expanding leaden packing into the internal flange recesses of pipe connections.

Dum'my. *Add.* 4. (*Print.*) A blank book in which copy and cuts are pasted in the way desired for the make-up of a book to be printed.

5. A card on which a number of cuts or views are arranged to be copied as a group, photographically or otherwise.

6. (*Binding.*) A book made up with leaves of a given number and size and weight of paper, and bound in such a style as to represent the finished book in external appearance and size.

Dump Car. See reference, p. 761, * "*Mech. Dict.*" ; also, —

Car, New England Car Co.	* "*Sc. Am.*," xlii. 306.
Car, Screw lever, *Van Wormer*	* "*R. R. Gaz.*," xxiv. 695.
Cart, *Whistling*	* "*Sc. Am.*," xxxii. 111.
Scow, *Allen*	* "*Sc. Am.*," xxxvi. 166.

Dump'ing Bar'row. A barrow arranged to upset its load. Used especially in furnaces. See Charging Barrow.

French dumping barrows, Figs. 8, 9, p. 322, * "*Scientific American*," xxxix.

Fig. 889.

French Dumping Bucket.

Dump'ing Buck'et. A suspended bucket, discharging by flap bottom when a latch is withdrawn.

Willis & Rowe. * "*Scientific American*," xxxvi. 4.

Dump'ing Grate. A tipping grate in a stove or heater.

Dump'y Bit. (*Manége.*) A curb bit having the length of the lower arm of the cheek piece so reduced that it is but a trifle larger than the upper arm.

Dump'y Lev'el. A surveyor's level with a short telescope of large aperture.

Dancer, Br. . . . . . * "*Engineering*," xxvi. 140.

Du'plex Air Com-pres'sor. See Air Compressor, Plate I., p. 14.

Du'plex Bor'ing and Fa'cing Ma-chine'. A tool intended for such work as boring out both ends of a coupling rod at once, or boring two cylinders at the same time, or facing two valve seats on the same piece simultaneously.

Bede et Cie., Verviers, Belgium . "*Engineer*," * xli. 5.

Du'plex Bor'ing, Turn'ing, and Groov'ing Ma-chine'. A machine having the characteristics of a double-ended gap-lathe, with two face plates and tail stocks and separate driving gear; also a hollow head spindle, which admits of the passage of a car axle so as to present the ends of the axle or the wheels thereon for simultaneous action by the various tools for turning, boring, or key-way grooving.

Atock . . . . "*Engineering*," * xxi. 310.

Du'plex Ma-chine'. One capable of performing similar operations upon two pieces of work simultaneously. Instances are given under two heads; *supra et infra.*

Du'plex Plan'ing Ma-chine'. One having duplicated parts capable of acting upon two faces of the same piece, or two pieces independently, etc. The adjustments are according to construction and purpose. Adamson's is furnished with two tables, each provided with independent driving gear, the arrangement being such that the tables may be worked either together or separately. The machine can thus be used as one large planing machine with independently set cutters operating on two faces, or as two smaller independent machines. Or a piece may be bolted to one, and operated by a tool carrier on the other.

"*Engineering*" . . . . * xxi. 291, 294.

Du'plex Slide Rest. A lathe with a tool-rest on either side of the object being turned. See Duplex Lathe, Fig. 1803, p. 763, "*Mech. Dict.*"

Du'plex Tel'e-graph. An instrument for sending two messages over the same wire simultaneously. See p. 764, * "*Mech. Dict.*"

Ailhaud, Fr.	* "*Engineering*," xxiv. 74.
	* "*Jour. Soc. Tel. Eng.*," vi. 205.
Banker	* "*Scientific Am. Sup.*," 2737.
	* "*Telegraphic Jour.*," vii. 82.
Berstein Multiplex	Br. Patent, 2,575 of 1855.
Dennett, Translator	* "*Telegraphic Jour.*," vi. 292.
d'Infreville	* "*Telegraphic Jour.*," iv. 23.
Electro-mechanical	* "*Scientific Amer. Sup.*," 80.
Fahie, Paper by	* "*Jour. Soc. Tel. Eng.*," v. 473.
Haskins	* "*Telegraphic Jour.*," iv. 45.
Koch	* "*Telegraphic Jour.*," iv. 290.
Lines, history of early	* "*Rept. Vienna Exp.*," 1873.
Morel	"*Eng. & Min. J.*," xxvi. 166.
Muirhead	* "*Teleg. Jour.*," vii. 160, 177.
Schwendler, on Theory of	"*Jour. Soc. Tel. Eng.*," vi. 360; * 534; vii. 104.
Sieur, Fr.	* "*Engineering*," xxvii. 169.
Stearns (submarine)	* *Lines'* "*Rept. Vienna Exp.*," 1873.
	* "*Telegraphic Jour.*," vii. 163.
Theiler	* "*Telegraphic Jour.*," vii. 227.
Treatise on	* "*Engineering*," xxix. 448.
	"*Scientific Amer. Sup.*," 1053.
Vianisi	* "*Jour. Soc. Tel. Eng.*," viii. 149

Du'plex Wheel Lathe. (*Machine Tools.*) A double wheel lathe. See Wheel Lathe, Fig. 7183, p. 2767, "*Mech. Dict.*"

Dust Col'lar. (*Railway.*) A ring or flange around an axle to keep dust from entering the axle box. See Axle Box.

Dust Col-lect'or. A device in flouring mills or factories to collect the dust which furnishes the material for explosion or is injurious to the health of the operatives.

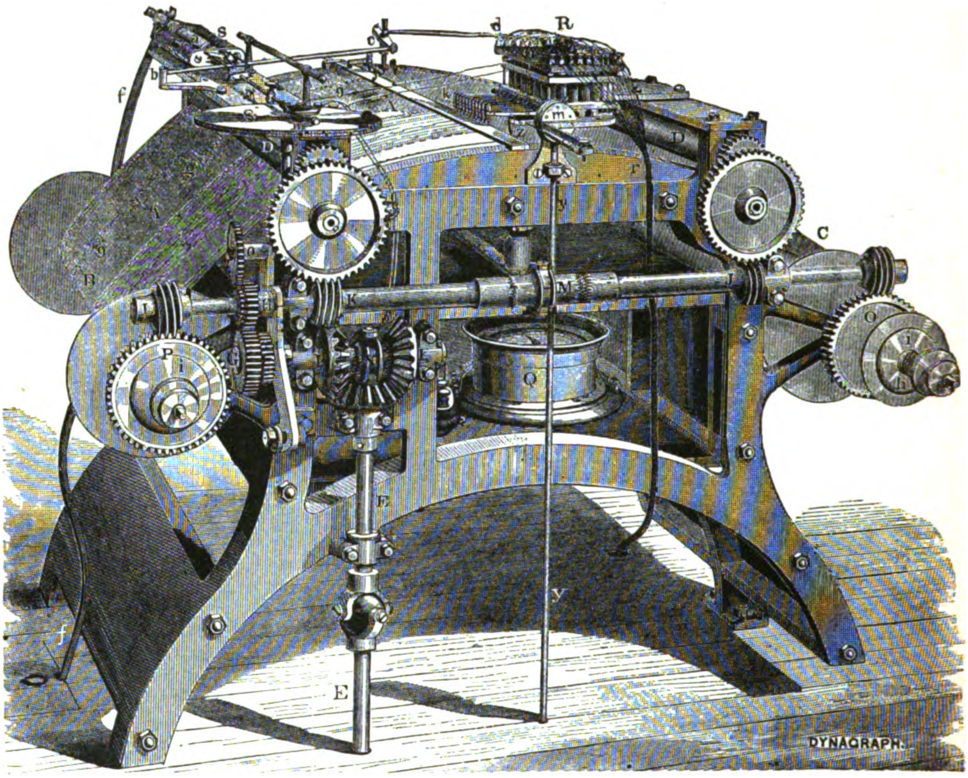
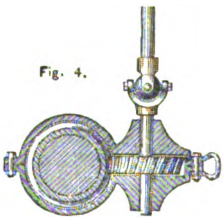


Fig. 4.



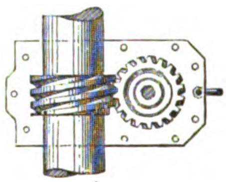


Fig. 5.

Fig. 2.

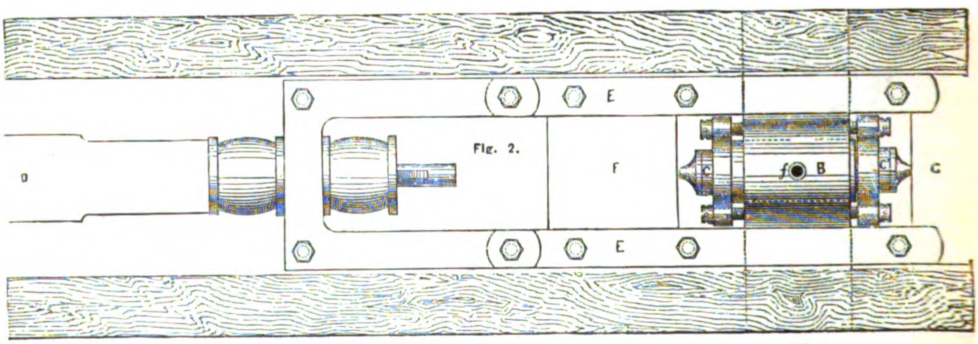
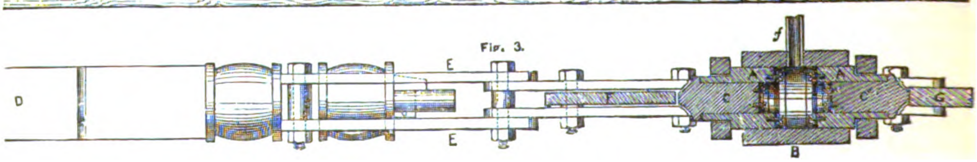


Fig. 3.



See page 281.

Blower, *Norcross*, *Stover* . * } "*Manuf. & Builder*," xi. 150.
Fairbanks . . . . }
Conductor, *Stover* . . . * }
Fairbanks . . . . * } "*Manuf. & Builder*," ix. 126.
Sturtevant . . . . * }
Flour mills, *Smith* . . . * "*American Miller*," vii. 311.

Dust'er. (*Add.*) 3. A machine for sifting dry poisons upon plants to destroy insects.

Allen's duster for destroying cotton worm, "*Comstock's Report on Cotton Insects*," 1879, * p. 247.
See also COTTON-WORM DESTROYER, p. 226, *supra*.

4. A dusting brush. Feather brushes and tails of animals were anciently used.

Dust Guard. A device to prevent dust from entering the journal-box of a car-axle, and the oil from escaping thence. See p. 459, "*Mech. Dict.*"

Balch & Heintzelman, * "*Railroad Gazette*," viii., p. 307.

Dust'ing Ma-chine'. A machine for removing the dust from crude granulated gunpowder.

"*Ordnance Report*," 1879, Appendix I., Plate IV., Fig. 9. and description on pp. 106, 107.
Dusting reel, Br. . . . . * "*Engineering*," xxv. 188.

Dy'na-graph. (*Railway.*) A machine for recording the phenomena occurring to a train in traveling upon a railway track.

Pambour, in his book on Locomotive Engines (edition of 1836, p. 83), discusses the question of determining the friction and resistance of railway rolling stock, and details the difficulties which accompanied the attempts to solve the problem. The interposition of a dynamometer between the engine and the car or cars was the means applied.

The apparatus of Prof. P. H. Dudley is placed in a car and uses 14 recording pens which make diagrams of the various phenomena.

The dynagraph track inspection record is traced on a continuous roll of profile paper wound in a length of 150′ upon a drum. The paper has various groups of rulings and the tracings are made by glass tube-pens filled with *eozine*.

The following diagram gives the nature and order of the indications on the record, — the broad paper ribbon which is shown in Plate X., as passing beneath the pens and wound upon a roller at the left of the machine.

The places of the tracings and explanations are shown in the column, which is not a *fac-simile* but merely an explanatory statement in columnar form.

NORTH TRACK.

Surfaces of rails and low joints.
North rail.
(*Tracing.*)
Horizontal scale 50′ to 1″ of paper.
Vertical scale full size.
(*Tracing.*)
South rail.

Gage of track.
North rail.
(*Tracing.*)
Alignment of joints.
(*Tracing.*)
South rail.

Distance by instrument.

Mile posts and stations.

Oscillations of car.
(*Tracing.*)

10 seconds.

Seconds.

(*Tracing.*) Representing elevation of rail on curves.

The machine as represented in Fig. 1, Plate X., is placed in an eight-wheeled car, 50′ long, constructed especially for the purpose. The draw-bar of this car is connected with a piston which works in a cylinder under the floor, and which is filled with oil. (Figs. 2, 3.) These are so arranged that if the draw-bar is subjected to strains of either tension or compression they are resisted by the oil in the cylinder, and the former is therefore subject to the pressure due to the strains on the draw-bar or the resistance of the train. The cylinder is connected by a pipe, *f*, Figs. 1, 2, and 3, with a smaller cylinder *a*, 7-16″ in diameter at the top of the machine. This has a piston fitted into it which is connected by a rod with the parallel motion *b c d*. This latter carries a pen, *e*, which draws a diagram of the resistance of the train on a roll of paper, *A A*, 30″ wide. Part of the diagram drawn by this pen is shown at *g g*. The roll of paper is placed in the drum *C*, and is drawn over the table *A A* by feed-rolls, *D D*, and is wound up on the drum *B*. These drums and rolls are driven by a worm-gear on the axle, shown in Figs. 4 and 5, which operates the vertical shaft *E E*, Fig. 1. The worm-gear, being on the axle, is underneath the floor of the car, and is not shown in Fig. 1. The shaft *E* has a miter-wheel at the upper end which gears into a pair of miters, *F F*, which are loose on a horizontal shaft, *G F*.

A clutch collar *N* is attached to the shaft by a feather and is arranged so that it can engage with either of the miter wheels, so that the machine can be used in running in either direction. The shaft *G F* has a pinion on it, not shown in the engraving, behind the pair of change gear wheels *G*. This pinion engages with one of the wheels *G* and that with the wheel *H* on the horizontal shaft *L I*. On this shaft are four worms, *L*, *K*, *J*, and *I*. *I* and *L* are keyed to the shaft, but *J* and *K* are attached to sleeves which are loose on the outside of the shaft. Either *J* or *K* can be driven by the clutch *M*, which is attached to the shaft by a feather. The worms *I* and *L* drive the worm-wheels *O* and *P*, which are connected to the shafts of the drums by the friction produced by springs (one of them shown at *h*) against disks, *i*, *i*, the purpose of the drums being simply to wind and unwind the paper, and keep it taut; which is effected by the friction arrangement. The paper is fed over the table uniformly for the distance traveled by either pair of the feed-rollers *D* or *D′*. Only one of each pair of these rollers is shown, the other being below the surface of the table. These rollers are 2.472″ in diameter, and are made of steel and ground with the utmost precision, so as to be 0.003″ larger in diameter in the center than at the ends, the object of this being to draw the paper through evenly. If the rolls were made perfectly straight they would be liable to seize the paper on one side more than on the other The paper can be wound by the mechanism in either way, that is, from *C* on to *B*, or from *B* on to *C*, so that the instrument can be used while running the car in either direction.

As stated before, the pen *e* draws a diagram of the resistance of the train. A stationary pen, *j*, draws a straight base line on the paper as it is rolled across the table. When there is no tension or compression on the draw-bar and cylinder underneath the car, and consequently no pressure on the fluid in the cylinder *a*, its piston is drawn back by the springs *s s* and with it the lever *b c*, so that the position of the pen *e* corresponds with that of *j* and the base line which the latter draws. So soon as there is any pressure in the cylinder *a* its piston is forced outward against the tension of the springs *s s*, and consequently the pen *e* is carried away from the base-line a distance proportional to the pressure, and the diagram thus indicates the tension on the draw-bar.

The speed of the train is recorded by means of an electrical attachment with the chronometer clock *Q*. This is arranged so as to break an electrical circuit every second, which releases an armature of an electro-magnet at *R*, with which one of the pens, shown at *k*, is connected. This moves the pen 1-16″ horizontally, which produces an indentation in the line which is drawn on the paper. The distance between these indentations indicates the space traveled over in one second. The next pencil to *k* is arranged so as to make a similar record every ten seconds. Still another pen can be used to record minutes.

A pen is also arranged so that by an electrical connection it records each revolution of the driving-wheels. Another records the mile-posts as they are passed, which is done by an assistant, who touches an electrical key at each post. The alignment of the road, that is, the curves and straight lines, are recorded by a pen in a similar way. A pen next to this is connected with a water-meter attached to the feed-pipe of the locomotive, and records the quantity of water consumed at different times and places. Still another pen is arranged so that an assistant on the locomotive records every shovelful of coal as it is put on the fire. The same pen has been used to record the time that black smoke escaped from the chimney. A pen is also provided which records the distance run by the car, and another records the indications of an anemometer on top of the car. At *z* is the fourteenth pen, which records the surface of the track. This is done by a small vessel or cylinder about 3″ in diameter, which is attached to the equalizing lever immediately over the journal-box. This vessel is filled with oil and covered with a thin metallic diaphragm, which is pressed down by a spiral spring. The chamber containing the oil is connected by a pipe with a gage, *m*, which also has a similar diaphragm which acts against a compound lever carrying the pencil *z*. The jolting of the car over inequalities of the track produces pulsations in the diaphragm over the journal-box, and consequently more or less pressure on the liquid, which pressure is communicated to the upper diaphragm at *m*, and thus recorded by the pen *z*.

An integrating apparatus is also attached to the instrument at *S*. This consists of a plate, *S*, which is attached to the end of a vertical shaft driven by the gear-wheel *O* and a worm, not shown in the engraving. The speeds are so arranged that the plate makes three revolutions per mile run by the car. A small wheel, *n*, which is attached to a rod, *q*, connected with the piston in the cylinder *a*, bears on the plate *S*. When there is no pressure in the cylinder, the small wheel *n* is exactly in the center of *S*, and consequently the revolution of *S* does not cause the wheel *n* to revolve. When the piston is forced out by the pressure, the small wheel is carried beyond the center of the plate *S*, and consequently the movement of the latter then causes the small wheel to revolve. Of course the greater the pressure in the cylinder *a* the farther will the wheel *n* be carried from the center of *S* and the greater will be the path on which it rolls, and consequently the larger the number of its revolutions. At each revolution of the wheel it breaks an electrical circuit, and connecting by a wire with one of the electromagnets at *R* operates a lever which carries one of the pens shown at *k*. It is obvious from this that the greater the pressure on the cylinder *a* the larger the number of revolutions which will be made by the small wheel *n*, and therefore that they will be a measure of the work done; so that multiplying the number of revolutions by a known constant will give the number of foot-pounds.

The disk *S* is graduated on the edge, and has a vernier attachment with which very minute measurements can be made of the distance run.

The battery jars for working the electrical apparatus are carried underneath the car in a locker, and are connected with the magnets by the wires shown at *r*.

The pens consist of small glass tubes, which are drawn to a fine point and filled with eozine, one of the products of coal-tar distillation. A half grain of this is dissolved in an ounce of water, and makes a beautiful red color.

The draw-bar cylinder *B* is shown in plan in Fig. 2, and in section in Fig. 3, and is 4″ in diameter, and has a pair of large pistons, *A A*, which fit into it at each end. Into these an auxiliary pair of pistons, *C C*′, are fitted. These are used in making experiments with light loads. The packing is of the ordinary kind used in hydraulic rams. *D* is the draw-bar which is connected with the pistons by a frame, *E E*. In drawing a train the cross-bar *G* presses against the piston *C*′, and in pushing the bar *F* presses against *C*, so that in either case the strain on the draw-bar produces a corresponding pressure on the liquid (oil) in the cylinder. The pipe *L* connects the main cylinder *B* with the smaller cylinder *a*, Fig. 1, on the dynagraph above, the working of which has already been described.

Figs. 4 and 5 represent the worm gear on the axle by which motion is transmitted to the mechanism above through the shaft.

See account of Bavarian experiments by Baron M. M. Von Weber, "*Transactions of Am. Soc. C. E.*," February, 1879, and reference to same in "*Railroad Gazette*," * xxiv. 375.

See also the following references to dynagraph cars: —

E. Ry. of France . . .	"*Engineering*," * xxvi. 290, * 307, * 330.
Dudley	"*Eng. & Min. Jour.*," xxii. 37.
	"*American R. R. Jour.*," liii. 619.
	"*Scientific Amer. Sup.*," 131, 1145.
	"*Scientific Amer.*," xxxvii. 264.
	"*Railroad Gazette*," xx. 317.
	* "*Railroad Gazette*," xxiii. 494.
Brake car for tests.	
Westinghouse . . .	"*Engineer*," xliii. 380.
	* "*Engineer*," xliii. 402.
	* "*Engineering*," xxv. 470.

In connection with this subject the following references will be useful, — the number of United States patent, the name of the inventor, and the subject matter of the patent being given: —

SPEED, COURSE, GRADE, AND DISTANCE RECORDERS.

No.	Inventor. Subject.
16,902	*Adams & Clark*, Grade delineator.
27,764	*Billings*, Speed register.
32,959	*Bogardus*, Grade recorder.
30,528	*Collier*, River course delineator.
155,605	*Crawley*, Velocimeter.
205,844	*Dorpmüller*, Speed recorder.
196,643	*Dunlap & Magill*, Speed and distance recorder.
202,433	*Gobel*, Distance and velocity recorder.
231,799	*Hergenroder*, Surveyor and plotter.
179,200	*Kettell*, Station indicator and speed recorder.
36,411	*Krausch*, Engine recorder.
222,293	*Luders*, Shock recorder.
183,479	*Manger*, Recording surveyor.
15,017	*Peverley*, Ship recording-compass.
229,456	*Petri*, Speed indicator and recorder.
147,021	*Rankin*, Ship's course recorder.
138,437	*Richardson*, Locomotive recorder.
219.527	*Richardson*, Speed and time recorder.
47,906	*Schön*, Recording surveyor.
118,160	*Sheltman*, Speed recorder.
176,584	*Simonds*, Time and distance recorder.
37,650	*Van Horn*, Profiler. River bed.
20,908	*Wampler*, Graphodometer.
153,470	*Wythe*, Railway speed recorder.
173,251	*Wythe*. Railway speed recorder.
198,232	*Wythe*, Railway speed recorder. (Pencil carrier.)
203,865	*Wythe*, Railway speed recorder.

See also English patents: -

2,692 of 1855.	581 of 1867.
2,141 of 1860.	890 of 1858.
11,619 of 1847.	8,645 of 1840.
2,892 of 1856.	1,673 of 1857.
1,407 of 1863.	2,285 of 1863.

See also United States Patents: —

Lewis, 1867, Velocimeter.
Horn, 1868, Mileage register.
Guebhard & Tronchon, 1873, Cab register.
Keeler, 1864, Speed indicator.
Bowsher, 1868, Speed indicator.
Bilgram, 1871, Speed indicator.
Speed & Poage, 1874, Speed indicator.
Liernur, 1858, Speed recorder.
Beweckert, 1857, Speed indicator.
Brown, 1874, Revolution indicator.
Elliott, 1874, Tachometer.

See also Figs. 5366, 5367, 5372, 5373, 5374, and pp. 2261-2264, "*Mech. Dict.*"

See also under the following heads in this and former volumes: —

Delineator.	Log.
Grade recorder.	Odometer.
Sounding instruments.	Surveying instruments.

See also specific indexes, METERS, p. 1427, "*Mech. Dict.;*" MEASURING and RECORDING INSTRUMENTS, *infra*.

Dy-nam'ic E'lec-tric'i-ty. Electricity in a state of action. The opposite of *static*.

Dy'nam-ite. A mixture of nitro-glycerine and infusorial silica. See p. 767, "*Mech. Dict.*"

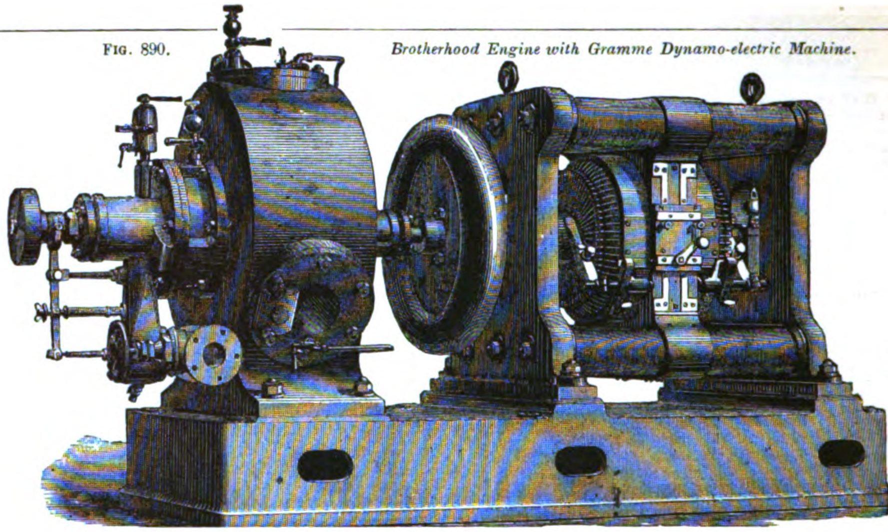
See also the following references: —

Roux	"*Iron Age*," xvii., May 18, p. 7.
Apparatus	* "*Engineer*," xli. 171.
In agriculture. . . .	"*Scientific American Sup.*," 2136.
	"*Scientific American*," xxxv. 242.
In Germany	"*Technologiste*," xxxviii. 17.
In plowing	"*Iron Age*," xviii., Nov. 2, p. 11.
In clearing	"*Iron Age*," xviii., Nov. 30, p. 1.
Nobel	"*Technologiste*," xli. 94.
Manufacture	"*Scientific American*," xlii. 276.
	* "*Scientific American*," xxxiv. 83.
	"*Scientific Amer.*," xxxviii. 58.
	"*Scientific American Sup.*," 692.
Sobrero	"*Technologiste*," xxxvii. 161.
	"*Van Nostrand's Mag.*," xv. 480.
Pile driving.	
Paper by *Lockert* . .	"*Technologiste*," xl. 37.

Dy-na'mo-e-lec'tric En'gine. A steam-engine adapted for driving a dynamo-electric machine. While many forms of steam-engine have been used for this purpose, the direct acting has some more peculiar features of compactness and special adaptation.

Fig. 890, Plate XI., shows the adaptation of the *Brotherhood* three-cylinder engine to driving a *Gramme* machine. The engine consists of three steam cylinders arranged radially around a framing at equal angular distances apart, their axes converging in a point: within the central space around this point revolves a crank axle, which is kept in rotation by the successive impulses of the three pistons which are connected to its crank-pin by connecting rods, the heads of which are provided with brasses bearing against it; and a circular distributing valve revolving with the shaft regulates the admission of steam to each cylinder in succession and determines the position of the cut-off, and, therefore, the period during which each cylinder is being worked by the expansive force of its imprisoned steam.

Fig. 890. *Brotherhood Engine with Gramme Dynamo-electric Machine.*



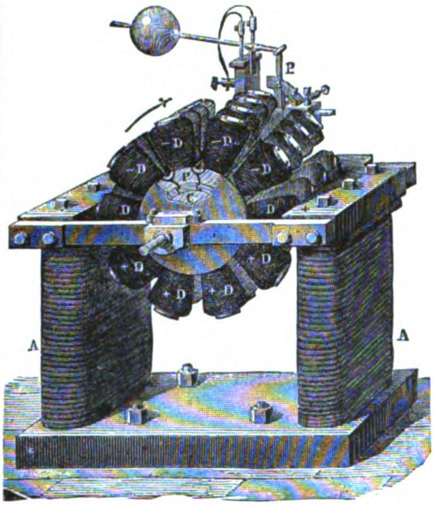


Fig. 892. *Lontin Dynamo-electric Machine.*

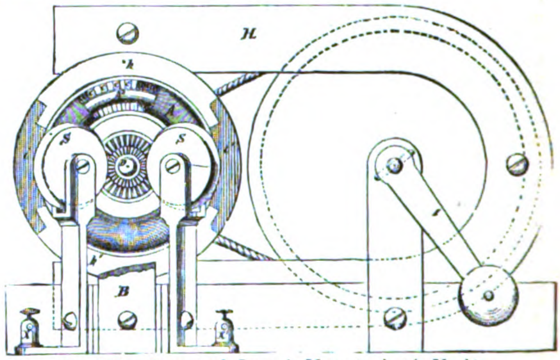
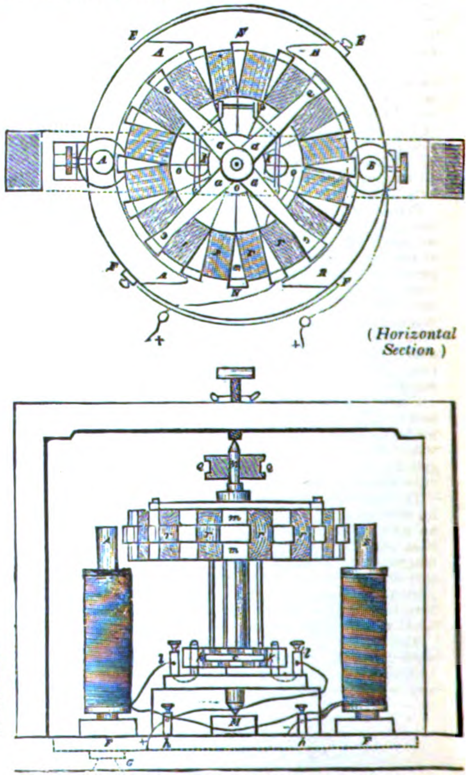


Fig. 893. *Gramme & Ivernois Magneto-electric Machine*



(*Horizontal Section*)

(**Elevation.**)

Fig. 891. ***Pacinotti Magneto-electric Machine.***

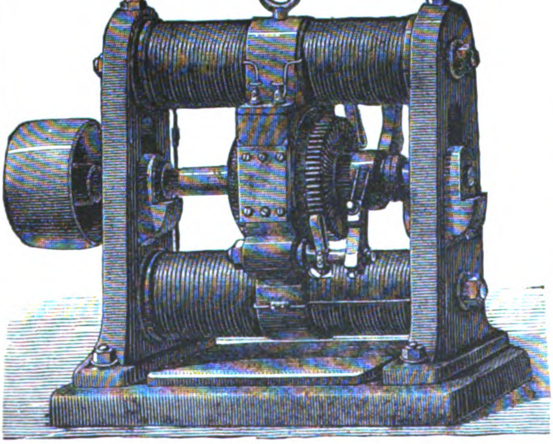


Fig. 894. ***Gramme Electric Light Machine.***

The shaft and armature spindle lie in the same line and are coupled direct to one another, thus avoiding the use of belting or gearing. The apparatus represented was constructed for the British government for torpedo work, the current being utilized in a *Serrin* lamp. The machine absorbs 13 horse-power, running at 500 revolutions per minute, when it produces a light of 48,000 normal sperm candles.

The consumption of steam, which is worked at 80 lbs. to the square inch, is 41.1 lb. per indicated horse-power per hour. The weight of the whole apparatus is 4,256 lbs., of which the *Gramme* machine represents 2,240.

Dy-na'mo-e-lec'tric Ma-chine'. Speaking generally, the term dynamo-electric machine is applied to any one which produces a current of electricity, by the conversion of dynamic or mechanical energy into electric force by the movement of some of its parts in the neighborhood of others.

More definitely, "An electro-voltaic generator whose magnetic field is derived from an *electro*-magnet, in contradistinction to a magneto-electric generator whose magnetic field is derived from a *permanent* magnet." — *Sawyer.*

In the still more modern terminology, a machine for translating motion into electricity, in which the magnetic field in which the armature rotates is formed by electro-magnets having their coils connected in a circuit with the coils of the armature and the main line, whereby upon starting the machine with a minimum of magnetism in the cores of the field magnets, an inter-reacting cumulative action takes place, the initial magnetism creating an initial current in the armature, which, flowing around the field magnets, increase their force, in turn reacting on the armature coils, and so on until the maximum current is produced when the field cores attain saturation.

The discovery of electric induction by Prof. Faraday, in the year 1831, drew the attention of the scientific world to the possibility of utilizing motive power as a means of generating a current of electricity.

"Faraday demonstrated before the Royal Society that if a magnetized bar of steel be introduced into the center of a helix of insulated wire, there is at the moment of introduction of the magnet a current of electricity set up in a certain direction in the insulated wire forming the helix, while on the withdrawal of the magnet from the helix a current in an opposite direction takes place.

"He also discovered that the same phenomenon was to be observed if for the magnet was substituted a coil of insulated wire, through which the current from a voltaic element was passing: and further, that when an insulated coil of wire was made to revolve before the poles of a permanent magnet, electric currents were induced in the wires of the coil. It is on these discoveries that are based the action of all magneto-electric machines." — "*Journal of the Society of Arts.*"

Pixii was the first to construct a magnetic machine. His machine had a revolving permanent vertical horse-shoe magnet above which was fastened an electro-magnet, and the poles of the two brought into close proximity. As the poles of the permanent passed those of the electro-magnet, a series of reversed currents were set up in the wires of the latter. A small circular commutator was placed below the horse-shoe magnet and revolved with it.

Saxton placed the permanent magnet horizontal, and the axis of the revolving electro-magnet in corresponding position. He also increased the relative size of the horse-shoe magnet.

Clarke placed the axis of the electro-magnet at the side of and at right angles to the permanent, so that its poles were made to pass those points of the latter where the greatest strength was to be obtained. A commutator placed on the spindle of the electro-magnets corrected the reversal of the currents generated.

In the Niaudet machine the current is continuous. A number of bobbins with soft iron cores are fixed parallel to an axis with which they revolve. The poles of these bobbins turn between the poles of the permanent horse-shoe magnets, one magnet being at each end of the bobbins; a sort of duplication of the Clarke machine. The bobbins are joined in series, with connection made at the point of juncture to a commutator. Two contact springs make the connections to the terminals of the machine.

The Nollet ("Alliance") machine (1850) was originally intended by its inventor for the decomposition of water, the hydrogen gas to be carbureted by passing through camphene, and used for lighting purposes. It contains a number of gun-metal disks running on a horizontal shaft, and carrying near the circumference of each disk a series of 16 bobbins with soft iron cores, arranged equidistant and parallel to the shaft, and free to turn with the disks between the poles of 8 horse-shoe permanent magnets, the poles of which are placed radially to the shaft. The faces of the magnets are parallel to the disks, so that in each circumference there are 16 poles corresponding to the 16 bobbins. The bobbins are connected in series, one end of the wire being connected to the shaft, and the other to an insulated ring upon the shaft; to these are connected the terminals.

The machine has been largely used for light-houses in France: at La Hève and Grinez, for instances.

The Holmes machine (1856) differs from the Nollet in the arrangement of the bobbins. They are held between two brass disks in two or more concentric circles, the bobbins rotating in front of the poles of a number of permanent magnets fixed on the frame, and arranged radial to the axis. This gives a quicker succession to the contacts. A commutator directs the alternating currents so as to pass off in the same direction. The South Foreland light, and afterwards the Dungeness lighthouse, were lighted by means of this machine. In later machines, the magnets are made to turn while the bobbins are fixed.

In the Siemens-Halske machine (1854) the electrical magnet was replaced by a cylindrical bar of soft iron with four longitudinal grooves × section, in which insulated wire is wound parallel to the axis, so as to form a complete cylinder. One end of the wire was soldered to the axis, and the other to an insulated ring at the extremity of the axis; these connected to the respective terminals. The poles of a permanent magnet were so formed as to embrace the cylinder without touching.

The Wheatstone machine is in general use for private wires in Great Britain, applied to the A B C telegraph. Attached to the poles of a permanent compound magnet is a set of 4 bobbins, the soft iron cores of which are fixed permanently to the magnet, two to each pole. In front of these cores is a soft iron revolving armature. The cores of the bobbins being fixed to the poles of the magnet, receive polarity from them and form 4 poles, 2 North, and 2 South. The turning armature passing in front of these poles induces currents in the bobbin wires, which by connections actuate the needle of the telegraph instrument.

The original dynamo-electric machine, or accumulative generator, is described in the English patent of Sóren Hjorth, of Copenhagen, No. 2,198, October 14, 1854. It is perhaps the most remarkable, from one point of view, of the series. It describes and illustrates a "Magneto-electric Battery," so constructed that "the currents induced in the coils of the revolving armature are allowed to pass round the electro-magnets; consequently, the more the electro-magnets are excited in the said manner the more will the armatures be excited, and more electricity of course be induced in the respective coilings; and while a mutual and accelerating force is thus produced in this manner between the electro-magnets and the armatures, an additional or secondary current is at the same time induced in the coiling of the electro-magnets by the motion of the armatures, the said current flowing in the same direction as that of the primary current after having passed the commutator. The direction of the current induced in the coils of the armatures will of course be reversed according to the change of the respective polarities, and the commutator is therefore applied for the purpose of causing the same to flow constantly in the same direction."

The cores may be cast-iron, or steel magnets.

It would seem that the invention of Sóren Hjorth and the English patent of 1854 had been entirely overlooked by the British, German, and French experts; and the claim of Dr. Siemens and Sir Charles Wheatstone to the invention of the accumulation generator, in 1867, was made in apparent ignorance of the claims of the Swedish inventor of 13 years previous. The latter claims are now revived, and the history of the dynamo-electric machine must be re-written: *e. g.*, the account in "*Engineering*," xxiv. 307; xxviii. 63, etc. —

"Early in 1867, an announcement was made to the Royal Society simultaneously by Dr. C. W. Siemens and Sir Charles Wheatstone, of the discovery made independently by Dr. Werner Siemens and Sir Charles, of the reaction principle of magnetization, by which a very powerful electric current may be generated through the building up of the effects of action and reaction taking place between an electro-magnet and a magneto-electric inductor revolving in its magnetic field, and included in the same circuit."

It appears that the discovery was announced by Dr. Werner Siemens to the Berlin Academy of Science a month before its announcement to the Royal Society. Mr. S. A. Varley and Mr. M. G. Farmer were also working on the same invention apparently about the same time.

The Wilde machine (1866) is one of the foundation machines, using a Siemens-Halske armature between the poles of a field electro-magnet, which is excited by a small hand magneto-electric machine. It may be compared to one small Siemens machine placed on top of another of larger size. The current from the smaller one is used for magnetizing the two powerful electro-magnets of the larger one: the latter replacing the permanent ones ordinarily used in the Siemens.

The first machine for the production of an electric current constant in direction and intensity was the electro-magnetic ring machine of Dr. A. Pacinotti, of Pisa, Italy, 1860, and described in "*Il Nuovo Cimento*," June, 1864.

The peculiarity of the machine was the movable electro-magnet in the form of a circular iron ring in which the magnetic poles were movable, instead of remaining stationary, as in the previous machines. The machine as shown in Fig. 891, Plate XI., and the description following, have reference to its application as an electro-magnetic machine, but Pacinotti indicated, in the Italian publication referred to, a way in which, by the use of the same annular armature, the electro-magnetic may be converted into a magneto-electric machine capable of producing, by the constant use in connection with it of a permanent or electro-magnet, a continuous current of a constant direction.

"This movable ring of iron had the shape of a spur-wheel of 16 teeth, and was firmly secured to the axis of the machine by means of four strips of brass. Small wooden wedges were placed upon the teeth of the ring, and the space so formed between each two of the wedges filled up regularly with insulated copper wire. These spools were all wound in the same direction, and the terminal end of each was soldered to the beginning of the one succeeding it, so that the whole system of 16 spools virtually formed a single coil of wire surrounding the ring in a regular manner, and returning upon itself.

"Wires were soldered to the separate points of juncture and were led, parallel to the axis of rotation, to an equal number of insulated pieces of brass, mounted in two rows upon, and slightly projecting from, the surface of a disk firmly secured to the axis.

"The iron ring, with the bobbins wound upon it in the manner already described, was mounted in a horizontal position between the two legs of a powerful upright electro-magnet, the distance of which from the ring could be adjusted at pleasure by means of a set screw and a slot in the lower connecting cross-piece. Contact rollers *k k* were made to press, one on each side of the axis, against the lower wooden disk carrying the strips of brass, so that during the rotation of the ring all of the latter were brought successively into contact with them. When, therefore, the terminal posts *h h′* are placed in connection with the poles of a galvanic battery the current will pass, supposing it to enter at *h* (+), by way of the binding-post *l* to the roller *k*, and through the strip of brass on the disk against which the roller may happen to press at the time, up to the two wire coils of the armature whose point of juncture is in connection with the strip of brass.

The current here divides, each portion passing in an opposite direction through the spools surrounding each half circumference of the ring, to meet again to form one current at the left contact roller *k*, whence the reunited current passes to the second binding-post *l′*. From here the current proceeds to the leg *A* of the electro-magnet, circulates around it, and, after acting similarly with regard to the other leg, *B*, passes back by way of the binding-post *h′* to the negative pole of the battery. Magnetic poles thus became developed in the iron ring at the points *N S*, the position of the contact rollers having been so chosen as to bring about this effect, and the actions of attraction and repulsion taking place between them and the poles of the stationary electro-magnet gave rise to the rotation of the ring.

"In order to turn the action of the electro-magnet upon the magnetized iron ring to the greatest possible account, Pacinotti provided the two poles with armatures, *A A A*, *B B B*, of soft iron, which were made to surround the ring very closely for over two thirds of its circumference. Strips of brass, *E E*, *F F*, attached, served to give them greater security. In the elevation of the machine here given these armatures have been omitted in order not to conceal the ring and its surrounding spools." — *Prof. Henry Morton.*

In the Lontin machine, Fig. 892, Plate XI., the revolving armature is in the form of a central boss, *P*, into which are fixed 10 or more radial bars, *D*, of soft iron, circular in section, and slightly conical, and each wound with a coil of insulated copper wire, the ends of which are connected together in series and to a cylindrical commutator. The armature wheel revolves in the field of two powerful electro-magnets, *A A*, fixed vertically into an iron base-plate, by which they become the two limits of a horse-shoe electro-magnet. The cores of the radial magnetic inductors as they revolve approach very close to the poles of the inducing magnets *A A*, being at their point of closest proximity when in horizontal position. When the machine is revolving in the direction of the arrow all the radial bobbins above the horizontal line are receding from the left hand, the South pole of the magnet, and approaching the North pole, and the bobbins below the horizontal line *vice-versa*, the currents in the upper half of the circuit are in one direction, and those below are inverse.

The coils are coupled together in series, and each pair of contiguous coils is connected to a sector, *C*, of the cylindrical commutator, there being as many sectors as bobbins, and insulated from one another by strips of vulcanized rubber. Against the surface of this commutator collectors are pressed by springs, the one taking off the positive current and the other the negative, and the currents so induced are transmitted through the coils of the large vertical electro-magnets, the machine being on the dynamo-electric or reaction principle.

The figure shows a Lontin machine with 4 induction wheels fixed on the same shaft, each wheel carrying 10 bobbins. The bobbins are monnted helically on the shaft, so as to avoid any interval of inaction.

Up to the period of the invention of the Pacinotti machine the armature had its magnetism reversed as it rotated, involving a loss and waste of power. The Italian inventor devised the idea of the ring, and rotating the ring between the poles of a magnet in such a way that there should be no reversal of poles, but merely the traveling of the poles around in the ring. This ring was surrounded with wires from which the induced current was taken. The idea involved was embraced in the Gramme machine, and accepted by electricians only after much dispute and opposition. Gramme appears, however, to have been an independent and original inventor.

The Gramme machine, Fig. 893, Plate XI., consists of a permanent field magnet, between the poles of which are armatures of peculiar construction, formed by coiling around a soft-iron core a wire of copper, forming the entire coil into an endless bobbin, in the shape of a cylinder or ring; the wire being provided at suitable intervals with metallic rods or conductors for allowing the proper exit of the electric current generated. These rods extend axially of the core, and at their ends on diametrically opposite sides of said axis connect with two rolling commutators which lead to line.

It must be said, however, that neither Pacinotti nor Gramme originated the ring armature; for Elias, in 1842, constructed an electro-magnetic motor, the armature of which was an annular coil surrounding a ring core, having 6 polar protuberances at equal distances apart, and which revolved within a similar ring, forming the field-magnet.

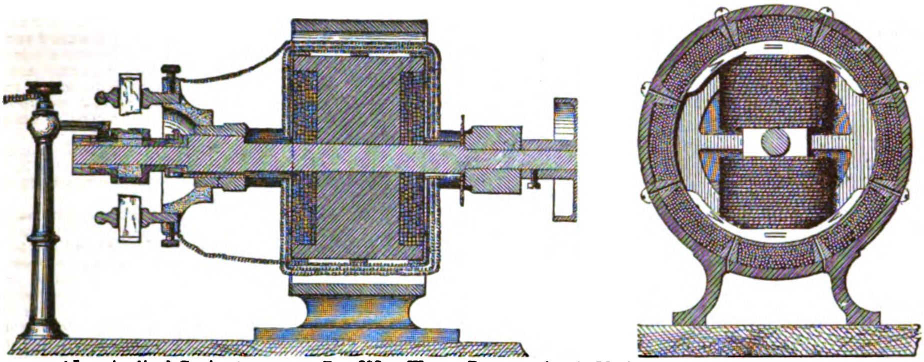
In Fig 893, Plate XI., *H* is the permanent electro-magnet, having additional poles, *h h′*, of a circular shape, so as to correspond with that of the cylinder or endless large bobbin, *A*. The poles are kept insulated from each other by means of the non-magnetic portions, *i i′*, and the large bobbin or cylinder *A* is composed of a continuous series of small bobbins connected end to end, the junctions being each connected to a conductor, *C*, which conductors are kept insulated from each other; on the free ends of these conductors act the rubbers or connecting rollers, *S S′*, for carrying the currents respectively to the posts *X X′*. The cylinder, or large bobbin, *A*. revolves by means of the shaft *D* in standards *B*, and motion may be transmitted to the shaft *D* by means of the crank *I*, and pulleys, or other mechanical contrivances. A^2 represents the soft iron core of the cylinder or large bobbin *A*.

In the earlier form of the Gramme machine the inventor mounted three rings upon one spindle, each revolving within the magnetic field of two very large rectangular electro-magnets. One of these rings supplied the current by which all the electro-magnets were excited, and the others were united so as to produce the external or useful current. But in the newer and far more powerful machines this arrangement is superseded, there being but one induction ring, and the coils of the electro-magnet are included in the circuit, the whole of the current traversing them. Fig. 894, Plate XI., represents the modern Gramme machine, such as is used for illumination purposes. The ring is mounted on a horizontal shaft which is revolved at a speed of 900 revolutions per minute within the electric field of the four horizontal electro-magnets shown in the cut. The two upper magnets are united to a common pole-piece, which embraces about three-eighths of the circumference of the ring, and the two lower magnets are connected to a similar pole-piece opposite in polarity to that attached to the upper magnets.

The Siemens machine, Fig. 895, Plate XII., has a cylindrical armature, the "longitudinal induction bobbin" revolving between two double poles of two pairs of electro-magnets.

The armature consists of a metallic cylinder with copper wires wound axially over its surface. The peculiar system of winding is the invention of Von Alteneck, who was thus associated with Dr. Siemens in the device. The system of winding and the possible variations are the subject of an elaborate article by M. Breguet, published in "*Engineering*" and reproduced in "*Van Nostrand's Engineering Magazine*," * xxii. 375.

These longitudinal coils of wire completely envelop the iron cylinder or armature, each section being wound parallel to a different plane passing longitudinally through the axis of the cylinder, there being as many of such planes as there are sections to be wound, and at equal angular distances from each other around the circumference of the



(*Longitudinal Section.*) FIG. 898. ***Weston Dynamo-electric Machine.*** (*Cross Section.*)

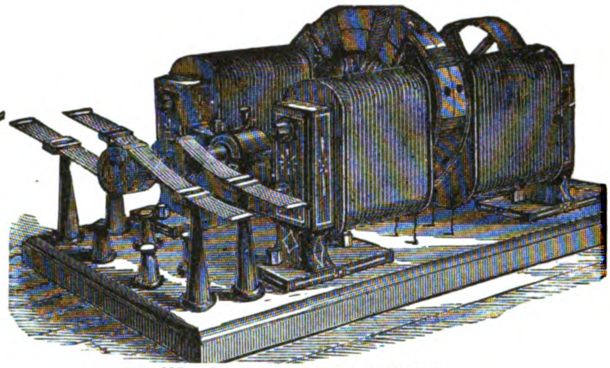


FIG. 896. *Brush Dynamo-electric Machine.*

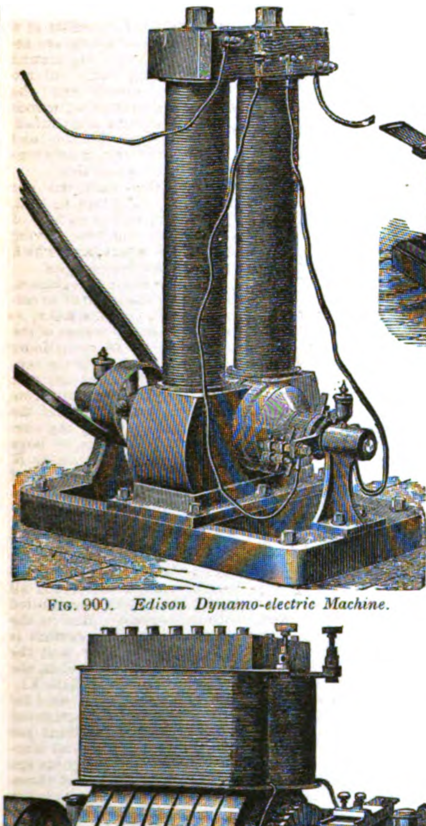


FIG. 900. *Edison Dynamo-electric Machine.*

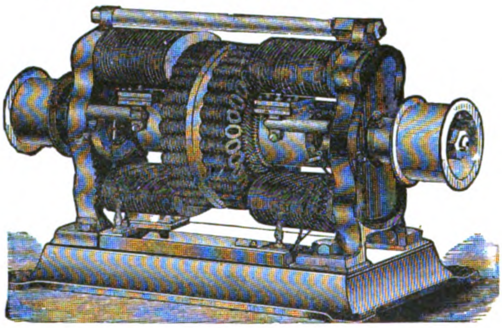


FIG. 897. *Wallace-Farmer Dynamo-electric Machine.*

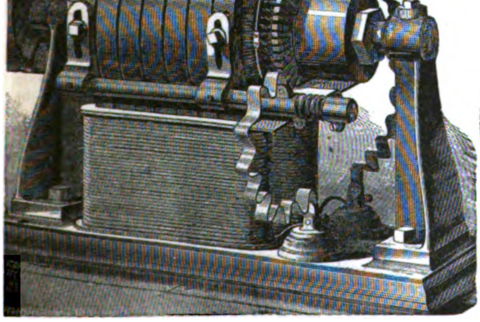


FIG. 899. ***Maxim Dynamo-electric Machine.***

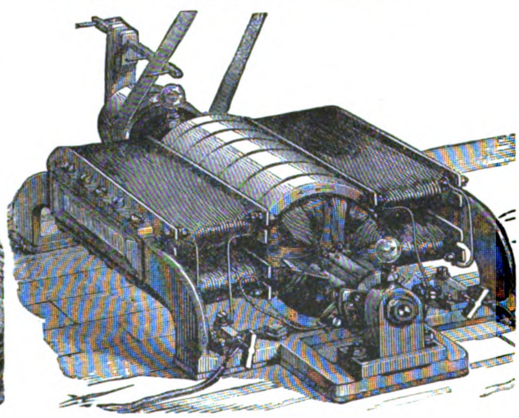


FIG. 895. ***Siemens' Bros. Dynamo-electric Machine.***

 See pages 284, 285.

cylinder. The ends of these coils are connected to a number of copper sectors insulated from one another, which together build up a cylindrical commutator rigidly attached to the armature spindle with which it revolves; and the currents are collected in a similar manner by conducting brushes pressing against the commutator as it revolves.

This system, consisting of the iron cylinder with its enveloping coils, is rotated at a high velocity within a powerful magnetic field produced by a series of electro-magnets, the coils of which are included in the circuit of the rotating armature through the brushes, and are magnetized thereby. The curved bars, seen above and below the revolving armature, are of soft iron of rectangular section, and are the prolongation of the cores of the powerful electro-magnets, shown on each side of the armature, the cores of which are long flat bars wound with insulated wire.

The magnet cores, instead of being flat continuous plates, are divided longitudinally into several bars having air spaces between them, the object of which is, firstly, to prevent cross-currents being induced in the magnets; secondly, to maintain the lines of magnetic force parallel to the length of the bar: thirdly, to permit of a circulation and escape of air between the revolving armature and the magnets, so as to reduce the accumulative heating of the machine; *lastly*, for convenience of manufacture.

Of the curved portions of the magnetic cores, each surrounds two sixths of the entire circumference of the induction cylinder, so that two thirds of it are embraced by the magnets, and the coils of each set of magnets are so wound as to produce a point or pole in the center of the length of the cores, a North consequent pole being produced at the mid-length of the upper set of magnets, and a South consequent pole being produced at the corresponding point in the lower set of magnets. Thus a very intense magnetic field is formed within the cylindrical space included between the upper and lower sets of magnet bars, and within this space is revolved at a high velocity the induction cylinder or armature, which has been described.

In the Brush machine, Fig. 896, Plate XII., the wires are wound in slots in the revolving cylinder, and the projecting parts between the slots are brought nearer to the faces of the poles of the field magnets than in the Siemens machine.

Referring to Fig. 896, the machine is seen to consist of two large horse-shoe electro-magnets placed with their similar poles facing each other, the armature revolving between them. The currents are generated in the coils of copper wire wound upon the armature. The coils are 8 in number, opposite ones being connected end to end, and their terminals carried to the commutator, which consists of segments of brass, secured to a ring of non-conducting material carried on the shaft. The commutator is so arranged that at any instant 3 pairs of coils are interposed in the circuit of the machine. The current is conveyed from the commutator by means of brushes made of strips of hard brass joined together at their outer ends and connected with a binding screw on the base.

The Wallace-Farmer machine, Fig. 897, Plate XII., has a magnetic field produced by two electro-magnets, with the poles of opposite character facing each other. Between the arms of the magnets, and passing through the uprights supporting them, is the shaft, carrying at its center the rotating armature. The latter consists of a disk of cast-iron, near the periphery of which, and at right angles to either face, are iron cores wound with insulated wire, thus constituting a double series of coils. These armature coils being connected end to end, the loops so formed are connected in the same manner on to a commutator of the same construction as that of the Gramme. As the armature rotates the cores pass between the opposed North and South poles of the field magnets, and the current generated depends on the change of polarity of the cores.

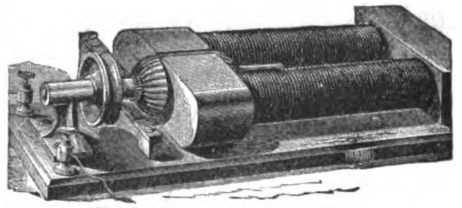
In the Weston machine, Fig. 898, Plate XII., the rotating magnet is inclosed in stationary coils in an annular stationary iron shell. The coils are wound in cylindrical form upon a skeleton frame of non-magnetic material, within which the electro-magnet rotates. The latter is mounted upon a neutral axis, and its periphery moves in close proximity to the surrounding coil. Apertures at the end of the cylinder admit air into the space within the coils. The skeleton frame is divided into 8 segments, and each of the three coils traverses the entire exterior of the skeleton frame, extending across the ends of the cylinder, from the segment on one side to the segment diametrically opposite, and the free ends of the coil are respectively connected with two stationary brushes bearing upon directly opposite sides of the cylindrical commutator.

In a late patent of Weston, the skeleton core is rendered discontinuous by a series of deep transverse grooves, and by a longitudinal slit from end to end of the armature, and currents of air are passed through to counteract the heat produced by the resistance of the current, and which might destroy the insulation and does increase the resistance.

Maxim's dynamo-electric machine, Fig. 899, Plate XII., has an armature of soft-iron rings with the wire wound parallel with the axis, both plates and wires being so arranged that a free circulation of air is admitted through the armature to prevent dangerous heating. The commutator is large and heavy, and the sections curved in a right and left spiral, so as to avoid any break in the current.

Maxim's current regulator, a governor for dynamo-electric machines (Patent No. 228,543), is automatic in case of an over-current to cause the operation of electro-magnetic de-

Fig. 901.



Edison's Dynamo-electric Machine.
(Field Magnet, Horizontal.)

vices, releasing or bringing into action mechanism for shifting the position of the brushes, and thus reducing the current.

The Edison magneto-electric machine, Fig. 904, Plate XII., and Figs. 901 to 905, has a revolving armature, a cylinder of wood with two iron heads, and around the cylinder and between the heads fine iron wire is wound. At the ends of the cylinder, outside the iron heads, are disks of hard rubber, and the wires forming the induction helix are wound lengthwise of the cylinder into notches in the edges of the disk.

The Edison machine exhibited at the Electrical Congress, Paris, 1881, is shown in Figs. 904, 905, and is thus described by Comte Th. du Moncel: —

"The field magnets were

Fig. 902.

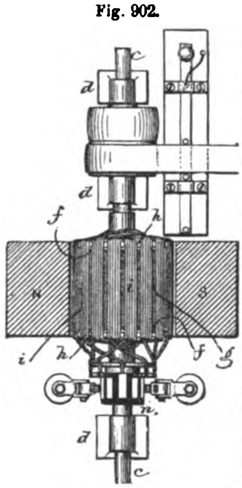
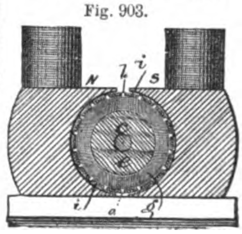


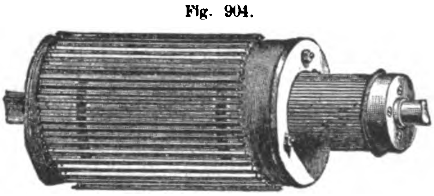
Fig. 903.



(Top View.) *(Transverse Section.)*
Edison's Dynamo-electric Machine.

arranged as a derivation taken from the commutator, putting it into the induced circuit, as in Wheatstone and Siemens' systems. Then the armature was arranged on Siemens' principle, so that the wire consisted of bars of copper. These bars lie close to each other around the cylinder which forms the armature, and they generate the current. Their

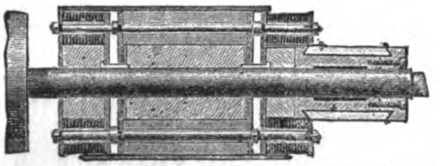
Fig. 904.



Revolving Armature of Edison's Dynamo-electric Machine (Detached).

extremities correspond to disks of copper (at right angles to them) laid one against the other at the ends of the cylinder, and insulated from each other. Each bar is fastened to its corresponding disks in such a way as to form a single circuit enveloping the cylinder longitudinally, and which is made perfect through the coupled bars two and two with the commutator blocks (made after the Gramme pattern). Figs. 904 and 905 give an idea of this new arrangement. The center of the cylinder itself is occupied outside of the rotating axle by a cylinder of wood, which, in its turn, is surrounded by a thick tube made of a series of very thin disks of iron, separated from each other by tissue paper. This arrange-

Fig. 905.



Revolving Armature of Edison's Dynamo-electric Machine (Longitudinal Section).

ment facilitates the rapid changes of polarity in the plates. This tube is terminated at its two extremities by two thick clamping disks which are made to compress the others laterally, and the copper disks of the working coil occupy the two compartments at the extremities of the cylinder, as seen in Fig 905. Under such conditions as those the resistance of the generator is small, and permits of great subdivision of the current in multiple arc; nor is there any insulation to be burned, and it is even possible, in case of deterioration of the bars, to renew them easily, for they are simply screwed against the upper disks corresponding to them. In another arrangement adopted by Mr. Edison, the field magnets lie horizontal instead of being placed vertical "

Seeley's disk armature is an amplification of the idea of "Arago's disk." The disk is constructed of insulated wire revolving in a magnetic field arranged radially with reference to the axis of the armature.

The disk consists essentially of wire wound in radial directions, so that the radii on entering may be moved before magnet poles of the same name, while the radii outgoing move before the opposite poles. The whole mass of the disk, so far as it is practicable, is filled out or made up of the radial winding, and the sectors of out and in wires are equal in number and symmetrical in form and arrangement.

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* "*Engineering*," xxvii. 513.
* *Laboulaye's* "*Dict.*," iv., ed. 1877, art. "*Equivalent de l'Electricité*."
* "*La Lumière Electr.*," ii. 259.
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de Meritens . . . . . * *Van Nostr. Mag.*," xxii. 444.
* "*Engineering*," xxviii. 372.
* "*La Lumière Electr.*," ii. 135, * 190; iii. 23; * iv. 175.
du Moncel, paper by . . * "*App. de l'Électricité*," v. 537.
Edison . . . . . . * "*Scientific Amer.*," xli. 242.
* "*La Lumière Elec.*," i. 169; * v. 1, * 88, * 205.
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* "*Sc. Am. Sup.*," Jan. 14, 1882.
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Fein . . . . * "*La Lumière Electr.*," iv. 59.
Fitzgerald . . . . . * "*Engineer*," l. 284.
Gary . . . . * "*Sc. Amer.*," xl. 144, 145, 151.
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* "*Engineer*," xlv. 447; * xlix. 174.
* "*App. de l'Électricité*," v. 522.
* "*La Lumière Electr.*," i. 114; * ii. 87; * iv. 117; * v. 336.
"*Iron Age*," xxv., Mar. 11, p. 1.
* "*Engineering*." xxix. 184.
Gramme . . . . "*Van Nostr. Mag.*," xv. 49; * xxii. 412-414, 418.
* "*Scientific Amer. Sup.*," 2468.
Gramme-d'Ivernois . . * "*Journal Soc. Tel. Eng.*," viii. 239, pl. 7.
Gulcher . . . . * "*La Lumière Electr.*," v. 371.
Hefner-Altenek . . . * "*La Lumière Electr.*," iii. 431.
Hopkins . . . . . . * "*Scientific Amer. Sup.*," 2553.
Hopkinson-Muirhead . . * "*La Lumière Electr.*," v. 51.
Hospitalier . . . . * "*La Lumière Electr.*," ii. 151, * 171.
Houston-Thomson . . . * "*Scientific Amer. Sup.*," 2708.
Hjorth . . . . * "*Jour. Soc. Tel. Eng.*," viii. 229, pl. 4.
Jablochkoff . . . . . * "*Scientific Amer. Sup.*," 2187.
* "*La Lumière Electr.*," iii. 348.
Lachaussée . . . . . * "*La Lumière Electr.*," iv. 387.
Lachinoff . . . . . * "*La Lumière Electr.*," iii. 360.
Ladd . . . . * "*Van Nostr. Mag.*," xxii. 405.
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Lontin . . . . * "*Engineering*," xxv. 49; xxviii. 174.
* "*Sc. Amer. Sup.*," 1223, 1814.
* "*Van Nostr. Mag.*," xxii. 443.
* "*App. de l'Électr.*," v. 534.
* "*Jour. Soc. Tel. Eng.*," viii. 237, pl. 8.
* "*La Lumière Electr.*," i. 15; ii. 21.
Maxim . . . . * "*La Lumière Electr.*," ii. 412, * 416.
* "*Manf. & Build.*," xii. 196, 223.
* "*Scientific American*," xliii. 130, 150, 262.
* "*La Lumière Electr.*," v 15.
Maxim (Governor) . . . * "*Scientific Amer.*," xliii. 255.
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Nelson, Br. . . . . . "*Telegraphic Journal*," iv. 104.
Niaudet . . . . . . * "*Engineer*," xliv. 401.
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Nollet. See "Alliance."
Pacinotti . . . . . . * "*Telegraphic Journal*," vii. 217.
* "*Van Nostr. Mag.*," xxii. 406.
* "*La Lumière Electr.*," v. 434.
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Pixii . . . . * "*Engineer*," xliv. 383.
* "*Van Nostr. Mag.*," xxii. 402.
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Schottlander . . . . * "*Jour. Soc. Tel. Eng.*," viii. 228, p. 3.
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* "*La Lumière Electr.*," ii. 45.
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* "*Telegraphic Journal*," v. 273.
* "*Van Nostr. Mag.*," xxii. 405.
Lighthouse . . . . * "*Engineer*," xliv. 401.
Siemens-Halske . . . . * "*La Lumière Electr.*," v. 369.
Siemens-Hefner-Altenek . * "*App. de l'Électricité*," v. 526.
Société l'Alliance. See "Alliance."
Transmission of power by electricity. "*Engineer*," xliv. 451.
"*Van Nostr. Mag.*," xx. 334.
Siemens . . . . . * "*Scientific Amer.*," xlii. 127.
Trouvé . . . . . . * "*Scientific Amer. Sup.*," 4131.
Treatise on, from "Engineering" . . . . . * "*Van Nostr. Mag.*," xviii. 355, 375; * xxii. 340.
Wallace-Farmer . . . . * "*Engineer*," xlv. 447.
* "*Iron Age*," xxiii, Jan. 9, p. 7.
* "*La Lumière Electr.*," ii. 343.
Western Union Telegraph * "*Scientific Am.*," xlii. 63.
Weston . . . . * "*Telegraphic Journal*," vi. 157.
* "*Iron Age*," xix., Jan. 11, p. 19; * xxiv., July 17, p. 1.
* "*Manuf. & Builder*," ix. 246.
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* "*La Lumière Electr.*," i. 172; iv. 311.
Factory . . . . * "*Scientific American*," xii. 399.
Wilde . . . . * "*Van Nostr. Mag.*," xxii. 404.
* "*Journal Soc. Tel. Eng.*," viii. 235, pl. 5; * 240, pl. 8.

Dy-nam'o-graph. (*Surgical.*) An instrument for registering the muscular power of the hand of an individual applied to the compression of an elliptic spring. See DYNAMOMETER.

Dyn'a-mom'e-ter. 1. (*Surgical.*) An elliptic spring with indicating finger and graduated arm, to be collapsed by the grasp of the hand, as a measurer of the muscular power of the hand of the individual.

Fig. 283, Part 1, *Tiemann's "Armam. Chirurgicum."* Another instrument has a bulb to be compressed by the hand, ejecting a liquid which rises in a tube against a graduated scale. Fig. 285, *Ibid.*

2. A machine used for testing the lifting strength of persons. See HEALTH LIFT; LIFTING MACHINE; EXERCISING MACHINE.

3. An instrument for measuring the compression exerted by a charge of powder in explosion.

Such an instrument is also known as an *internal-pressure gage*, or a *piezometer*: each of which see.

Lieut.-Col. Benton's dynamometer is designed to be used in connection with the Rodman pressure gage, for the purpose of determining the pressure per square inch exerted within the bores of cannon and small arms by the ignition of powder. It may also be used for testing the strength of materials, or for measuring their compression within certain limits.

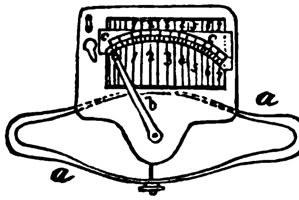
The apparatus is described in the "*Report of the Chief of Ordnance, U. S. A.*," 1877, * 874 and Plates I.-V

Lieut. Metcalfe's dynamometer for measuring the recoil of fire-arms, measures the recoil by means of a cut made in a material of uniform resistance, such as copper or lead, by a Rodman knife interposed between the metal and the butt of the gun. See Appendix N and plate, "*Ordnance Report*," 1878, p. 109.

4. An instrument for measuring tractile force exerted by an engine or team.

A simple form is that of Miller. It is self-registering, and consists of an ordinary dynameter spring, *aa*, with needle, *b*, and graduated scale, *c*.

Fig. 906.



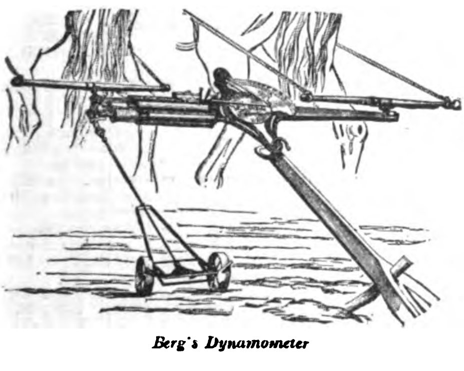
Miller's Dynamometer.

A strip of paper carefully ruled to correspond with the graduated scale is caused to pass under the needle at a uniform rate, by means of rollers moved by a train of gearing, with a fly to regulate the motion. This mechanism is inclosed in a box beneath the graduated scale. Every impulse of the power is accurately noted upon the graduated paper by a pencil attached to the needle, enabling the operator to determine, not only the mean and extreme draft, but also the unsteadiness of draft as indicated by the range of vibration of the needle.

The instrument is connected to the object, the draft of which is to be tested, and to the power used, by a hook and clevis.

The dynamometer of *Berg*, Kjöbenhavn, Denmark, is shown in Fig. 907. Draft upon the double-tree condenses a spring and causes a pointer to traverse a graduated sector and show the force exerted. Attached to the pointer arm is a rod which moves a traversing pencil, the point of which rests on a traveling band of paper, which is rotated by a small trailing carriage.

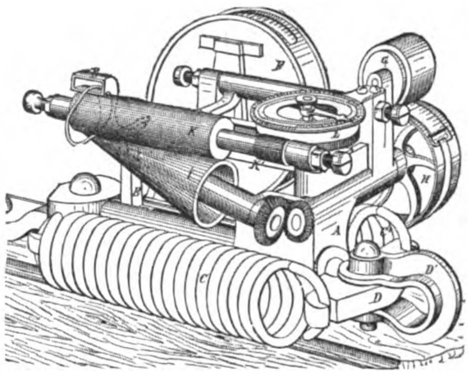
Fig. 907



Berg's Dynamometer

The dynamometer of *Baldwin & Eickemeyer* was used at the Centennial Exhibition in 1876 in testing the mowing machines. It differs from other dynamometers in so far as it compounds the average draft applied to the machine for a given distance, — say, 100 feet, — and thus facilitates the tests very materially, as all calculations of diagrams are avoided.

Fig. 908.



Baldwin & Eickemeyer's Dynamometer.

Two coiled springs, *C C'*, united by cross-bar *D*, and attached by clevis *D'* to the double-tree of the team, form the connection between the draft-power and the pole of the machine to which the apparatus is hooked. The cross-head *D* is the forward end of a T-shaped bar fitted into the frame on the extreme end of which the belt-guide *E* is fastened. The position of the belt-guide thus depends upon the amount of power applied to the clevis *D'*, as the springs lengthen or contract by variations in the said force.

To record and average the draft so applied is the function of the recording mechanism. The base-line of 100' is measured by a tape line 100' long, wound up in the tape case *F*, which is drawn out through a slot and passes between the rubber friction roller *G* and the driving pulley *H*. One end of a string is fastened to the ring in the end of the tape line and the other end of the string to a peg in the ground As soon as the team starts, the tape line begins to pay out, turning the driving pulley *H* until the 100' is expended, and setting in motion the recording mechanism which ceases when the tape is expended. A pair of bevel wheels connects the shaft of the driving roller *H* with the conical roller *I*, giving it a determined number of revolutions during the expenditure of 100' of tape

Above the conical roller *I* is a parallel roller *K*, which is sustained on conical end screws, and its shaft carries a worm *K*, which engages the gear on the periphery of the drum of the indicator dial. An endless cord passes between the rollers *I K*, issuing through a guide *F*, carried by the post *E* on a stem of the T-bar *D*. When no strain is applied to the clevis *D'*, *E* is at the rear position shown in the cut, and were the apparatus even in motion by means of the strain upon the tape line, the end of which was fast to the ground peg, no indication would be given upon the recording dial, because as the endless cord is on the point of the roller it gives no motion to the roller *K*, and, through the latter, to the dial. When, however, strain is brought by draft on the clevis *D'*, the endless cord is drawn forward, and the cord passes between rollers *I K* at such point between the apex and the base of roller *I* as the draft may have occasioned. The heavier the draft the larger the portion of the roller *I* traversed by the cord and in exactly the same proportion is the motion of the roller *K* and accordingly of the dial. Any fluctuation in the draft exerted is immediately manifest by the creeping of the cord toward the point or toward the base, as the power exerted diminishes or increases, and equally, the indicator travels more or less slowly. The extent of the motion of the indicator is the sum of all the effects, and it is set to zero at the commencement of each trial.

The reading of the indicator is the perfected record, and no calculations of diagrams are necessary.

Emerson's dynamometer, in one form, is shown at 5, Fig 1813, p. 768, "*Mech. Dict.*" Quite a variety of lever dynamometers, fixed and portable, are now made on this principle. These dynamometers are graduated by applying the

DYNAMOMETRICAL TRIALS OF REAPERS AND MOWERS AT MARMONT (SEINE-ET-MARNE) FRANCE, JULY 25, 1878.

Designation of machines.	1. At work. 2. Moving: in gear but not cutting. 3. Moving; not in gear.	Surface of Diagram, measured by the Planimeter.	Length of Trace on Paper of Dynamometer.	Mean Ordinate.	Corresponding Effort.	Width of Cut.	Effort corresponding to one Meter of Width of Cut.	Length of Course.	Time of Course.	Rate of Motion per Second.	Stroke of Knife.	Weight of Machine.	Weight of Driver.	Total Weight.	Price of Machine.	Estimate of Power required to cut: † One Hectare of Wheat. ‡ One Hectare of Lucern.	Weight of Wheat cut per Square Meter.	
		Square Millimeters.	Meters.	Millimeters.	Kilogrammeters.	Meters.	Kilogrammeters.	Meters.	"	Meters.	Meters.	Kilos.	Kilos.	Kilos.	Francs.	Kilogrammeters.	Kilos.	
Cyrus H. McCormick's binding-reaper.	1	22,580	1.284	17.58	184.48	1.48	124.66	110	78 6	1.400	0.149	544	92	636	2,000			Mean of work by the four reapers, 0.8155 kilos per sq. meter = 8,155 kilos per hectare.
	2	*54,550	1.298	*43.03	128.49	1.48	86.82	110	77.4	1.290	0.149	544	92	636	2,000	†1,246,600	0.8446	
	3	*43,160	1.386	*31.14	95.19	1.48	64.32	110	83 4	1.320	0.149	544	92	636	2,000			
Walter A. Wood's binding-reaper.	1	29,840	1.642	18.18	190.78	1.51	126.34	110	114.8	0.958	0.137	544	92	636	2,000			
	2	38,270	3.059	12.51	131.28	1.51	86.94	110	119.0	0.924	0.137	514	92	636	2,000	†1,263,400	0.7947	
	3	12,890	1.223	10.54	110.61	1 51	73.35	110	86.0	1.280	0.137	544	92	636	2,000			
D. M. Osborne & Co.'s binding-reaper.	1	20,560	1.225	16.73	176.09	1 58	111.45	110	78.6	1.400	0.077	533	92	625	1,750			
	2	17,945	1.300	13.80	144.32	1.58	91.66	110	92.2	1.193	0.077	533	92	625	1,750	†1,114,500	0.8228	
	3	11,100	1.206	9.22	96 75	1.58	61.68	110	75.6	1.455	0.077	533	92	625	1,750			
Johnston Harvester Co.'s reaper.	1	10,960	1.115	9.83	103.16	1.50	68.77	110	89 0	1.236	0.075	458	92	550	1,050			
	2	6,290	1.002	6.28	65.90	1.50	43.93	110	84.3	1 305	0.075	458	92	550	1,050	†687,700	0.8000	
	3	5,550	1.055	5.26	55.20	1.50	36.80	110	80.2	1.372	0.075	458	92	550	1,050			
Aultman's mower, "Buckeye"	1	*20,900	0.721	*28.29	88.62	1.27	69.78	110	78.6	1.400	0.070	325	92	417	625			Mean of work by the four mowers, 1.355 kilos per sq. meter = 13,550 kilos per hectare.
	2	*19,180	1.196	*16.04	49.03	1.27	38.61	110	92.2	1.109	0.070	325	92	417	625	‡697,800	. . .	
	3	*16,070	1.148	*14.00	42.80	1.27	33.70	110	95.0	1.158	0.070	325	92	417	625			
Warder & Mitchell's mower, "New Champion."	1 ††	*32,350	1.384	*23.28	71.47	1.28	55 84	110	117.2	0.939	0.076	258	92	350	675			
	1 ‡‡	*22,820	0.880	*25.93	79 27	1.28	61.93	110	117.4	0.937	0.076	258	92	350	675	‡619,300	. . .	
	2	*18,050	1.349	*13.89	42.46	1.28	33.17	110	110.2	0 908	0.076	258	92	350	675			
	3	*10,860	0.936	*11.60	35.46	1.28	27.70	110	98.0	1.120	0 076	258	92	350	675			
William Anson Wood's mower.	1	*27,230	0.986	*27.52	84.13	1.28	65 73	110	81.2	1.122	0 070	295	92	387	675			
	2	*19,280	0.558	*16.65	50.90	1.28	39.77	110	74.2	1.482	0.070	295	92	387	675	‡657,300	. . .	
	3	*15,180	1.196	*13 53	41.36	1.28	32.31	110	83.6	1.316	0.070	295	92	387	675			
Walter A. Wood's mower.	1	*36,080	1 549	*23.29	71.20	1.29	55 99	110	99 4	1.107	0.069	254	92	346	675			
	2	*23,970	1.863	*17.58	53.74	1.29	41.66	110	82.6	1 332	0.069	254	92	346	675	‡564,500	. . .	
	3	*11,470	0.900	*12.74	38.95	1.29	30.19	110	79.0	1.392	0.069	254	92	346	675			

Meter = 39.37079 inches, approximately 1 1-10th yards.
Millimeter, 1-1000 meter = 0.0394 inch.
Kilo, *i. e.*, kilogram = 1,000 grams = 2.2046 pounds avoirdupois, approximately 2 1-5th pounds.
Kilogrammeter = a force of 1 kilo exerted through 1 meter.
Hectare = 2.471 acres.

* Essays marked thus * employed the dynamometer with the weaker springs; the other essays were with a more powerful instrument.

†† Ordinary height of stubble. ‡‡ Extra short stubble.

The dynamometer used was that belonging to the *Conservatoire des Arts et Métiers* of Paris. Tests and calculations by Professor Tresca, *fils*, of the *Conservatoire*.

weights at a point which, if revolving, would describe a circle of a given number of feet, the smallest size at 4, the larger from 10 to 60, depending somewhat upon the speed they are run.

The same method is used to compute the power as described in water-wheel tests. Suppose the instrument to be graduated upon a 4′ circle, pulley making 500 revolutions per minute, weight indicated after deducting centrifugal force, 35 pounds, $500 \times 4 = 2{,}000 \times 35 = 70{,}000 \div 33{,}000 = 2.12$.

The manner of using the portable dynamometer is to place it between the motor and the machine to be tested, level and secure it to the floor, then belt from motor to driving pulley of dynamometer, and observe the weight indicated, caused by centrifugal force of the levers (equivalent to balancing scales), then belt from pulley of dynamometer to pulley of machine, from the weight then indicated, deduct the centrifugal force, then compute as before described.

These dynamometers are usually made in two sizes. The small size, capable of testing up to 5-horse power, and large one up to 25-horse power.

The table on the opposite page gives the tests of harvesting machines at the Paris Exposition of 1878. The trials took place at Marmont near Paris, and the writer was member of the special jury as well as of the class. It is appended as indicating the thorough method of testing: —

The machine operating in crop.
The machine operating but not in crop.
The machine empty, moving but not in operation.

The column " Estimate of power required to cut one hectare " is the ultimate result *in nuce*.

See the following references: —

Batchelder	* "*Sc. Am.*," xxxix. 127.
	* "*Sc. Am.*," xxxviii. 130.
Blackinton	* "*Sc. Am.*," xxxvii. 66.
Eastern Ry. of France, Car	* "*Engineering*," xxvi. 290, 307, 330.
Edison	"*Sc. Amer.*," xli. 86, 276
Froude, Propellers	* "*Eng'ing*," xxiv. 67, 90.
Propellers	* "*Sc. Am. Sup.*," 1407.
Giffard, Balloons, Paris, 1878	"*Sc. Am.*," xxxix. 179.
Hausner, Fabrics	* "*Sc. Am. Sup.*," 1236.
Külliches, Locomotives, Ger.	"*Van Nostrand's Mag.*," xix. 560.
Maxim	* "*Manuf. & Builder*," xii. 228.
Reaper trial, Br., 1876	"*Sc. Am. Sup.*," 681.
Prony brake	* "*Sc. Am. Sup.*," 704, Fig. 7.
	"*Sc. Am.*," xxxviii. 130.
Electric currents, *Weber*	* "*Sc. Am. Sup.*," 3965.

Dynamometer for threads and tissues, article *Dynamométer*, *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," tome iv., ed. 1877.

Dynamometers of *Tresca*, *Morin*, *Bentall*, *Ibid.*, tome i., article, *Dynamometér*.

See also Testing Machine, and list under Measuring Instruments, *infra*.

Dyne. (*Electricity.*) The unit of *force*, namely: A force which, acting on a mass of one gram, for one second, imparts a velocity of one centimeter per second or increases or diminishes the initial velocity of such mass by that amount. — *Gordon.*

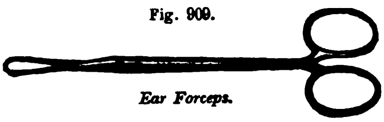
Dy'si-ot. A German alloy, a whitish brass, readily fused.

Copper	62
Lead	18
Tin	10
Zinc	10
	100

E.

Ear For'ceps. (*Surgical.*) An instrument for extracting foreign bodies from the external meatus.

Fig. 909.



Ear Forceps.

The prongs are fine, and come into complete apposition in the mode of some bullet forceps. *Dr. Francis H. Brown.*

Ear In'stru-ments. (*Surgical.*) These are of three kinds: —

1. For exploration and diagnosis.
2. For operation.
3. For prothesis.

See: —

1. Otoscope.
Reflector.
Diagnostic tube.
Ear probe.
Explorer.
Tuning fork.
Specula.
Port acid glass.
Mastoid process knife.
Ear syringe.
Eyelets and eyelet forceps.
Angular forceps.
Tympanum perforator.
Nose clamp.
Tensor tympani instr.
Air-bag.
Ear forceps.

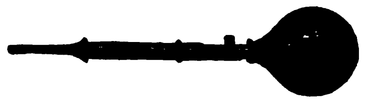
2. Curette.
Hook for foreign bodies.
Polypus knife.
Polypus forceps.
Polypus snare.
Eustachian catheter.
Meatus knife.
Eustachian canal inflator.
Ear spoon.
Powder blower.
Capillary spray instrument.
Maryngotome.
Bistoury.

3. Auricle.
Apparitor auris.
Ear trumpet.
Cornet.

Ear Lift'er. (*Harvesting.*) A long projecting guard finger on the knife bar of a reaper, to insinuate itself beneath the grain which has been storm beaten, or laid in the field. A row of lifters is placed in advance of the regular guards. *Hornsby.*

Ear Pow'der-blow'er. An instrument to introduce powder into the ear by the way of the

Fig. 910.



Ear Insufflator.

external meatus. One section of the stem has a sliding cap, which is withdrawn to allow the powder to be introduced. Compression of the bulb ejects the powder at the nozzle. A form of syringe.

See Auto-insufflator and Atomizer, Figs. 128, 131, pp. 55 and 57 respectively, *supra*.

Ear Spout. A trough which hangs by a wire to the ear and conducts outflow water to a basin, while syringing.

Earth Bat'te-ry. (*Electricity.*) One in which the elements are imbedded in the earth to be acted upon by the moisture of the ground.

Cerpaux's earth electric battery consists of a combination of plates of zinc and copper, separated by slats and blocks of wood, inserted in moist earth or sand.

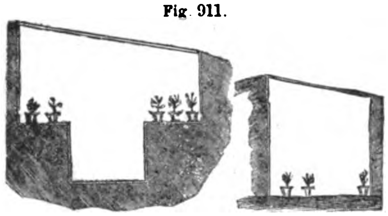
"*Scientific American Supplement*"	452, * 2489.
Sabine's "*Electric Telegraph*"	230.
"*Scientific American Supplement*"	* 774.
"*Scientific American*"	xxxiv. 296.

Earth Flax. Amianthus. See Asbestos.

Earth Pit. A sunken trench or pit, Fig. 911, in which to protect plants during winter, using the heat of the earth below and around, and excluding the cold above by means of sashes, and any necessary shutters or matting in very cold weather. A cold pit.

Earth'quake In'di-ca'tor. An instrument to indicate, and in some instances record, the per-

Fig. 911.



Earth Pit.

turbations of the ground in case of earthquakes. See SEISMOMETER, *"Mech. Dict.," et infra.*

Ea'sel. A frame or tripod on which a board, canvas, or other object is supported at a convenient angle for drawing, plotting, or painting.

That shown is by Boudriot, of Hague, Germany.

The drawing board is suspended from two sliding frames by ropes passing over pulleys on the top of the easel, and it

Fig. 912

Draftsman's Easel.

is balanced by a ball weight attached to the ropes. The board can be inclined at any angle by means of adjustable telescoping struts. The easel has adjustable arms, carrying sliding carriages, from one of which a lamp is suspended, and a small table for the instruments from the other. The easel can be adjusted to suit persons of different heights, and to accommodate different kinds of work.

Fig. 913 shows Brownell's easel for painting and striping pottery. The vase is placed on the turn-

Fig. 913.

Porcelain Painter's Easel.

table, and the hand-rest adjusted to a convenient height and position to bring the hair pencil to bear upon the object, which is chucked on the table by means of centering pins in the flanged rim.

Eas'ing Valve. A small valve in the center (say) of a large valve, the former being lifted by a moderate power, to equalize the pressure before the large valve opens.

"*Engineer*," xlv. . . . . *Cormack*, * 188.
McNaught, * 297.
Borsig, * 297.

Eb'o-nite. Another name for hard black rubber. The inventor, Charles Goodyear, between 1840 and 1850, made a number of finely molded articles in this material.

It is produced by the process of vulcanization, the heat, quantity of sulphur, and time employed being in excess of the ordinary vulcanization. The hard and fibrous rubbers of the Malayan Archipelago are preferred to the Para or the African rubber for this purpose.

The carefully washed and dried rubber is mixed by means of heated rollers with from 25 to 50 per cent. of sulphur (which must be free from acid), according to the hardness required. 3 per cent. of lampblack may be added to improve the color, and calcined magnesia is sometimes added. The material becomes plastic while hot, and non-elastic when cold.

The ebonite is cured in steam at 135° C. during a period of from 6 to 10 hours, according to the thickness of the article. At a heat of 140° to 150° C. the process is shortened.

Ebonite in its plastic state is molded in tin, type metal, or tinned brass molds. A very slight application of oil, followed by black-leading, prevents adhesion.

Ebonite works like horn or ivory, and can be turned, but requires a high rate of speed. It is dressed down by flour-glass paper and fine emery, and polished by cloth charged with fine brick-dust and water, oil, or paraffine; subsequently by rotten-stone or tripoli.

When heated, it may be bent to shape, so that articles such as bracelets are made flat, heated to 100° C., and bent to shape. Junctions are easily made in the vulcanizer when the ebonite is not at its hardest condition.

The uses of ebonite depend largely upon its properties of hardness, elasticity (in certain grades), electrical non-conductivity, compactness, inertness toward most chemical products, capacity for shaping by molds, turning, polishing.

Gutta-percha, shellac, asphalt, graphite, are added to some compositions, and sulphur as high as 60 per cent. An approved formula is

Rubber	100
Sulphur	45
Gutta percha	10

Combined under heat. Molded in a material not affected by the sulphur; exposed to a heat of 315° F. in a steam pan, at a pressure of 12 pounds to the square inch.

Eb'o-ny, Ar'ti-fi'cial.

Boil oak wood for 48 hours in a solution of alum, and then brush over with a decoction of logwood, prepared as follows: —

Boil 1 part of logwood in 10 parts of water; filter, evaporate to one half. To each quart of this solution add 12 drops saturated neutral solution of indigo.

After the application of the dye rub the wood with a saturated filtered solution of verdigris in hot, concentrated acetic acid, and repeat till the required black color is attained.

Or. Boil 2 quarts of water with ½ pound of logwood and add 1 ounce pearl-ash; wash the wood with this first, and then with the following wash: 2 quarts of water boiled with ½ pound of logwood, ½ ounce sulphate of iron, ½ ounce of acetate of copper, and ½ pound rusty steel filings.

Or: Dip in a solution of logwood. When dry, rub clean, dip in a solution of bichromate of potassium; dry and rub again.

Or: Wash repeatedly in a solution of sulphate of iron. Dry; then wash repeatedly in hot solution of logwood. Dry; wash with sponge and water. Dry; rub with linseed oil.

See the following references: —

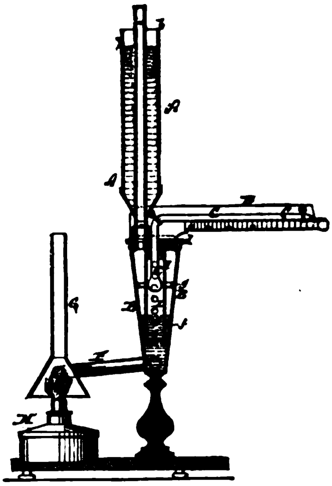
	"*Iron Age*," xxiii., April 10, p. 1.
	"*Manufac. & Builder*," ix. 96, 120.
Ebonite	"*Scientific American Sup.*," 4008.
	"*Mining & Sc. Press*," xxxii. 23.
	"*Eng. Mechanic*," xxv. 142, 165.
Ebonizing wood . . .	"*Manufac. & Builder*," x. 240.
	"*Mining & Sc. Press*," xl. 263.
	"*Scientific American*," xxxviii. 191, 219, 251; xxxiv. 40.
	"*Scientific American*," xxxvii. 137. 145.

"*English Mechanic*," xxv. 644.
Imitation . . . . . . "*English Mechanic*," xxvii. 135.
Polishing . . . . . . "*English Mechanic*," xxiii. 363.

E-bul'li-o-scope. (*Add.*) The ebullioscope of M. Malligand, of Paris, is an instrument for ascertaining the quantity of alcohol present in liquids. U. S. Patent, No. 173,128.

It was found by the Abbé Brossard-Vidal that alcohol holding certain matters in solution, such as sugar, resins, citric

Fig. 914.



Malligand's Ebullioscope.

and tartaric acids, gives a different result, the presence of these matters in moderate quantities not affecting the boiling-point of the alcohol in which they are dissolved. This fact led to the method of estimating the proportion of alcohol present in wines and other alcoholic liquors by comparison of their boiling-points with the boiling-points of different mixtures of alcohol and water in known proportions.

In using the apparatus, pure water is placed in the boiler until it reaches the lower ring *f*, or mark, in the boiler. The water is then boiled, the boiling-point being noted by bringing the zero of the movable scale *E* opposite the degree indicated by the mercurial column *C*. The water is then replaced by the liquid to be tested, care having been taken to rinse out the boiler with some of the same, so that no water is allowed to remain. The boiler is then filled up to the upper ring *g*, or mark, in the boiler, and cold water supplied to the condenser-vessel *b*, attached at the top of the instrument. The lamp is then lighted, and as soon as the mercurial column becomes stationary in the stem, then, by means of the mercury above the scale *E*, the degree of the boiling is at once indicated.

The peculiarities of the instrument consist in the condensers *a b* for returning the vapors of the liquids under test, so as to keep them at normal strength; in heating the liquid in detail by pipe *F* through the flame, thus insuring circulation and proximate equality of temperature throughout the boiler *B*.

See HYPSOMETER, for the instrument for ascertaining altitudes by the observation of the boiling point of water.

E'bur-ine. Dust of ivory or bone compounded with gum tragacanth or albumen, by pressure and heat; colored at pleasure. The name adopted by the French inventor, Latry.

A cement is usually added, but the organic matter in the bone seems to answer if the heat be carefully regulated.

The material is a grayish-white, but may be colored by pigments, an addition which renders albumen necessary. It is used in connection with *bois-durci* or wood concrete (made of sawdust and bullocks' blood).

Eburine may be colored and molded, and made to imitate jasper, malachite, lapis-lazuli; to form moldings, seals, cameos, ornaments of various kinds.

Latry . . . . "*Technologiste*," xxxix. 221.

See list under COMPOSITIONS, p. 212 *supra;* also EBONITE, p. 290.

E'bur-ite. See EBURINE.

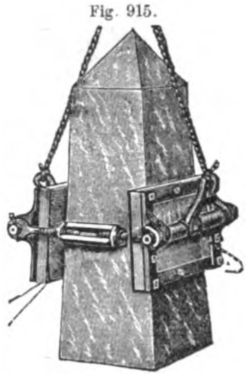
Ec-cen'tric Chuck. An oval and eccentric lathe chuck of considerable range and variety of work is shown in "*English Mechanic*," and reproduced in "*Scientific American Supplement*," * 1413.

See also *Penney* . . . . . * "*Engineering*," xxv. 308.

Ec-cen'tric Clamp. A lifting arrangement for stone monuments, columns, pillars, etc., which should not be defaced by leaving holes or by clamps which mar the surface of the object.

The lifting of the load turns the eccentrics and binds the rubber-faced plates firmly against the object. The size is adjusted by the turnbuckles at the sides.

Fig. 915.

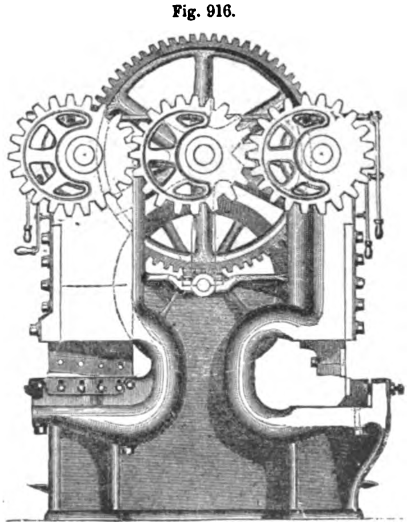


Eccentric Clamp.

Ec-cen'tric Geared Press. An iron-shearing and punching twin-power press in which the power is transmitted through eccentric gearing.

The middle shaft receives a uniform velocity by its large spur-wheel driven by a pinion below. On this shaft is an elliptic gear hung eccentrically, which alternately imparts to the eccentrics on the right and left respectively a slow motion during the penetrating down-stroke and a rapid motion

Fig. 916.



Eccentric Geared Press.

during the up-stroke, increasing the power two-fold in the former case and the speed two-fold in the latter, proximately. The greater part of the upward stroke is in fact accomplished in one-sixth of the time occupied in the revolution of the shaft carrying the shear or punch, as the case may be.

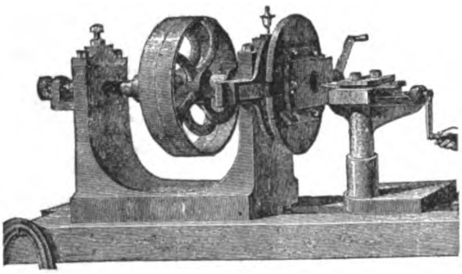
Ivens & Brooks . . . . . * "*Engineer*," xli 450.

Ec-cen'tric Lathe. A lathe with a compound face plate or sliding frame with guides by which the object is so presented that the tool works an oval upon it.

Maxwell of Cincinnati, in 1866, made an important improvement in so arranging the lathe that the amount of ponderable weight was at all times the same on every side of the axis, independent of the piece being turned. This prevented the very serious vibration incident to rapid running of eccentric lathes not thus arranged.

The machine shown in Fig. 917 is made by *Arbey* of Paris.

Fig. 917.

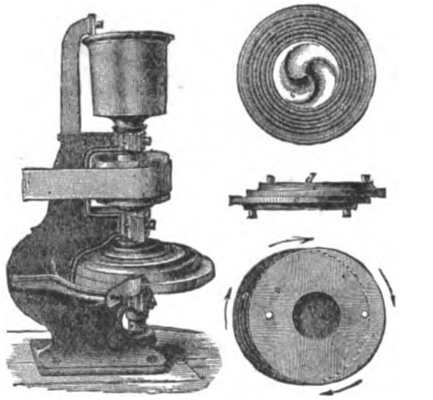


Eccentric Lathe.

Ec-cen'tric Mill. In the Bogardus eccentric mill, both plates revolve in the same direction (with nearly equal speed), on centers, which are apart from each other one or two inches, more or less; the center of the one, or the axis thereto affixed, resting on, or revolving upon a stationary bearing; whilst the prime mover, by means of a belt or gearing, causes the motion of the other plate.

The driven plate communicates motion to the

Fig. 918.



Bogardus Eccentric Mill.

other, the circles which are cut in the plates acting as a revolving shears. The faces of the plates are variously formed for different purposes.

Ec-cen'tric Valve. A stop valve moved by an eccentric upon the valve stem, or, as in the case cited, by an equivalent motion of a short-throw-crank.

See *Elliott & Burnett*, Br. . . * "*Engineer*," xliv. 193.
* "*Engineering*," xxiii. 98.
* "*Sc. American Sup.*," 1570.

Ech'o-scope. (*Surgical.*) An instrument invented by Dr. Speir to intensify sounds produced by percussion of the thorax.

Fig. 267, p. 83, Part I., *Tiemann's* "*Armamentarium Chirurgicum.*"

E-con'o-mi'zer. An apparatus for heating the feed water by the waste heat from a boiler or furnace. See FUEL ECONOMIZER.

E-cra'seur. (*Surgical.*) A flexible loop for cutting, or tearing loose a tumor, polypus, etc.

The following figures refer to *Tiemann's* "*Armamentarium Chirurgicum.*"

The écraseurs of *Chassaignac*, *Edwards*, *Emmett*, *Tiemann*, and *Barnes*, for uterine and ovarian tumors, are jointed chains. Pages 92, 93, Part III. Of the same class, is *Sims'* porte chain écraseur, Fig. 470, Part III.

The instruments of *Smith*, *Braxton*, *Hicks*, and *Van Buren* for the same purposes, are of wire. *Ibid.*

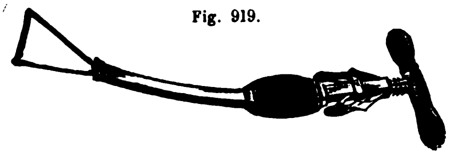
The galvano-cautery sling or écraseur, *Ibid.*, p. 100. See also, *Ibid.*, p. 113, Part I.

Gibbs' Laryngeal écraseur, *Ibid.*, Fig. 338, Part II.

Some écraseurs are shown under CAUTERY INSTRUMENTS, *supra.*

The écraseur of *Dr. J. Harry Thompson* is designed for the rapid removal of uterine polypoid growths. It enables

Fig. 919.



Dr. J. H. Thompson's Ecraseur.

the operator to readily pass the chain around the tumor, the steel springs keeping it taut until the tumor has been completely encircled.

Dr. Nott's rectilineal écraseur is especially intended for the removal of hemorrhoids, and division of the pedicle of ovarian tumors. It is a species of clamp with screw fastening handles, the jaws being respectively a blade and a slit. See Fig. 6, p. 64, vol. vii., Dr. Thompson's report of Group XXIV., * "*Centennial Exhibition Reports.*"

E-de ma-glot'tis Tube. (*Surgical.*) A flat spring ring to be introduced into the glottis to prevent its being closed by swelling.

Edge Grind'stone. One the peripheral edge of which is the portion utilized; as distinguished from surface grindstone.

Edge Key. A tool used in boot-making for rubbing and burnishing the edges of soles. The disks are made of patterns: plain, convex, scotch edge, fluted, etc.

Edge Laid Belt. One made by cutting up the hides into strips of the width of the intended thickness of the belt, and setting them on edge. These strips have holes punched through them about ⅛" diameter and 1" apart. Nails, made of round wire, clinched up at one end for a head and flattened at the other, are used for fastening the leathern strips together.

Edge Mold'ing Ma-chine'. One for cutting moldings on the edges of boards, the latter lying upon a table and presented to a revolving cutter which projects upwardly through a hole in the table. Fig. 3200, p. 1468, "*Mech. Dict.*"

Bentel, Margedant & Co. * "*Manuf. and Builder*," xii. 153.
* "*Engineer*," xli. 412.

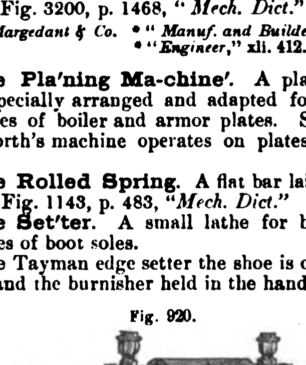
Edge Pla'ning Ma-chine'. A planing machine specially arranged and adapted for planing the edges of boiler and armor plates. Sir Joseph Whitworth's machine operates on plates up to 15′ length.

Edge Rolled Spring. A flat bar laid spirally as in *v*, Fig. 1143, p. 483, "*Mech. Dict.*"

Edge Set'ter. A small lathe for burnishing the edges of boot soles.

In the Tayman edge setter the shoe is carried on a jack and the burnisher held in the hand.

Fig. 920.



Edge Setter.

Edge Trim'mer. (*Boot-Making.*) A small machine for paring the boot sole. The boot is held on a jack, moving automatically, and the knife trims the edge and takes out the feather. — Tayman.

Edg'ing and Di-vid'ing Bench. A circular saw of special adaption for sawing blocks into voussoir shapes, used in one form (Mansel's, Br.) of car-wheels.

The bed is moved to and fro by a screw, and the travel of the bed is adjusted and determined by the movable projections attached to the bed, which, by communicating motion to the system of levers, throw the strap on to one of the three pulleys for stopping, or for motion in one or other direction. The table has a fast return motion given it by means of a double ring of cogs, on the crown wheel fixed to the screw.

Robinson, Br. . . . . * "*Engineer*," xlv. 216.

Edg'ing Ma-chine'. (*Machine-tool.*) A machine with horizontal adjustable bed, and one or more cutters on vertical spindles: used for milling around the inside or outside edges of irregular shapes, and for surfacing and inside milling. A *profiling machine*. Jones, Lamson & Co.

The *Pratt & Whitney* edging machine has an accurate automatic movement for cutting circles of less than 3″ diameter, and their tangents. Made with one, two, or three spindles.

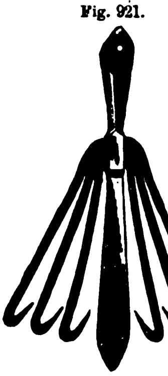
Edg'ing Saw. A circular saw arranged upon a bench for ripping boards to make strips or straight-edges. The board is placed on a movable table and fed past the saw. See also Double Edger.

Eel Spear. (*Fishing.*) A spear, Fig. 921, with 3 or more barbed prongs for catching eels by thrusting it into the mud they inhabit. See also Grains.

Patents:	S. Hedges	No. 172,312.
	C. M. Knowles	218,540.

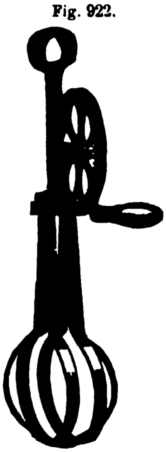
Egg Beat'er. The Dover egg-beater has two revolving flat loops on different shafts, each passing alternately inside of the other, gathering the egg towards the center of the bowl and whirling it in cross currents.

Fig. 921.



Eel Spear.

Fig. 922.



Dover Egg-beater.

The following references may be consulted: —

Beater, *Mann* . . .	* "*Scientific American*,"	xlii. 115.
Boiler	* "*Scientific American*,"	xxxviii. 354.
Paper cup, *Washburne*,	* "*Scientific American*,"	xxxv. 195.
Dessicated	"*Sc. Am.*,"	xxxvi. 275, 408; xl. 88.
Holder, *Birch* . . .	* "*Scientific American*,"	xli. 399.
Guilbeault	* "*Scientific American*,"	xxxv. 131.
Opener, *Kry*	* "*Scientific American*,"	xxxix. 328.
Tongs, *Koska* . . .	* "*Scientific American*,"	xlii. 83.

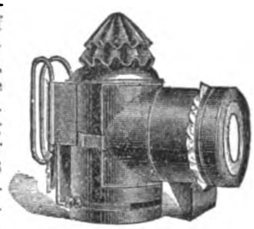
Egg'-end Steam Boil'er. A form of steam boiler with hemispherical ends. When of large size, the longitudinal seams are double riveted. When dished ends are used, the larger sizes have longitudinal or gusset stays, or both.

Egg'-shell Ware. (*Ceramics.*) A name applied to very thin porcelain, resembling the egg-shell in its extreme lightness. Made in Japan, and imitated in Europe.

See Prof. Wurtz, Report (Centennial) on Japanese Porcelain.

Egg Test'er. A dark lantern, having an opening at which an egg is placed in order to observe the condition of its contents; the translucency of a fresh egg, or the condition of the embryo chick observed. The fertility of the egg can be determined after being under heat for 48 hours. Used for commercial purposes in testing freshness of eggs, and in connection with incubators in observing the fertility of the egg and progress of the embryo.

Fig. 923.



Egg Tester.

E-ject'or. A form of pump. See p. 775, "*Mech. Dict.*"

Friedmann's	* "*Scientific American*,"	xli. 319.
Nagel & Kaempt . . .	* "*Scientific American Sup.*,"	292.
Vacuum brake ejector .	* *Forney's* "*Dictionary*,"	435.

E-las'tic Wheel. (*Railway.*) A car-wheel in which some elastic material is interposed between the tire and the wheel-center or hub to resist the concussions. Different substances are used, such as paper, wood, india-rubber, oakum, etc. See Figs. 1170, 1171, pp. 493, 494, "*Mech. Dict.*"

El'bow. A bent pipe coupling or L joint. See also Bend.

El'bow Ap'pa-ra'tus. (*Surgical.*) 1. An apparatus for the gradual extension of contracted muscles of the arm; false anchylosis of the elbow.

Fig. 53, Part IV., *Tiemann's* "*Armam. Chirurgicum.*"

2. A splint for luxated elbow.

Hamilton's elbow splint, Fig. 148, Part IV., *Ibid.*
Andrews' elbow splint, p. 123, Part IV., *Ibid.*

El'bow Scis'sors. (*Surgical.*) Scissors bent in the blade or shank for convenience in cutting. See several instances in Figs. 4671, 4672, p. 2054, "*Mech. Dict.*"

El'der Brake. (*Railway.*) A brake for eight-wheeled cars, with a horizontal lever having a fixed fulcrum under the car-body, at its center, and pulleys at each end, over which a chain passes, which is connected with the brake-levers of each truck. One lever on each truck also has a pulley or sheave at its end, over which a chain runs which is connected with the opposite lever, and also with the central lever. The latter is connected by rods and chains with brake-windlasses by which the brakes are applied at each end of the car. — *Forney.*

E-lec'tri-cal Di'a-pa'son. An apparatus invented by George M. Hopkins, for compounding rectangular vibrations, so as to produce both sounds and figures.

Sir Charles Wheatstone contrived a small machine for the purpose, using tuning-forks; *Prof. Dolbear* used mirrors on a whirling table to describe curves upon a screen; *Lissajou* drew curves by means of two pendulums. In each of these there was a certain incompleteness; the forks lacked continuity of action, the mirrors gave no sound, the pendulums (as arranged without sustaining power) had neither continuity nor sound. It must be said, however, that *Lissajou* has, since his first invention, applied electricity to maintain the vibration of the diapason.

Hopkins' apparatus has two reeds or tongues vibrated by an electric current and connected with a single mirror, the latter receives a beam of light from a lantern and reflects it through a lens upon a screen. The steel tongues are pivoted at one end and are arranged relatively so that they vibrate in planes at right angles to each other. They are thus the equivalent of the Lissajou pendulums. The image upon the screen is the resultant of the two rectangular vibratory motions.

If only one tongue vibrates a straight line will appear on the screen, which will be inclined at an angle of 45° from the horizontal. The line produced by one of the tongues forms a right angle with the line produced by the other, and when both tongues vibrate simultaneously the two motions combine, and the reflected pencil describes a more or less complex curve, the form of which depends on the number of vibrations of the two tuning-forks in a given time.

The tones of the tongues are varied by moving the slide so that any possible combination of tones within the given compass (in this case an octave and a half) may be produced.

"*Scientific American*" . . . . xxxix. 223.

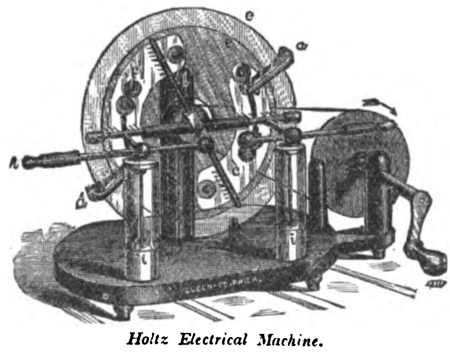
See also COMPARATOR, *Prof. Barnard's Report Paris Exposition*, 1867, * pp. 507-509.

E-lec'tri-cal Gen'er-a'tor. See DYNAMO-ELECTRIC MACHINE; ELECTRO-MAGNETIC MACHINE.

E-lec'tri-cal Ma-chine'. *Franklin's* electrical machine is in possession of the Franklin Institute of Pennsylvania, and was shown at the Centennial Exhibition.

Fig. 925 is the Toepler Holtz electrical machine. The stationary glass plate *e* is held in rubber supports upon the platform, with the armatures *c c* at the back. The inner

Fig. 924.



Holtz Electrical Machine.

circular revolving-plate *e* is attached to the axis, the metallic disks outward. The arms *a a'* are attached to their sockets in such a way that the metallic brush just touches the brass disks when the plate *e* is rotated, but does not touch the plate. *i i* are the condensers.

To operate the machine place the balls close together, turn the wheel in the direction of the arrow until the sparks pass between the balls, then separate them gradually; the wheel-plate being rapidly revolved, a torrent of brilliant sparks will discharge between the balls. The small brass disks on the anterior surface of the plate *e*, when revolved rub against the metallic brushes, on *a a'*, a small quantity of electricity is carried around to the armatures *c c'*, upon the back of the large stationary plate, the initial charge is thus given to the outer plate *e*, this in turn reacts on the revolving plate.

See the following references: —

Holtz	* "*Scientific American*," xxxvii. 261.
Carré	
Thomson	
Gramme	* "*Scientific American Sup.*," 674.
Holtz	"*Scientific American Sup.*," 1058.
Military, Fr. . . .	* "*Scientific American Sup.*," 4055, 1456.
Frictional.	
Marum & Winter .	* "*Manufac. & Builder*," viii. 204.
Induction, *Holtz* . .	* "*Telegraphic Journal*," v. 126.
Battery, *Onimus* . .	* "*Scientific American*," xxxv. 67.
Planté, Paper by Niaudet	* "*Jour. Soc. Tel. Eng.*," vii. 75.
Paper on *Wiesendangir*	* "*Scientific American Sup.*," 4028.

E-lec'tri-cal Sold'er-ing I'ron. A tool for use in tin-shops and at the jeweler's or mechanical dentist's bench.

It consists of two metallic conductors placed side by side, with a small space between them for insulation, and joined at the end by a small piece of platinum or other refractory substance having a high electrical resistance. A handle is provided, having the proper insulation and binding screws for the wires. A simple form of switch is also provided for regulating the current. When the current flows through the tool, the platinum point is raised to a high temperature, and may be used to melt gold or silver solders

E-lec'tric Bat'te-ry. 1. (*Static.*) The Leyden jars.

2. (*Dynamic.*) The battery consisting of a series of galvanic elements. See GALVANIC BATTERY, and list, *infra.*

E-lec'tric Brush. 1. A brush with wire bristles, and having metallic plates in the handle which cause a galvanic action, especially when the brush is dipped in water or used in brushing the damp hair. — Dr. Post.

2. A brush included in an electric circuit, and used upon the hair or flesh as a therapeutic.

3. A circuit closer consisting of a bunch of wire used in telegraphic instruments using perforated slips.

E-lec'tric Bul'let-probe. (*Surgical.*) An instrument which indicates contact with the bullet by a sound induced by the completion of an electric circuit between the points of the forceps and through the bullet. Fig. 3966, p. 1803, "*Mech. Dict.*"

E-lec'tric Ca'ble. Plow for trenching and laying electric cables (French). "*La Lumière Electrique,*" reported in "*Scientific American,*" * xlvi. 246.

E-lec'tric Call. An audible signal communicated by electricity. An *annunciator, call-bell, buzzer,* etc.

E-lec'tric Can'dle. (*Electricity.*) A form of electric light in which the carbons are placed parallel; as in the Jablochkoff light.

The waste of the two must be equal, and they are therefore fed by alternating currents.

1. Candles with *columbin*; that is, a material which separates and insulates them, — the Jablochkoff, which combines the incandescent and the arc.

2. Candles without columbin are arc lamps. The Wilde, Jamin, and Debrun are of this class. The distance apart of the carbons is permanently fixed (*à écart fixe*).

The Clerc and Burean lamps, known as solar lamps (*lampe-soliel*) have nearly parallel carbons, and are allied to the incandescent class by the interposition of lime between the carbon points made incandescent by the passage of the current across them.

See —

Cohné, Eng.	"*Scientific American*," xli. 265.
Regulator, *Heinrich*, Br.	* "*Engineer*," xlviii. 413.
Jablochkoff	* "*Eng. & Min. Jour.*," xxviii. 45.
	"*Min. & Sc. Press*," xxxv. 42.
	"*Scientific Amer.*," xxxvi. 339.
	"*Scientific American Sup.*," 1240, 1249, 1337, 1366.
Planté	"*Manufact. & Builder*," ix. 205.
	"*Manufact. & Builder*," x. 14.
Scaife	"*Scientific American Sup.*," 1720.

E-lec'tric Chro'no-scopes and Chron'o-graphs. References to the following electric chronographs and chronoscopes with electric actuation are to be found in *Comte du Moncel's "Exposé des Application de l'Électricite,"* tome iv., Paris, 3d, edition, at the pages noted: —

	Page.	Figure.	Plate.
* *Atwood* machines	298	9-10	vi.
* *Bashford*	240, 266	51	
Bond	237		
* *Breguet*	207	11	vi
* *Breguet & Konstantinoff* . .	211	8	vi.
* *Breguet & Marcy*	232	49	
* *Cornu*	245	55	
Digney	237		

	Page.	Figure.	Plate.
• *Fleurais*	242	52	
Gloesner	218		
• *Hardy & Strange*	227	44	
Hipp	207, 238		
Hirsch & Plantamour	201, 208		
Hughes	250		
Lartigue	250		
Leboulenge	258		
• *Leverrier & Liais*	278	19	vi.
• *Liais*	234	50	
	234	19	vi.
• *Lawy*	287	57	
• *Marcel Deprez*	228	45	
• *Martin de Brettes*	216, 261	6, 7	vi.
	220	42	
• *Navez*	254	2	vi.
Pouillet	208, 254		
Schultz & Lissajous	225, 267		
Siemens	220		
Thalen	281		
Vignotti	225		
• *Villarceau*	190	41	
• *Wheatstone*	206, 252	1	vi.

See also • *Watkins*, "*Jour. Soc. Tel. Eng.*," ix. 121.

E-lec'tric Clock. (*Horology.*) The first clock, the pendulum of which received its impulse from electricity, was probably that of Mr. Bain.

The bob was made with a hole through it, and passed over two soft-iron cylinders, alternately magnetized by an electrical current at each beat of the pendulum.

An accurate regulator may control a number of subsidiary clocks, either upon the foregoing plan or by electricity operating upon their escapements, so as to cause their pallets to move the escapement wheel, the pinion of which drives the wheels to which the hands are connected.

In Shepherd's gravity escapement the pallet is raised by a temporary magnet, and then acts on the pendulum when swinging in one direction. Subsequently he made his magnets to attract and repel alternately.

Carpenter & Martin . . . • "*Telegr. Journal*," vi. 221.

Electrical clocks are made by —

Autenreith & Himmer, New York.	J. B. Kerz, Mayence.
E. Deschiens, Paris.	J. Ferucci, Udine, Italy.
Dumontin, Paris.	B. Egger, Vienna.
E. Barbier, Paris.	M. Illitsch, Vienna.
A. Postel & Co., Paris.	A. Gerard, Luttich, Belg.
Matt Hipp, Neufchâtel.	Paul Miller, Cologne.
Arzberger, Brunn.	

References to the following electric clocks and time markers may be found in *Comte du Moncel's* "*Exposé des Applications de l'Électricité*," vol. iv., Paris, 3d edition, at the pages noted: —

	Page.	Fig.	Plate.
• *Anthoine et Langreynay*	155	51	
• *Bain*	43, 68		
	115	17	I.
• *Breguet*	49	11, 12	I.
	51	4	V.
	55	14	
	68	5	V.
	152	7-10	III.
• *Callaud*	15, 156	32	
See also du Moncel, 2d ed., i. 317.			
• *Caselli*	33	5	
	27, 64	3	
• *Collin-Wagner*	70	19	
Combettes	138		
• *Detouche*	52, 127	8, 9	I.
		8	IV.
• *du Moncel*	42	16	I.
	78	1-6	III.
		14	V.
Elec. Chr. Strikers	91-108	11, 12	III.
• *Everts*	16	5	IV.
Faye	20		
• *Foucault*	12	14	I.
Fournier	41		
• *Froment*	126	4	II.
See also du Moncel, ii. 120.	20	4	I.
• *Garnier*	20	1-3	I.
	13	9, 10	II.
• *Garnier fils*	143	6, 7	V.
Gérard	151		
Gloesner	18, 67		
Gondolo et Perret	56		
• *Grasset*	141	18	III.
• *Hipp*	52	18	
	147	27-30	
• Italian	42	16	I.
Jones	85		
• *Kaiser*	58	2	IV.
	58	15	
• *Kerikuff*	166	35	
• *Laguérenne*	61, 94	7	IV.
• *Lasseau*	72	6	IV.
	145	12	V.
	145	20	
• *Leclanché & Napole*	8	1, 2	
	87	7	
• *Liais, E.*	11	4	IV.
	120	24	
	31	16	III.
	19	15	I.
	117	1	II.
• *Mildé*	34	6	
	158	3	IV.
	158	33, 34	
	100	22, 23	
• *Mouilleron*	154	11, 12	II.
• *Nollet*	48	10	I.
• Paris Observatory	87	21	
• *Régnard*	46	8-10	
	81	20	
• *Robert-Houdin*	28	5, 6, 13	I.
	135	11	V.
	127	5-10	II.
	127	25	
See also du Moncel, ii. 118.			
• *Royer*	139	13	II.
Perpet. calendar	169	36	
Siemens & Digny	54		
• *Vérité*	86, 124	3	II.
• *Volcke*	45	1	IV.
	12	2	IV.
Weare	115		
• *Wheatstone*	13, 64	16-18	

E-lec'tric Disk. A concave hollow pan, filled with hot water and included in an electric circuit, used upon the flesh therapeutically. *Electro-Masseur.*

E-lec'tric Egg. An electric manifestation in an egg-shaped glass vessel exhausted of air, and having conductors above and below. The connection with the induction coil being made, the tuft of light between the rods assumes an ovoidal form and becomes more nearly spherical as the air becomes more rare.

Hopkins . . . . • "*Scientific American Sup.*," 2645.

E-lec'tric Fur'nace. An invention of Dr. C. W. Siemens for melting in a guarded crucible highly refractory metals. It has the advantage of compactness, obviates the need of chimney, is more economical in the concentration of the effect of the energy of coal, and excludes the atmosphere from the object.

In Siemens' furnace, exhibited before the Royal Society, the positive electrode, which was made of iron, entered from below the crucible containing the metal to be melted, whereas the negative electrode, which was a rod of carbon, was attached by means of a lever to a solenoid regulator. The crucible was surrounded by charcoal contained in a copper vessel to prevent loss of heat, and so intense was the heat accumulated that in about 20 minutes two pounds of broken files were completely melted.

E-lec'tric Gov'er-nor. A device to limit the passage of an electric current. There are many forms and purposes; some are referred to subjectively as in connection with the electric light.

Siemens' electric current governor is founded upon the stretching of a wire by the heating incident to the passage of the electric current through it. This idea is the foundation of some of the devices in electric arc-lamps for regulating the distance between the carbons, and also one or more of the *Edison* regulators for limiting the passage of the current in the process of subdivision of current for the multiplication of lights.

Siemens' device for giving sensitiveness and promptness by increased radiating surface of the strip is shown in

"*Electrician*," reproduced in "*Scientific American*," * xl. 184.

See also DIFFERENTIAL; REGULATOR.

E-lec'tric Ham'mer. An apparatus consisting of three hollow coils of insulated wire having a movable core or rod of soft iron which is free to move up and down under the axial attraction of the coils when a current circulates in them. The central coil is traversed by a constant current which magnetizes the rod or hammer, and the two extreme coils are traversed by alternating currents from a dynamo-electric machine in such a manner that they alternately attract and repel the magnetic rod up and down so as to make it beat like a hammer. The range of blow is limited on one side by a spiral spring placed within an elastic cushion. — *Siemens & Halske.*

The apparatus is primarily intended for working a rock drill.

The idea is familiar in dental pluggers. Fig. 3837, p. 1750, "*Mech. Dict.*"

E-lec'tric Hose. An arrangement by which the fireman at the nozzle may communicate with the engineer at the fire-engine.

A wire runs along in the cotton or rubber part of the hose, continuing the connection as each section is attached, and over this passes electricity, generated by one of the fly-wheels of the engine. Connected with the nozzle is a little contrivance by which the engineer can be directed to turn on, cut off, slack up, or what not, by signals upon a gong attached to the engine.

"*Manufacturer & Builder*" . . . . xii. 18.

E-lec-tric'i-ty. Electrical nomenclature settled by the Electrical Congress in Paris, 1881: —

1. The fundamental units to be centimeter, gram, and second (C. G. S.), as heretofore.
2. The practical units, *ohm* and *volt*, to retain their present definition.
3. The unit of resistance, or *ohm*, to be represented by a column of mercury of a square millimeter section at the temperature zero centigrade.

A committee to ascertain and report height of such column in millimeters.

4. The name *ampere* to be given to the *current* produced by a volt in an ohm.
5. The name *coulomb* to be given to the *quantity* of electricity defined by the condition that an ampere gives one coulomb per second.
6. The name *farad* to be given to the capacity defined by the condition that a coulomb in a farad gives a volt.
7. The French *carcel-bec* given the preference over the English "candle-power," and over the German and other standards, as the arbitrary standard of illumination. But this to be considered only provisional and subject to revision.

E-lec-tric'i-ty, Te-leg'ra-phy, etc.

See under the following heads: —

Aërated battery.
Aërophone.
Agglomerated battery.
Alternating current machine.
Alum battery.
Aluminium battery.
Amalgamation.
Anderson battery.
Anode.
Aphongoscope.
Armature.
Articulating telegraph.
Audiphone.
Autograph telegraph.
Autographic printing telegraph.
Automatic repeater.
Automatic signal telegraph.
Automatic switch.
Bagration battery.
Base.
Battery.
Bequerel battery.
Balloon battery.
Bell magnet.
Bell telephone.
Bichromate battery.
Binding-post.
Bi-polar telephone.
Board clip.
Box relay.
Break.
Break circuit.
Breath battery.
Bunsen battery.
Burglar alarm.
Buzzer.
Byrne battery.
Callan battery.
Call annunciator.
Callaud battery.
Call bell.
Call button.
Camacho battery.
Candle.
Carbon battery.
Carbon button.
Carbon indicator.
Carbon telephone.
Carbon-zinc connector.
Carré battery.
Cathode.
Cation.
Cautery.
Cautery battery.
Cell.
C. G. S.
Chloride of lead battery.
Chloride of silver battery.
Chloride of tin battery.
Chromic acid battery.
Circuit.
Circuit breaker.
Clamp.
Clamond battery.
Coil.
Coke consuming battery.
Column battery.
Commutator.
Compound plate battery.
Conductivity.
Conductor.
Connection.
Constant battery.
Constant current.
Contact breaker.
Core.
Couronne de tasses.
Cruikshank battery.
Curb sender.
Current.
Current regulator.
Curves.
Cut-out.
Cyclograph.
Cycloscope.
Daniell battery.
De la Rue battery.
Density.
Dentiphone.
Derivation regulator.
Detector galvanometer.
Dia-magnetic.
Dianemoscope.
Dielectric machine
Differential regulator.
Diffuser.
Diffusion.
Division regulator.
Double connector.
Double-fluid battery.
Dry electric pile.
Dry pile.
Duplex telegraph.
Dynamic electricity.
Dynamo-electric machine.
Dyne.
Earth battery.
Electrical apparatus.
Electrical machine.
Electric battery.
Electric call.
Electric candle.
Electric clock.
Electric diapason.
Electric governor.
Electric hammer.
Electric hose.
Electric lamp.
Electric lantern
Electric light.
Electric light engine.
Electric light regulator.
Electric measurement apparatus.
Electric pen.
Electric railway.
Electric switch.
Electric telegraph.
Electro ballista.
Electrode.
Electro-harmonic telegraph.
Electrolysis.
Electrolyte.
Electro-magnet.
Electro-magnetic brake.
Electro-magnetic machine.
Electro-magnetic telegraph.
Electro-medical apparatus.
Electrometer.
Electromotograph.
Electro-motive force.
Electro-motor.
Electro-motor copying press.
Electro-motor printing telegraph.
Electro-plating.
Electroscope.
Electro-semaphore.
Electro-silicic light.
Elements.
Engine-room telegraph.
Erg.
Exchange.
Exchange switch.
Extra current.
Fac-simile telegraph.
Farad.
Faradaic generator.
Faure battery.
Filar suspension.
Filings separator.
Fire alarm.
Fire-alarm telegraph
Fixed interval regulator.
Flowing battery.
Friction machine.
Frommhold cell.
Fulgurata.
Fuller battery.
Gaiffe battery.
Galvanic battery.
Galvanic current.
Galvano-caustic.
Galvano-caustic battery.
Galvanometer.
Gas battery.
Gas-lighting by electricity.
Graphite battery.
Gravity battery.
Grenet battery.
Grove battery
Harmonic telegraph.
Harmonograph.
Helix.
Hill battery.
Hydraulic electric machine.
Hydrostat.
Incandescent light.
Inconstant battery.
Induced current.
Induction apparatus.
Induction balance.
Induction coil.
Inductophone.
Inductorium.
Inker.
Insulated.
Insulator.
Intensity.
Interrupted current.
Interrupter.
Inversion battery.
Ion.
Jack-knife.
Latimer-Clark battery.
Leclanché battery.
Leyden battery.
Lightning rod.
Linkage.
Local action.
Lock switch.
Log.
Magazine battery.
Magnet.
Magnetic battery.
Magnetic inclination, etc., apparatus.
Magnetic induction.
Magnetic instruments
Magnetic scale.
Magneto call-bell.
Magneto-electric machine
Magneto-printing telegraph.
Magneto telephone call.
Magnophone.
Many-light regulator.

Marie-Davy battery.
Marine battery.
Maynooth battery.
Mechanical battery.
Megalographe.
Megaphone.
Meidinger battery.
Menotti battery.
Mercury battery.
Micro-battery.
Microfarad.
Microphone.
Microtasimeter.
Microtelephone.
Moist battery.
Monophote regulator.
Motographic receiver.
Motophone.
Mouse-mill.
Muirhead battery.
Muncke battery.
Musical telegraph.
Needle annunciator.
Negative.
Niaudet battery.
Nickel battery.
Non-conductor.
Octoplex printing telegraph.
Ohm.
One-light regulator.
Oxidation.
Pantelephone.
Paper clip.
Para-magnetic.
Paratonnere.
Pencil holder.
Perchloride of iron battery.
Perfluent battery.
Peroxide of lead battery.
Peroxide of manganese battery.
Phonautograph.
Phoneidoscope.
Phonic apparatus
Phonic wheel.
Phonograph.
Phonomotor.
Phonophone.
Phonophote.
Phonoscope.
Photophone.
Pin switch.
Plunging battery.
Pneumatic battery.
Pneumatic telegraph.
Pneumatic tube.
Pocket relay.
Poggendorf battery.
Polarized relay.
Polarization.
Polemoscope.
Poles.
Polyphote regulator.
Ponci battery.
Porous cup.
Positive.
Potassium-chlorate battery.
Primary coil.
Primary current.
Printing telegraph.
Prism battery.
Private-line instrument.
Private-line printing telegraph.
Proof plane.
Pseudophone.
Pulvermacher battery.
Pyrophone.
Quadrant electrometer.
Quadruplex telegraph
Quantity.
Quicksilver battery.
Register.
Regulator.
Relay.
Repeater sounder.
Replenisher.
Reservoir battery
Resistance.
Rhé electromètre.
Rheophore.
Rheometer.
Rheostat.
Rheotome.
Sal ammoniac battery.
Sand battery.
Sea battery.
Secondary battery.
Secondary coil.
Secondary current.
Security hook.
Seismophone.
Sematrope.
Short circuit.
Shunt box.
Siemens-Halske battery.
Single-fluid battery.
Siphon recorder.
Siphon telegraph recorder.
Siren.
Skeleton bell.
Smee battery.
Soldering pot.
Sounder.
Speaking electric telegraph.
Spiral battery.
Standard battery.
Static electricity.
Stock reporting and printing telegraph.
Storage battery.
Submarine electric light.
Sulphate of lead battery.
Sulphate of mercury battery.
Switch.
Switch-board.
Switch-loop plug.
Switch table.
Tangent galvanometer.
Target, electric.
Tasimeter.
Telautograph.
Telectroscope.
Telegraph.
Telegraph cable.
Telegraph cable apparatus.
Telegraph inker.
Telegraph instruments.
Telegraph key.
Telegraph pole.
Telegraph wire.
Telemachon.
Telephone.
Telephone call signal.
Telephone exchange apparatus.
Telephone exchange table.
Telephonograph.
Telephote.
Tension.
Thermo-electric battery.
Thermo-electric pile.
Thermo multiplier.
Thermophone.
Thermotelephone.
Thomson battery.
Tom Thumb battery.
Topophone.
Translator.
Transmitter.
Tray battery.
Trembler.
Triple fluid battery.
Trough battery.
Trouvé battery.
Tyer battery.
Under current.
Underground telegraph wire.
Urine battery.
Vacuum shunt.
Varley battery.
Vibrating armature.
Volt.
Voltaic pencil.
Voltaic pile.
Walker battery.
Weber.
Window tube.
Wire resistance.
Wollaston battery.
Writing telegraph.

Consult: —

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Tal. P. Shaffner's "*The Telegraph Manual.*" New York, 1859.
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"*Telegraphic Journal.*" London.
"*The Journal of the Telegraph.*"

See also list of works under ELECTRIC LIGHT, *infra*.

E-lec'tric Lan'tern. A glass envelope for an electric light.

Ground and opal glasses have been used with the Jablochkoff light, but the result is the absorption of from 30 to 50 per cent. of the light.

M. Clémandot stuffs the double glass envelope with glass wool.

The transparent part of the lantern is conical in shape and tapers downward. The walls are made of united glass tubes, like Pandean pipes, each filled with glass wool, and closed at top and bottom to exclude dust. Not more than 15 per cent. of the total light is absorbed by this process; the opacity can be varied at will by introducing less or more wool into the tubes; and the light can be tinted any desired color, either by the stain given to the spun glass, or the tubes which build up the wall of the lantern.

E-lec'tric Light. The history of the electric light commences with the discovery of Galvanism by Galvani, of Bologna, and Volta, of Como; and the voltaic arc was first produced by Davy, in 1813, between the charcoal points of two conducting wires. He used for the purpose a trough battery of 2,000 elements.

The invention had not emerged from the domain of expensive experiment until the discovery of magneto-electricity by Faraday, in 1831. The magneto-electric machines of Pixii, Saxton, Clark, Niaudet, Siemens-Halske, Holmes, and Nollet, followed, and the light was adapted to and used in lighthouses: at Dungeness, in England, in 1862; and at La Heve, in France, in 1863. See DYNAMO-ELECTRIC MACHINE, *supra*, and p. 781, "*Mech. Dict.*" The history of the electric light has two branches, the generator and the applicator: the machine, and the light proper.

A great improvement upon the Holmes and "Alliance" (Nollet) machines was made by Dr. C. W. Siemens, who invented a peculiar form of armature known as the inductive cylinder. This was followed in 1866 by the machine of Wilde, who made the remarkable discovery that if a current from a small magneto-electrical machine was made to pass around the coils of a large magnet, the attractive power of that magnet would be immensely greater than the force of the magnets in a small machine. Thus, by working a small machine, passing the currents through the electro-magnets of a large one, and then taking from the armature of the large one the current to be used, great electric power was obtained in a small compass.

The discovery of the reaction principle of magnetization by Hjorth, of Stockholm, Sweden, in 1854, was a remarkable one in the history of the art, but it seems to have slumbered unnoticed until the announcement by Wheatstone and Siemens, in 1867. By this principle of action a powerful electric current may be generated through the building up of the effects of action and reaction taking place between an electro-magnet and a magneto-electric inductor revolving in its magnetic field and included in the same circuit. The subject has, however, been considered on p. 283, *supra.*

Leaving machines (pp. 283–286, *supra*), it may be said that the electric lights naturally divide into two groups:

Incandescent. *Arc.*

The Werderman is a sort of cross, having an incandescent point with an arc around it.

"The voltaic arc is a portion of the electric circuit, possessing all the characteristics of other portions of the circuit. The molecules entrained constitute between the two points a movable chain, possessing more or less conductivity, and more or less heated, according to the intensity of the current on one hand, and the nature and distance apart of the electrodes on the other. What occurs is precisely as though the electrodes were united by a wire or a carbon rod of very small section, and thus it may be said that the light produced by the voltaic arc and the light produced by incandescence are results of the same cause, namely, the heating of a bad conductor interposed in the circuit." — *Fontaine.*

Each plan has its own class of difficulties to contend with. The arc is formed by the passage of the current between two separated carbons. These burn away gradually, the positive twice as fast as the negative carbon. It is necessary that they shall preserve an exactly equal distance, and this brings the necessity for automatic regulation. It is this feature that has given rise to the greater number of the patents on the arc class of electric lights. Various inventions in this department are due to *Archereau, Lacassauge-Thiers, Gaiffe, Foucault, Duboscq, Hefner-Alteneck, Serrin, Browning, Siemens, Brush, Thomas, Jamin, Thomson-Houston, Sawyer*, etc.

The other side of the question, the incandescent class of lights, has also had its own class of difficulties: the necessity for finding a material which shall not appreciably waste when heated to the violent degree necessary. Platinum, iridium, and carbon, are the principal substances employed.

Platinum leaf was preferred to iridium by *Starr*, in his English patent of 1845. (King, Scotch Patent, Nov. 26, 1845, communication.) He afterward used gas retort carbon in a vacuum.

In the case of the carbon, it is of course necessary to exclude oxygen. This has been done in a satisfactory degree by exhaustion, absorption, and exclusion.

By exhaustion, as in *Edison's*, by means of air-pump.

By absorption; by exposure of chemicals which absorb oxygen in the globe.

By exclusion: filling the globe with nitrogen gas, as in *Kosloff's, Sawyer's, Farmer's*, etc.; or filling the globe with hydro-carbon vapor, as in *Maxim's*. The exhaustive process, and the exclusion by nitrogen, were used by *Depretz*, in 1849, in his incandescent lamp, consisting of carbon in a sealed glass globe.

The *Jablochkoff* candle of two parallel carbons separated by insulation material, belongs to another class.

The multitude of devices is now so great that it is necessary, in the present abridged résumé, to do little more than cite the inventions and give references in the cases of over 100 inventors of electric lights, cited in the list below (pp. 301, 302).

The electric light is now used in lighthouses in Britain, France, Russia, Austria, Sweden, and Egypt. The usual limit is machines equal to 200 carcel burners.

The introduction of the electric light into streets, works, and factories, is treated of in an article reproduced in "*Van Nostrand's Magazine*," xx. 70–84.

Plates XIII., XIV., show the principal electric lamps.

Brush's electric light mechanism consists of an arrangement by which the carbon sticks are automatically adjusted and kept in proper relation. See Fig. 925, Plate XIII.

The movable pencil is surrounded by an annulus which binds it and prevents its descent, until, by the increase of distance between the carbon pencils, the current is so far weakened as to cause an electro-magnet to lower its carbon-holding armature and release the bind of the annulus upon the pencil, which slips downward until, by the proximity of the carbon, a current of sufficient force is established to restore the electro-magnetic device to its former position.

A is a helix of copper wire through which a current flows, making an electro-magnet of the soft iron axial core which carries the carbon-holder *B*. The current passes from point *P* to point *N*, embracing the coil, armature carbon-holders, and carbons *F F′* in its passage.

The axial magnetism produced in the helix by the passage of the current will draw up the core, separating the carbon points far enough to produce the light. As the carbons burn away, the increased length of the electric arc increases its resistance and weakens the magnetism of the helix, and, therefore, the rod and carbon move downward by the force of gravity, until, by the shortening of the arc, the magnetism of the helix is strengthened and the downward movement arrested.

An enlarged view, Fig. 926, Plate XIII., shows the annulus *D*, the armature, carbon-holder *B*, lifting tongue *C′* of the core *C*, clamp *B′*, carbon *F*, set-screw *D′*.

The *Maxim* arc lamp Figs. 927, 928, Plate XIII., has a pair of vertical carbons, the holders of which are so connected by gearing or rolling contact in the case beneath, that they mutually approach and establish the current. Thereupon a current passes, an electro-magnet is excited, and its armature draws downward a cord and separates the carbons, the result of which is the establishment of the voltaic arc. As the carbons waste the arc becomes larger, the resistance greater, the electro-magnet feebler, and the carbons are again gradually approached.

Siemens's is an arc lamp; his improvements concern the regulator by which the degree of proximity of the carbons is automatically accomplished. The upper carbon *B*, Fig. 929, Plate XIII., passes through the core of an electro-magnetic regulator *F*. The lower carbon, *A*, is continually pressed upward by the action of a weight, *a*, and restrained by a clamp, *c*, which loosens as the carbon consumes. The upper carbon is, by the release of a wheel, *f*, allowed to descend as it wastes, and the tube carrying the upper carbon is kept floating in balance by the action of the solenoid *E* on its core *P′*, automatically adjusting the distance of the carbon points to suit the voltaic arc.

The *Skinner & Thomas* arc electric light, Fig. 930, Plate XIII., employs (preferably) for the negative electrode an iridium-tipped rod *G*, which is practically indestructible, and secures the immobility of the point of light; the problem of automatic adjustment is thus restricted to the positive electrode *H*, which is of carbon. The maintenance of the predetermined arc-interval until the complete consumption of the positive is obtained by the following means: —

The positive wire *P* from the generator connects with a helix *F* of insulated wire around the non-magnetic bobbin *A*, consisting of a thin, longitudinally split brass tube, the ends of which are respectively secured in collars *B, C*, of vulcanite. This helix *E*, constituting the terminus of the positive wire, has an axial extension of twice the length of the carbon rod. From the collar *C* depends the loop *F*, bearing the erect negative *G*, of copper tipped with iridium. Inside the hollow bobbin *A*, is a loosely-fitting soft iron armature, or *suction-core K*, the brass stem of which, *J*, terminates in the clamp of the positive electrode — the carbon *H*. The weight of the core and its adjuncts is nearly balanced by the counterpoise chains and weight-cups of shot, and the diminution of the weight of the consuming carbon is equipoised by the passing over of the chains from the outside to the inside of the helix. To a cross-bar *O*, on the carbon stem *J*, are fastened two erect brass rods, *R, R*, on the upper ends of which are two wheels, *Q, Q*, which press lightly against opposite sides of the helix *E*, on lines left naked by the removal of the insulating material, establishing electrical connection. One side of the pendant *F* communicates by wires *N′ N″* with the negative rheophore.

The action is as follows: —

The shunt wheels *Q Q′*, having, with their supporting frame *O R R′*, been, by means of set-screw *j*, fixed at their proper height relatively to the core *K*. and the counterpoise *M* having been so loaded as to diminish the virtual weight of core and adjuncts to that which just insures their descent at any relaxation of the coil-magnetism, connection of the wires *P N*, with the generator, causes the current to flow as indicated by the arrows, and thus to impart magnetic properties to the helix *E*, which, in turn, results in elevating the core and its attached electrode *H*, so as to create an arc-interval.

Disintegration of the carbon tip increases the arc-interval and consequent tension and decrease of current, with corresponding reduction of coil-magnetism. This permits the

Fig. 925. *Brush Electric Light.*

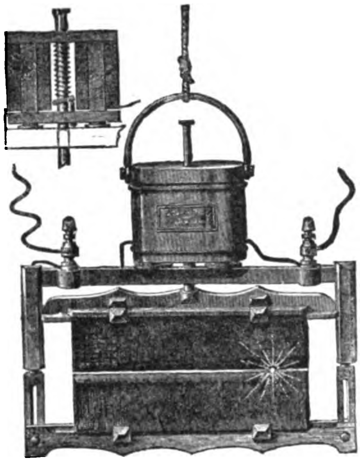

Fig. 932. *Wallace-Farmer Arc Electric Light*

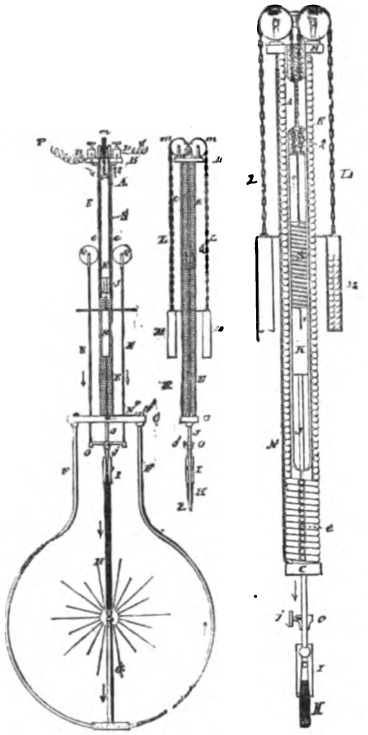

Fig. 930. *Skinner & Thomas Arc Electric Light.*

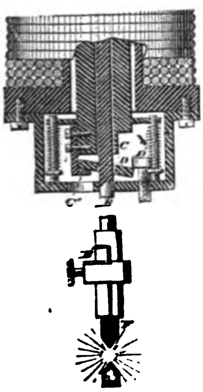

Fig. 926. *Brush Carbon Regulator.*

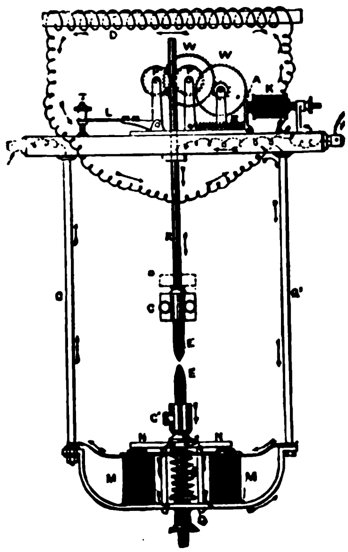

Fig 931. *Thomson & Houston Arc Light*

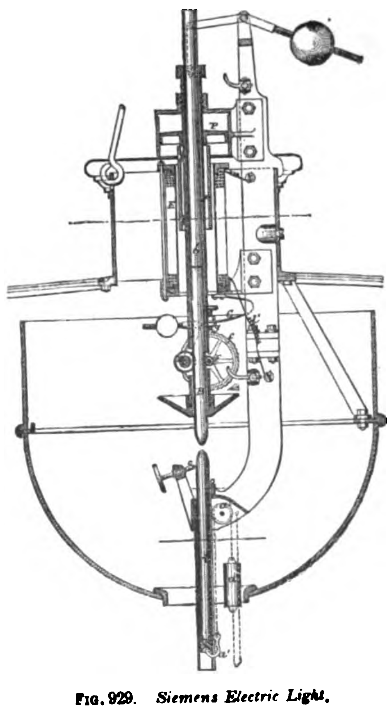

Fig. 929. *Siemens Electric Light.*

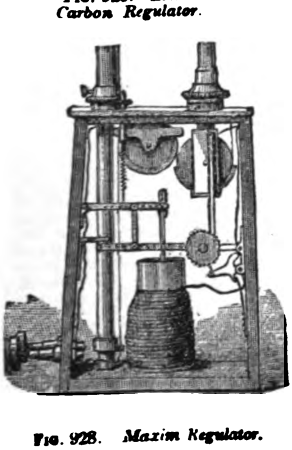

Fig. 928. *Maxim Regulator.*

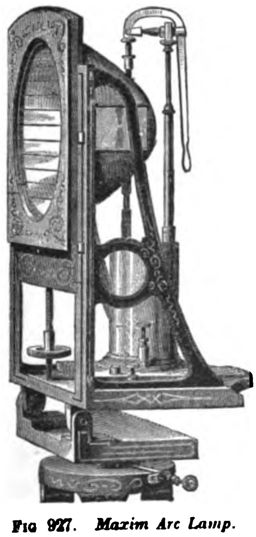

Fig 927. *Maxim Arc Lamp.*

 See pages 298, 299.

weight of the positive element to prevail over the upward drag of the coil-suction until the two opposing forces, gravity and magnetism, being restored to equilibrium, the normal arc-interval is reëstablished. These movements are so prompt and delicate that a sensibly uniform light is obtained.

The right-hand portion of Fig. 930, Plate XIII., shows the device for the equalization of arc electric lamps in series, and is termed the "*differential*."

It is well known that no two arc electric lamps, employed in series, behave precisely alike. In one lamp the magnetic lift, incident to increased current-flow, takes place more promptly, and with greater facility, with a consequently greater arc-interval than in the others. Such disproportionate increase of arc-interval in one lamp necessarily weakens the current throughout the series, and thus detracts from the lifting power of all, but most so from those of the most sluggish movement. The heavier working lamps, thus dwindling in illuminative action, cease, one by one, to respond to the continually waning magnetic energy. In strong contrast with and at the expense of this enfeebled action of the weaker lamps, the arc of the most susceptible or easiest working lamp continues to expand until it practically monopolizes the effective activity of the entire circuit.

The remedy for such unequal action lies in a provision whereby — when the arc-resistance of any given lamp becomes higher than normal — the current is automatically diverted from the arc of that lamp to the next lamp of the series — or to "line" or generator, as the case may be, — to sufficiently reduce or counteract the "helix-suction" of the lamp thus regulated, to restore its arc-interval to normal length, and at the same time, by diminution of its arc-resistance, to secure resumption of normal current-flow throughout the series.

Skinner & Thomas's device for this purpose is shown in the right-hand portion of Fig. 930, Plate XIII. On the core *K* is wound a helix *S* of fine wire, which communicates from a point in the positive element (above the electrode) directly with the negative rheophore *N*, so as to shunt the arc. The portion *Q* of the differential wire, which communicates from the differential helix to the rheophore *N*, is convoluted so as to permit the free descent and ascent of the core.

By the expression "differential" is meant that the said helix *S* is so wound as to induce on the core magnetism of opposite polarity to that induced by the main helix, whose magnetism (when a current is passing through the differential), being thus more or less neutralized, operates with diminished suction so as to permit the descent of the electrode until the normal arc-interval is resumed. The prime and the differential coil-magnetisms consequently preponderate alternately at each respective change of arc-interval above and below the normal one.

Proper adjustment of the parts is had when the resistance of the differential is such that, in the normal condition of the arc, the magnetism induced in the core by the prime helix minus the counter-magnetism induced in the core by the differential helix just balances the surplus weight of core and adjuncts over that of the counter-balance.

By aid of this system of regulation a current can be almost indefinitely divided and the double benefit be secured of preventing excessive activity of any individual lamp, and of insuring to each lamp in the series its proper share of illuminative action. See also REGULATOR, *infra*.

The *Thomson-Houston*, Fig. 931, Plate XIII., is an arc lamp, and the invention particularly concerns the regulator.

The carbons are fed by mechanical means controlled by electro-magnetic detent in a shunt of the main circuit. One of the carbon electrodes is attached to the armature of an electro-magnet, and, on the passage of an electric current, said armature is attracted to said electro-magnet, and then held in a fixed position in respect thereto, thus effecting separation of the electrodes. The motion of the other electrode is under the control of a separate electro-magnet, whose coils are in a shunt-circuit around the arc between the electrodes. When the distance between the electrodes is increased by their consumption, the shunted current operates an escapement, which allows the slow approach of the electrode. Said approach ceases when the distance between the electrodes has reached the normal. This cessation of feeding occurs when the escapement above referred to is thrown out of action from the weakening of the current in the shunt-magnet. These actions are independent of considerable variations in the current strength.

In the *Rapieff* light the voltaic arc is produced between four carbon rods arranged in pairs, each forming the letter V. The apices of the V's meet in a common center. A regulator is attached which keeps the carbons at an invariable distance. One of the carbons at a time can be detached without interrupting the current.

In the *Wallace* lamp the light is produced between the edges of two carbon plates, which last 100 hours. The edges gradually consume, and the light flies to the point where the plates are nearest in contact.

The lamps of *Wright*, 1845, *Molt*, *Lontin*, and *Reynier* embrace the plate, disk, or roller principle.

The *Wallace-Farmer* electric light is shown in Fig. 932, Plate XIII.

Like the one just mentioned, the frame carries two gas carbons, forming the electric wick. These slats are 9″ × 3″, the positive (upper) ½″ thick and the negative (lower) ¼″ thick. The lower is fixed, the upper adjustable. In the absence of current the upper rests on the lower; but as soon as a current passes, the armature by which it is suspended is raised in the coil, and separates the carbons ⅛″. The electro-magnet is contained in the box, and the sectional view shows clearly its construction. The arc chooses the nearest points of the carbon edges and gradually wears them away, the electro-magnet being adjusted to keep an equal distance between the nearest points of the carbons at any one time.

The *Reynier* lamp has assumed two forms, *arc* and *incandescent* respectively: the former has two carbon disks revolving in planes inclined to each other, so that the edges approach and a voltaic arc spans the interval.

The *Jamin* electric light is an arc. It has at least two nearly parallel carbons and in some cases not less than three groups of two each; one member in each case is adjustable towards its fellow. The candle has thus two vertical rods which differ from the Jablochkoff in that there is no insulating material between them. They are erected or suspended in sockets, one of which is pivoted so that a small electro-magnet controlling it can maintain automatically the proper distance between the two ends. Fig. 933, Plate XIV.

The carbon pencils are surrounded with an elliptical coil of wire, through which passes the current that gives the light. The coil is in the same vertical plane as the carbon rods. A more elaborate arrangement is shown in "*Plumber & Sanitary Engineer*," * iii. 400.

The *Weston* is an arc light, having two erect nearly parallel carbon rods, the positive twice the bulk of the negative. They are supported in sockets, the negative being pivoted so that its upper end can be adjusted towards and from the positive, towards which it is inclined by a spring. As soon as electric connection is made, the armature of an electro-magnet withdraws the movable carbon from contact and the voltaic arc is established.

Jablochkoff's invention is an electric candle; his object is the "absolute suppression of any mechanical regulator." Instead of automatically feeding them towards each other he fixes them parallel at a short distance from each other and separates them by an isolating substance which is consumed at the same time with the carbons. Fig. 934, Plate XIV.

The separating substance is an earthy infusible powder put around the carbons in a closed envelope of asbestos. The electric stream gradually dissipates the intractable substance, clearing it away from the carbons and exposing them, somewhat as the wick of a candle is exposed by the burning away of the tallow.

a b are the carbons, *e* the asbestos case, *d f* metallic sheath, *h j* jaws, *k* tightening screw, *p n* terminals.

The *Lontin* lamp and the *Reynier* keep a slender rod of carbon in contact with a slowly revolving wheel, touching it on the outer rim and keeping a certain length of the rod incandescent.

The *Reynier* lamp, Fig. 935, Plate XIV., has a slender pencil of carbon, *c*, which is traversed through a portion of its length by the current (from *l* to *B*), and is impelled axially against a revolving contact which carries off the ashes of the carbon. The portion of the pencil between the upper contact *l* and the lower revolving contact *B* becomes incandescent, and burns, tapering away towards the end, the rod being continually fed forward.

Kosloff's (1875) is an incandescent light, the current passing through sticks of carbon in a globe filled with nitrogen gas, the carbon is mounted on an inserted metallic conductor and placed between two insulating supports of porcelain, clay, or other material. The carbons are in a globe, hermetically sealed, filled with nitrogen gas.

In the *Sawyer* electric lamp the feeding of the carbon pencil to the contact piece is effected by a spring and cord running over pulleys. The pencil of carbon is heated to incandescence in a hermetically sealed glass globe filled with nitrogen gas or exhausted of air. The summit of the upper carbon is pressed between grooved rollers. The base of the lamp-globe is imbedded in a cup having an annular space, and the base of the lamp is in two sections, for facilitating the renewal of the carbon. Fig. 936, Plate XIV.

The *Sawyer-Man* is an incandescent lamp. The incandescent strip is automatically fed through one conductor and against another, the part between the two conductors giving a light. The two conductors are supported by spiral standards, the length and extent of surface serving to dissipate the heat and thus preserve the insulation. The whole is incased in a glass globe filled with nitrogen. Fig. 937, Plate XIV.

Edison's carbon-arc lamp is an incandescent lamp. The arc *F* is attached by clamps *G G′* to the platinum wires *W*, which are sealed in the summit of the interior glass dome. At a lower point is an enlargement E E' upon which sits the lower end of the tube, the upper portion of which is the device A around the incandescent arc. The patent No. 230,255 particularly concerns the mode of sealing the wires in the foot, and the mode of exhausting and sealing the dome, to secure entire freedom from oxygen in the interior. B is the pillar of the lamp and D D' binding posts for the wires. Fig. 938, Plate XIV.

In one form of the carbon arc lamp the carbons are of slips of paper or cardboard cut to horse-shoe shape and charred, then mounted by platinum clamps on the sealed wires.

One of *Edison's* regulators is an automatic shunt fitted to the lamp, by which a portion of the current is diverted from the circuit of the light producing portion of the apparatus whenever its temperature approaches an injurious limit.

Edison's expansion, pneumatic, and vibratory regulators are described, illustrated, and compared in an article by F. R. Upton, in "*Scribner's Monthly*," vol. xix., pp. 531-544.

In another of *Edison's* electric regulators he makes use of a coil of wire with a pyro-insulating material between the coils, and a surrounding case rendered incandescent by the heat of the coil. In the same lamp, which is adapted to be used in multiple arc, a thermal circuit is arranged so that the amount of light can be varied at pleasure by an adjusting-screw that regulates the point at which the thermal regulator acts to open the electric circuit and lessen the current, so that the incandescent case can be more or less luminous. The claim for a thermostatic regulator is, however, held by *Maxim* in his patent, No. 247,380, Sept. 20, 1881.

Edison's safety device, for preventing an abnormal flow of current through any branch, consists of a piece of very small conductor interposed in the main conductors of a house or in the derived circuit of a lamp. It is preferably interposed between the line wires and every lamp, limiting to the latter the amount of current designed for it.

Farmer's is an incandescent lamp, the globe of which contains a vacuum, or an artificial atmosphere — say nitrogen. From the stopper of the globe rise two uprights, between which is held a removable carbon slip, which, upon passage of the current, becomes incandescent. Fig. 939, Plate XIV.

The *Maxim* is an incandescent lamp, the light being produced by a strip or conductor of low conductivity, forming a part of the electric circuit. Fig. 940, Plate XIV.

The illumination takes place in a glass chamber deprived of oxygen, but instead of excluding the air by exhaustion, or filling the globe with nitrogen, the air is displaced with a hydro-carbon, preferably gasoline, and such liquid then expelled by heat, so as to leave in the globe a hydrocarbon partial vacuum, or a highly-attenuated atmosphere of hydrocarbon vapor surrounding the conductor or light-giving part of the lamp. The continuous incandescent conductor is mounted upon electrical connections of platinum.

Edison's carbon coil lamp is an incandescent; a filament of carbon either in arc or coil shape, that is, of "carbon wire or sheets coiled or arranged in such manner as to offer great resistance to the passage of the electric current, and at the same time present but a slight surface from which radiation may take place."

The electricity is conducted into the vacuum bulb through platinum wires sealed in the glass.

In Fig. 941, Plate XIV., a represents a carbon coil attached to platinum conductors d d' by a plastic composition of lamp-black and tar. c c', h are clamps.

Khotinsky (French patent, No. 107,307, of March 19, 1875) shows an incandescent carbon lamp, having in its base resistance coils and a switch whereby the current can be passed wholly through the carbon or wholly through a resistance equal to the resistance of the carbon, or if a partial light is desired, then partly through the carbon and partly through a resistance, the arrangement being such that the total resistance is always equal to a certain amount. The current is shifted automatically to another carbon in same lamp when one breaks.

The *Werdermann* lamp has a vertical rod of carbon which impinges at its upper end upon a disk of carbon, Fig. 942, Plate XIV. The upper end of the rod becomes incandescent, and a voltaic arc is also formed.

The upper part only of the carbon rod is in the circuit, and the length of this portion can be increased or diminished by shifting the collar which transmits the current. The rod is kept pressed against the disk by a cord and weight, and consumes very slowly. The disk is negative; 2″ in diameter, 1″ thick, encircled by a band of copper, which is prolonged to a terminal. The positive carbon is a round pencil 3 mm. in diameter, and slides in a tube.

"Dr. Tyndall and Mr. Douglass, chief engineer to the Trinity Board, in reporting lately to the Elder Brethren upon the power of these machines and their applicability to light-houses, give a table showing that a machine weighing not more than 3 cwt. is capable of producing a light equal to 1250-candle power per horse-power expenditure of mechanical energy. Assuming that each horse-power is maintained with an expenditure of 3 lbs. of coal per hour (which is an excessive estimate), it would appear that 1 lb. of coal suffices to maintain a light equal to 417½ normal candles for one hour. The same amount of light would be produced by 139 cubic feet of gas of 18-candle power, for the production of which 30 lbs. of coal are consumed. Assuming that of this quantity, after heating the retorts, etc., 50 per cent. is returned in the form of gas-coke, there remains a net expenditure of 15 lbs. of coal in the case of gas-lighting to produce the effect of 1 lb. of fuel expended in electric lighting, or a ratio of 15 to 1 in favor of the latter. Add to the advantages of cheapness in maintenance, and of a reduced capital expenditure in favor of the electric light, those of its great superiority in quality and its freedom from the deleterious effects of gas in heating and polluting the atmosphere in which it burns, and it seems not improbable that it will supersede before long its competitor in many of its applications." — *Dr. C. W. Siemens*, Address, January 23, 1878.

The annual report of the United States Light-house Board contains the details of some recent tests with electric lamps, made at the Stevens Institute of Technology by Prof. Morton. The results of these experiments are embodied in the following table, in which the term hand-lamp is employed to signify that the distance between the carbons was regulated by hand: —

Machine.	Lamp.	Average Candle Power.	Average Horse Power.	Average Candle Power per Horse Power.
Maxim (ordinary type)	Maxim	3,297	5.483	729
Maxim	Hand lamp	3,930	5.585	704
Siemens	Siemens	4,651	4.863	956
Siemens	Siemens	4,548	4.742	959
Weston	Hand lamp	8,585	4.769	1,800
Weston	Maxim	7,787	4.683	1,663
Weston	Siemens	7,262	5.056	1,436
Weston	Weston	6,063	4.552	1,332
Maxim (with magnets of low resistance)	Maxim	7,524	7.400	1,017
Brush	Brush	4,365	2.8467	1,533
Brush	Siemens	3,532	2.9573	1,194

The results of the attempts at the "Division of the Electric Light," may be divided into four classes, *series*, *multiple arc*, *multiple series*, and the *commutator system*

The *series* system, *i. e.*, with the lamps all arranged in succession in one unbranched circuit, was the first one employed, and is still found to be the best when arc lamps are used.

In the *multiple arc* system the conductor is divided into numerous branches, in each of which is placed one lamp. Two main conductors are run out from the generator and divided and sub-divided while still remaining in pairs, and at various points the lamps are connected so as to bridge the said pair. A ground return is sometimes substituted for one of the conductors. The first mention of multiple arc lighting appears in du Moncel's "*Exposé des Applications de l'Électricité*," Paris, 1857. It has the advantage over the series system, that the extinguishment or breakage of one lamp does not materially affect the others, but as all the lamps are in parallel branches the total external resistance is exceedingly small, and for this reason the system is more particularly adapted for incandescent lamps which are made of such high resistances as 100 and 200 ohms on that account.

The *multiple series* system is a combination of the first and second. The circuit is divided as in the multiple arc, but more than one lamp is placed in each branch, so that the resistance may be made such as desired. This system seems to have been first described in a patent to Sawyer and Man, 205,303. June 25, 1878. *Brush* (patent, No. 261,077, July 11, 1882) shows and claims a multiple series system, in which the different branches are connected by cross connections between the lights in such a manner that the breaking of circuit at one lamp will have no appreciable effect on any of the other lamps in the system.

In the fourth system a *commutator* is employed which so divides the current among different branch conductors each having one or more lamps, that each lamp is traversed by the current for a small fraction of a second. By means of a sufficiently rapid commutator the impulses to each light follow each other in such quick succession as to give the effect of a continuous light.

Secondary batteries were described by Jablochoff in his French patent of 1876, as in a branch or shunt around each light. Fox, in his English patent of 1878, shows a network of conductors between which and the ground return are connected up in multiple arc incandescent lamps and secondary batteries.

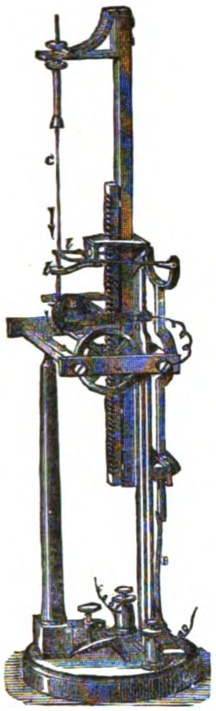

FIG. 935. *Reynier Incandescent Electric Light.*

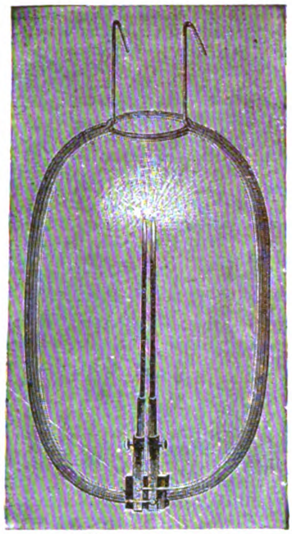

FIG. 933. *Jamin Arc Lamp.*

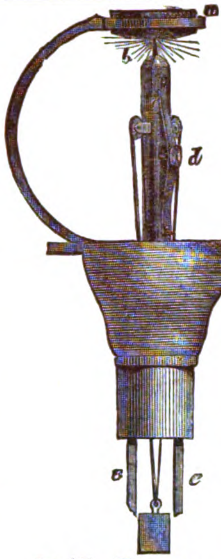

FIG. 942. *Werderman Electric Light.*

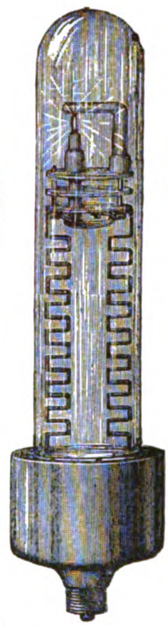

FIG. 397. *Sawyer-Man Incandescent Electric Lamp.*

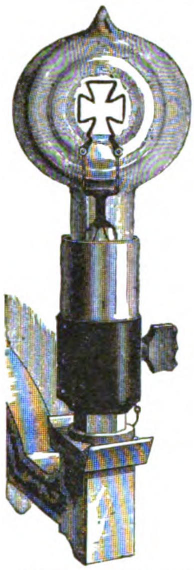

FIG. 940. *Maxim Lamp.*

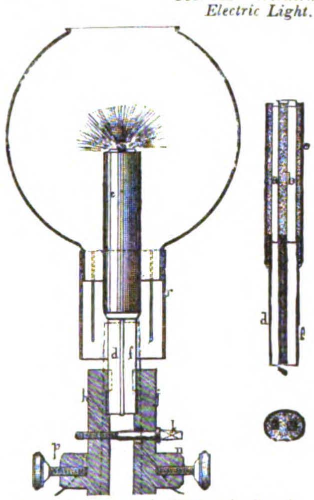

FIG. 934. *Jablochkoff Electric Candle.*

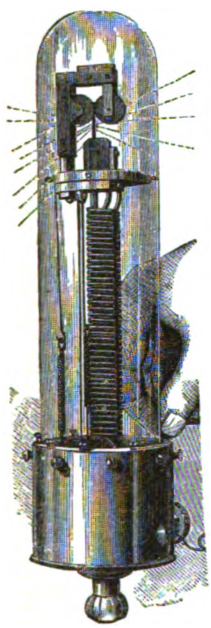

FIG. 936. *Sawyer Electric Light.*

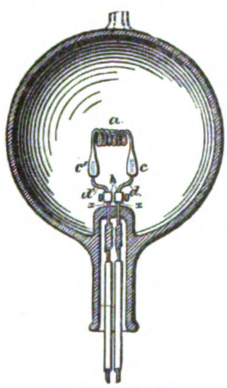

FIG. 941. *Edison Carbon-coil Lamp.*

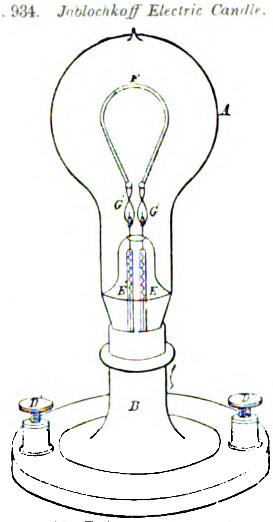

FIG. 938. *Edison Carbon-arc Lamp.*

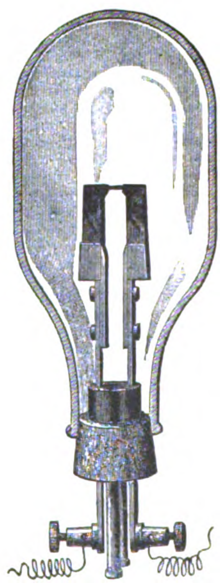

FIG. 939. *Farmer Electric Lamp.*

ELECTRIC CANDLES AND INCANDESCENT LAMPS.

See pages 299, 300.

E-lec'tric Light. Notices of the various Electric Lights in the technical journals of the period, 1876–1880 inclusive, may be found as follows: —

Abney, Capt. W. de W. paper by "Scientific Am. Sup.," 2087.
Adams, W. G., paper by — "Jour. Frank. Ins.," Oct. '81.
Andre-Brougham — * "Scientific Amer.," xlii. 245. * "La Lumière Electr.," ii. 175.
Andrews — * "La Lumière Electr.," v. 69.
Archereau (1849) — * "Engineer," xliv. 365. * "Scientific Am. Sup.," 2575. * "App. de l'Électricité," v. 477.
Atlas Co., steam engine for — * "Telegraphic Jour.," vii. 189.
Baillache — "App. de l'Électricité," v. 511.
Barker, paper by — "Technologiste," xli. 86.
Bergot — * "La Lumière Electr.," iv. 294.
Berlin, at — "Technologiste," xlii. 201.
Blooker, railroad cars — "Technologiste," xli. 440, 401.
Bolton, Col., historical notes * "Jour. Soc. Tel. Eng.," viii. 213–281.
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E-lec'tric Light Meter. An invention of Edison for measuring the quantity of electric current passing to a light or to a house. A part of the system of divisional current arrangement for public lighting.

The current goes from line by the house-wire to the apparatus, passing through two contacting platinum points and thence to a magnet. The device is to cut a house out of the circuit if too great a flow of electricity should occur. In the latter case the magnet will draw down a lever and sever the contact of the platinum points, thereby breaking the circuit.

E-lec'tric Light Reg'u-la'tor. An apparatus or device: —

1. To determine the amount of current passing to the electric lamp.
2. To adjust the carbons of the arc light so that they shall preserve their exact relative distance.

Of these there are two orders: —

a. The *monophote*, or *one-light* regulator.
b. The *polyphote, many light*, or *division* regulator.

The *polyphote* has three classes: —

a. Differential.
b. Derivation.
c. Fixed interval, or regulator *à écart fixe.*

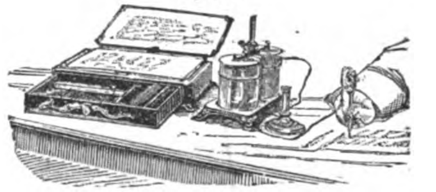
The *Serrin*,* *Mersanne*,* *Jablochkoff*, *Lontin*, *Rapieff* regulators are described on pp. 362–365, "*Engineering,*" xxvi., in a paper read by Mr. Shoolhed before the British Association at the Dublin meeting, 1878.

See also list under ELECTRIC LIGHT. Many of the objects there cited are *regulators*, as upon that feature of the apparatus more ingenuity has perhaps been expended than on other — excepting *generators.*

E-lec'tric Meas'ure-ment Ap'pa-ra'tus. An apparatus consisting of a box of graduated or cumulative resistances, and a galvanometer for determining the electro-motive force, resistance and strength of batteries, and resistance of conductors: for locating faults, breaks, and crosses on telegraph lines or cables; for measuring the amount of any metal deposited in a given time in electro-plating; and for determining the specific conductivity of metals.

E-lec'tric Pen. The electric pen consists of a small electro-magnetic engine, mounted upon the top of a tube pointed at the end. Within the tube is a needle to which is given an exceedingly rapid vertical motion by cams upon the rotating engine-

Fig. 943.



Edison's Electric Pen.

shaft. This needle is projected from the small end of the tube at the rate of 50 times per second. If the pen be held in writing position upon a sheet of writing paper placed on some soft substance, a letter may be written as fast as with an ordinary pen, but the characters, unlike the ink mark formed by the ordinary pen, will be composed of innumerable holes punctured in the paper by the rapid projection of the needle from the tube. The result is a perforated paper, which, treated as an ordinary stencil, will give similar result. The motive power used to drive the engine of the pen is derived from a voltaic battery of two Bunsen cells, shown in Fig. 943.

See references: —

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E-lec'tric Pho-tom'e-ter. Goodwin's electric photometer extinguishes candle and gas, and stops meter and clock by electricity.

"*American Gas-light Journal*" . * July 3, 1876, p. 5.

E-lec'tric Plow. A substitution of a dynamo-electric machine for the steam traction-engine, for the purpose of working the plows. The same arrangement of plow, rope, and installation is used (see STEAM PLOW, "*Mech. Dict.*"), but the power is conveyed to the winding drum on the head-lands of the field by wire from the central station where the engine, boiler, and current generator are situated.

The apparatus was invented by Chrétien & Félix, of Sermaize (Marne), France. The Gramme machine is used.

* "*Revue Industrielle.*"
* "*Engineer*" . . . . xlvii. 434.
* "*Scientific American*" . . . . July 17, 1879

E-lec'tric Rail'way. The car travels on insulated rails which form a part of the circuit, and the current works the dynamo machine on the car to rotate the wheels.

Siemens' electric railway at Berlin, between the suburbs Lichtenfeld and the Cadettenhaus, is one and a half miles long with a gage of 3', the rails of the ordinary pattern. A single car is propelled at 9 miles per hour, but might travel much faster; the car holds 20 persons; the dynamo machine is under the car; one rail positive and the other negative. The dynamo machine transmits its movement to the wheels by spiral steel springs. In addition to the ordinary brakes, means are provided to short circuit the machines on the carriages and to cause them to act as powerful brakes. Large stationary engines are used.

In the earlier experiments a central rail brought the current from the generator, the current returning by the outer rails. A copper brush on the car collected the current from the central rail. Several forms have been assumed from time to time. See references, *infra*.

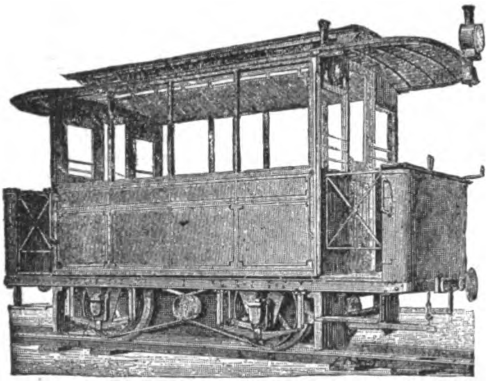
Chutter's engine, "*English Mechanic*," has also the feature of the positive and negative rails.

"*Scientific American Supplement*" . . . . . * 301.

The attention directed to the matter has unearthed a number of old devices. The *Lilly & Colton* electric locomotive described in the "*Scientific American*" for Sept. 25, 1847; *Bone's* French patent, 1848.

The *Edison* railway has a current conveyed to the track by two copper wires, one for each rail. The armature of the locomotive makes 4 revolutions for one of the wheel.

Fig. 944.



Gross-Lichterfelde Electric Railway Car.

There are six systems of electric traction at present in use, or being experimented with, namely : —

1. The small traction machine of Siemens with an isolated center rail, which was worked at the Berlin and Brussels Exhibitions.
2. A self-moving carriage on isolated rail and elevated road. This is an idea of Siemens, which has been temporarily abandoned.
3. The Gross-Lichterfelde Railway. An auto-mobile car with isolated rails, running since May 16, 1881.
4. The tramway shown at Electric Exposition in Paris, 1881. Auto-mobile car, with road on ground level, and conductor suspended above the way.
5. Electric tramway with accumulators. System of Philippart, Faure, and Reynier, Auto-mobile car having in it its own electric store.
6. The tricycle built by M. Trouvé. It is worked by the secondary piles of Gaston Planté, and by a Siemens' coil motor with Trouvé's improvement

Car, *Siemens*	* "*Engineering*," xxix. 487.
Locomotive, *Chutter* . .	* "*Scientific American Sup.*," 301.
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	* "*Sc. American*," xlii. 354, 368.

E-lec'tric Reg'is-ter. An automatically recording apparatus in which electricity is the moving agent.

The applications are very numerous, and a number are stated in the list following.

Cooley's electric register for rapid vibrations is an electro-chemical instrument in which the vibrating body closes an electric circuit at each vibration and makes an autographic record on a traveling band of prepared paper, through which the current is caused to pass. The number of dots within a given length of the paper, which travels at a calculated speed, indicates with great delicacy the number of vibrations in a given time. — * "*Scientific American Sup.*," 1563.

Various forms of electric registers are to be found in *Comte du Moncel's* "*Exposé des Applications de l'Électricité*," tome iv., Paris, 3d edition, at the pages here noted : —

		Page.	Figure.	Plate.
Anemographs, History of		303		
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	* *Van Baumhauer*	420		
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Udometrograph . .	* *Salleron* . . .	362	72	
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See also in lists, GRAPH, METER, SCOPE in "*Mech. Dict.*," and list under MEASURING, ETC., INSTRUMENTS, *infra*.

E-lec'tric Ro-ta'tor. An instrument operating through electrical devices to demonstrate the earth's rotation.

Fouville & Lontin .	* "*Scientific American*," xliii. 52.
	* "*Sc. American*," xxxix. 1, 37, 100.

See also GYROSCOPE, p. 1045, "*Mech. Dict.*," and references to Foucault's Pendulum, pp. 1045 and 1662, *ibid*.

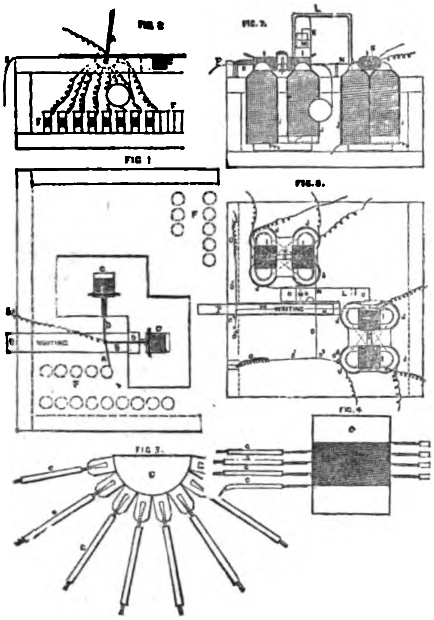
E-lec'tric Switch. A device for turning on the current to lights, etc., which gradually changes the current from an outside path to a path through the light by cutting out successively resistances in the lamp circuit and simultaneously cutting in resistances in the by-path circuit.

E-lec'tric Writ'ing Ap'pa-ra'tus. The autographic telegraph of *Caselli* is described on p. 191, "*Mech. Dict.*," and the Meyer apparatus, * p. 56, *supra*. Sawyer's and d'Arlincourt's, are also referred to on the last-mentioned page. Bonelli's facsimile telegraph is mentioned on p. 784, "*Mech. Dict.*" See also FACSIMILE TELEGRAPH; PANTELEGRAPH, *infra*.

Fig. 945 shows several views of Cowper's apparatus. Fig. 1 in the cut represents the sending instrument in plan, and 2 is an elevation of the same. The writer holds the pen, which is rigidly connected to the traveling contacts, and also to the batteries. The slip of paper on which the message is written moves under the pen instead of the pen traveling over the paper.

"Two sets of thin metallic plates, C C, form the contact apparatus; D D are the light connecting rods, the ends of which make contact with the plates; F F are the resistance coils connected to the contact plates, one coil for each plate, except the first of the series, which is connected direct to line. It will be noticed that the strength of the current entering the line depends upon the plate with which contact is made by the connecting rod. As the rod travels from the first of the series the resistance increases, the current having to pass through N — 1 resistance coils, as well as the line wire, N being the number of plates from the first of the series to the point at which contact is made. Generally, however, as one contact piece travels from the first of the series, the other travels towards the first of its series, and thus, while the current decreasingly varies in one line, the varia-

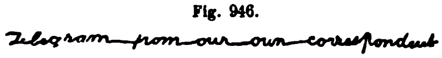
Fig. 945.



Cowper's Electric Writing Apparatus.

tion is increasing in the other. A slight knowledge of co-ordinate geometry will enable the student to plot the curve of any letter, and to calculate the variations in the strengths of the currents. Figs. 3 and 4 show respectively an eleva-

Fig. 946.



Written Message by Cowper's Instrument.

tion and plan of the thin metal plates, which are insulated the one from the other by paper soaked in paraffine. The receiving instrument, shown in plan and elevation in Figs. 5 and 6, differs from the sending instrument; H H are light soft iron bars on delicate bearings, having the ends surrounded by the coils I I, to which the bars form a movable core. Through these coils the varying currents of the line are sent, which, of course, have a varying action on the core. J J J J are four permanent or electro-magnets, between the poles of which the coils just named are placed. K is a syphon pen. The pen is adjustable from the bridge L, and the ink reservoir is shown at M. The light connecting rods N N transmit the motions of the movable cores to the pen; O O are springs to enable the pen to resist the pull of the magnets, the connections are shown in O^1 O^2 O^3, the latter being attached to a fixed post O^4

"The currents sent through the line wire by the sending instrument vary in strength or power, and cause the light bar of soft iron to move with varying power by its attraction to the stationary magnets; and in order to cause it to take its proper position according to each variation in power, a varying resistance is opposed to it, such as a spring which requires more power to compress it the more it is compressed, that the action of the soft iron bar, combined with that of a precisely similar bar actuated by the second line wire, will cause the position of the pen in the receiving instrument to follow the position of the pen in the hand of the operator at the sending instrument, and thus form the letters. The total strength of the spring or varying resistance can be regulated at will, so that the letters formed by the pen shall be of the same proportionate height and width as the letters written by the operator at the sending instrument. One convenient way of applying the varying resistance to the light bar of soft iron is by placing a very light spring to pull at the end of the bar in the direction of its length, but allowing of the motion of the bar which will thus cause the spring to act with more and more leverage as it moves more out of line with the spring. When so arranged there is required another spring to keep the connection with the pen tight, if such connection is flexible, so that the pen may go backwards as well as forwards over the paper, as the light bar of soft iron moves either one way or the other. But the spring or variable resistance may be made to act both to give the increasing resistance and the power to draw back the pen as well, if the spring is made to pull by a flexible or jointed connection at a fixed point, the line of such pull being parallel, or nearly so, to the light bar of soft iron, while another rigid or flexible connection from the end of the bar to the connection to the spring has the pen attached to it at about the middle of its length, which arrangement will give the same result as the two springs before described." — "*Engineering*."

E-lec'tro Bal-lis'ta. An apparatus for measuring the rapidity of flight of a shot. See BALLISTA. Electro-ballistic pendulum, "*Mech. Dict.*"

In *Boulengé's* apparatus the shot is made to break through two wire screens. The screen is a framework with fine wires, which are cut by the shot. One screen is near the muzzle of the gun, and the other at 100' distance. The screens are in connection with electro-magnets in the instrument house. While the wires in front of the screen are perfect, an electric current passes without interruption, and the electro-magnets suspend two rods of iron. When the shot is fired, No. 1 screen is torn, and the rod suspended to No. 1 magnet drops; an instant afterward, when the shot has reached No 2 screen, No 2 magnet detaches the second rod. The time between the falling of the two rods is so small, that ere the first has fallen half its length the second has dropped upon a trigger, which strikes the side of No. 1 rod. The latter is examined for the mark of the trigger, and the measure of this mark from the end, giving the distance traversed by the first detached rod, the rate being known, furnishes a figure which has only to be compared with a prepared scale in order to read off the number of feet per second at which the shot moved.

E-lec'tro-bronz'ing. A process for putting on iron a durable electro-bronze finish, resembling real bronze.

The articles to be bronzed are first put in a bath of paraffine, which stops further oxidation; they are then coated with a metallic substance and subjected to the electro-bronzing bath, after which they are treated with a peculiar protecting varnish, and are then ready for use.

E-lec'tro-cap'il-la-ry Mo'tor. A philosophic toy by M. Lippmann, founded upon the effect produced upon the capillary constant of mercury when an electric contact is made therewith.

In a glass tank filled with diluted sulphuric acid are two small cylinders containing mercury. A bundle of capillary tubes, open at both ends, is placed in each cylinder, resting on the mercury, each bundle being connected above with one end of a walking beam, to the prolongation of which is attached a connecting rod, crank, and fly-wheel. By means of a commutator on the axis of the fly-wheel the mercury in each cylinder is alternately connected with a small battery; its capillary constant is changed, its ascent in the tubes increased, that side preponderates, and causes semi-rotation of the fly-wheel. This sends the current to the other cylinder, which, acting similarly, completes the rotation.

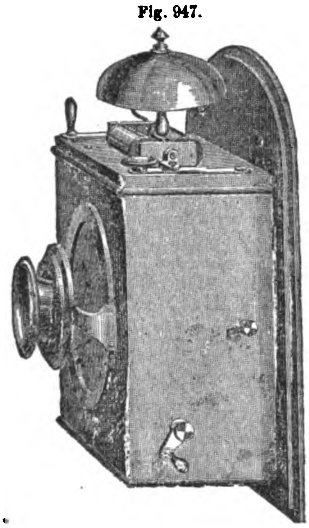
E-lec'tro-cau'te-ry. (*Electricity.*) See CAUTERY INSTRUMENT.

E-lec'tro-chem'i-cal Tel'e-phone. A telephonic receiver by Edison, in principle similar to the electro-motograph, which see.

If a strip of bibulous paper, slightly moistened with a weak solution of potassium hydrate, be laid upon a strip of metal, which by means of a key or contact maker can be connected to one pole of a voltaic battery, and a metallic strip, tipped with platinum, and connected to the other pole of the battery, be gently drawn over the surface of the paper, it will encounter a resistance, the amount of which, all other things being equal, will be determined by the coefficient of friction between the platinum-tipped spring and the surface of the moistened paper. The instant, however, that the circuit is closed by depressing the key, the friction between the two surfaces is reduced, and assuming a uniform tractive force to be exerted upon the strip, it will be found to slip over the surface of the paper every time that the key is depressed; and if the key be moved up and down, a series of pulsations or minute jerks will be felt by a person holding the strip, which pulsations are isochronous with the movements of the key.

The instrument shown in Figs 947-950 consists of a diaphragm which is set into vibration by the variations of friction taking place between a metallic strip and a chemically prepared rotating cylinder under variations of the strength of an electric current passing at the point of contact of the metallic strip and the cylinder. The diagram, Fig. 949, shows the disposition of the principal parts of the

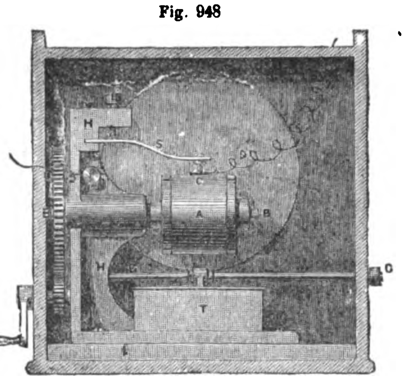
Fig. 947.



Electro-chemical Telephone.

apparatus. *A* is a cylinder composed of chalk and potassium hydrate with a small quantity of mercury acetate molded round a flanged roller or reel of brass which is lined with platinum on those surfaces which are in contact with the mixture, which is kept in a moistened condition Upon the upper circumference of the cylinder, which is caused to re-

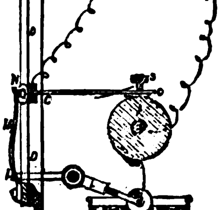
Fig. 948



Electro-chemical Telephone. (Vertical Section.)

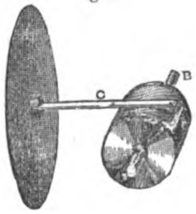
volve on the horizontal spindle *B B*, a metallic strip *C* is caused to press with a firm and uniform pressure by means of an adjustable spring, *S*. The portion of the strip which bears upon the cylinder is lined with platinum, and the opposite end is attached to a diaphragm, *D*, of mica 4″ in diameter, and firmly fixed by its circumference. The cylinder is connected to the copper element of a battery, and the strip

Fig. 949.



Electro-chemical Telephone. (Sectional diagram.)

Fig. 950.



Electro-chemical Telephone. (Detached view of diaphragm and roller.)

C to the zinc pole, with a transmitting telephone included in the circuit. If, when no current is passing through the instrument, the cylinder be rotated at a uniform speed away from the diaphragm, the friction between the cylinder and the strip *C* causes the diaphragm to be drawn inwards, *i. e.*, towards the cylinder, and the diaphragm would take up a fixed position dependent upon its own rigidity and the friction between the cylinder and the strip. The instant, however, that a current is transmitted through the instrument that friction is reduced and the diaphragm flies back by its own unopposed elasticity, the variation of friction being proportional to the variation of the strength of the electric current; and so extremely sensitive is this combination that the variations in the strength of the electric current caused by the human voice speaking against a carbon transmitting telephone instantly produce their corresponding variations of friction, and the diaphragm repeats the words, but very much louder than they were originally uttered at the distant station.

Of the other parts: *H H* is the cast-iron bracket holding the principal parts of the apparatus *G* is a shaft by which the forked lever *L* may be raised occasionally to bring the damping roller *R* from the trough *T* against the roller *A*.

"*Engineering*" . . . . * xxvii. 229.

E-lec'trode. (*Electricity.*) 1. A pole of a battery.

2. An instrument used in the application of electricity usually attached to the free extremities of conductors or cords. Sometimes called *rheophore*.

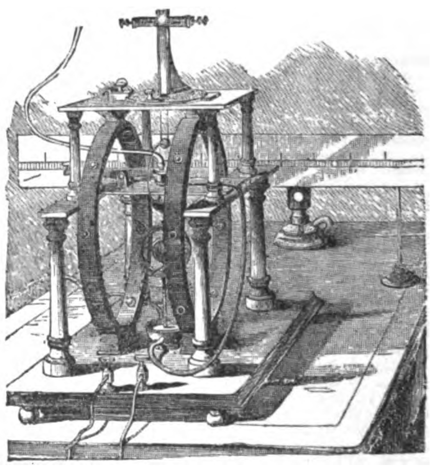
3. (*Surgical.*) Electrodes for various applications in electro-therapeutics are made of shapes appropriate. Among them may be mentioned: —

Plates for the feet, throat, temple, ankle.
Belts for the waist, wrist, arm, leg, knee, etc.
Insulated for rectum, vagina, urethra, bladder.
In form of needles, pessaries, forceps, plugs, balls, plates, sponges, brushes, pads.
60 forms are shown in the catalogue of the "*Western Electric Manufacturing Company.*"

4. One of the carbons (in some cases metal) in the arc electric light

E-lec'tro-dy-na-mom'e-ter. A measurer of the force of an electric current.

Fig. 951.



Electro-dynamometer.

The electrical current traverses the two large spirals of copper ribbon, and also the smaller spiral, whose bifilar suspension keeps it at right angles to the larger spirals when no current passes. The smaller spiral carries a small mirror, and the readings are taken from a distant scale, the light spot serving as an index. The circuit is completed through the smaller spiral by means of mercury cups kept cool by water running through their hollow walls.

Invented by Trowbridge and improved by Edison.

E-lec'tro Gild'ing. See ELECTRO PLATING.

E-lec'tro-graph. An instrument used for engraving the cylinders of copper or brass employed in the printing of woven fabrics and paper-hangings. Voltaic electricity is used to communicate the necessary movements in advancing the cutting tools at the appropriate times.

The cylinder to be engraved is first coated on its outer surface with a film of varnish. The required number of copies are then scratched through the ground by a series of diamond points arranged on the axis of the machine parallel with the axis of the cylinder. The metallic surface is thereby exposed in certain parts and is "bitten in" with acids. Each diamond point is in connection with a small temporary magnet, and the entire series is so arranged *en rapport* with the original design, that intermittent voltaic currents are established, which result in the diamonds being withdrawn from action at proper intervals.

E-lec'tro-har-mon'ic Tel'e-graph. An invention of Elisha Gray, of Chicago, by which numerous musical tones or a number of messages may be sent by telegraph simultaneously, on a single wire.

Figs. 6265-6269, pp. 2516-2518, "*Mech. Dict.*"
Gray . . . . . . "*Iron Age*," xvii., Ap. 13, p. 8.
Papers by *F. L. Pope* . * "*Sc. Am. Sup.*," 2088, 2097.
* "*Jour. Soc. Tel. Eng.*," vii. 356.

E'lec-trol'y-sis. (*Electricity.*) The process of resolving compound substances into their constituent elements by voltaic action.

Keith's apparatus . . * "*Engineering and Min. Jour.*," xxvi. 26, 37, 59.

E-lec'tro-mag'net. See under the following references: —

Magnets, *Bessin* . . . . . . "*Sc. Am.*," xxxix. 104.
Faulkner . . . . "*Sc. Am. Sup.*," xxxii.
forms of . . . . * "*Sc. Am. Sup.*," 2897-2899.
Penning . . . . * "*Telegr. Jour.*," iv. 139.
Paper by *Trowbridge* . . . "*Sc. Am. Sup.*," 367.
Electro-mag. engine, *Camacho* . * "*Sc. Am.*," xxxv. 310.
engine motor, *Deprez*, Fr. . "*Iron Age*," xxiv., Aug. 7, p. 15.
Egger, Austria . . . . . * "*Sc. Am. Sup*, 1240.
machine, *Gramme* . . . . * "*Engineer*," xlvi. 329.
testing machine, *Herring* . * "*Van Nostrand's Mag.*," xx. 405.
motor, *Ludwig* . . . . . * "*Sc. American*," xlii. 1.
engine, *Pixii* . . . . . . * "*Engineer*," xliv. 383.
engine, *Sawyer* . . . . . * "*Sc. Am. Sup.*," 301.
machine, *Varley* . . . . * "*Sc. Am. Sup.*," 1892.
Werdermann . . . . . . * "*Teleg. Jour.*," vi. 22.

E-lec'tro-mag-net'ic Brake. A railway brake operated through electric devices.

Achard . . . . . . * "*Scientific American*," xliii. 18.
N. Railway of France . * "*Engineer*," xlv. 456.
Spottiswood . . . . * "*Sc. Am. Sup.*," 807.
"*Manuf. and Builder*," xi. 228

E-lec'tro-mag-net'ic Mal'let. An instrument for plugging teeth. The plunger is reciprocated by a small electro-magnetic engine. See PLUGGER, p. 1750, * "*Mech. Dict.*"

E-lec'tro-mag-net'ic Tel'e-graph. The history of the magnetic telegraph, and the intimate connection of Prof. Joseph Henry therewith, with an account of the origin and development of Prof. Morse's invention, are so well told in a "Historical Account" of the same by William B. Taylor, of Washington, D. C., that it relieves the author from adding to that which he has said on the same subject in "*Mech. Dict.*," pp. 787-789. The "Historical Account" is published in the "*Smithsonian Report for* 1878," and as a brochure. See "*Biographical Memoir of Joseph Henry*," p. 158, *et seq.*

The "*Handbook of Electrical Diagrams and Connections*," by Davis & Rae, New York, 1876, gives an excellent description and series of cuts, showing the instruments, connections, and arrangements of various kinds and systems.

Telegraphy, *Thomasi*, Fr., "*Scientific American*," xxxvii. 40.
German historical collection of Instruments. Description and history, "*Lines' Report, Vienna Exposition*," 1873.
See list under ELECTRICITY for various systems and instruments.

E-lec'tro-mas'sage. See ELECTRO-MASSEUR.

E-lec'tro-mas'seur. An instrument for application of electricity to the human body. A small hollow metallic roller filled with hot water, and connected with a *Gaiffe* battery; it is rolled over the surface of the body. *Electro massage.* It is also made in other forms.

Fig. 955.

Post's Electro-masseur.

E-lec'tro-med'i-cal Ap'pa-ra'tus. See CAUTERY INSTRUMENT, ELECTRIC BULLET SEEKER; BATTERY; GALVANIC BATTERY; and list under ELECTRICITY.

See also list under SURGICAL INSTRUMENTS, pages 2459-2461 "*Mech. Dict.*," *et infra.*

E'lec-trom'e-ter. An instrument for measuring the force of an electric current, p. 789, "*Mech. Dict.*"

See also ELECTRO-DYNAMOMETER, *supra.*

* "*Engineering*," xxiii. 179, 201, 259, 319.
* "*Manufacturer & Builder*," xi. 253.
Hopkins . . . . . * *Sc. American*," xli. 99; xxxix. 185.
Absolute, Physical Society, London . "*Scientific American Sup.*," 1690.
Capillary . . . . . * "*Scientific American Sup.*," 1319.
Reflection, *Mascart* . * "*Scientific American Sup.*," 4103.
Reversing key, *Lodge* * "*Telegraphic Journal*," vii. 208.

E-lec'tro-mo'to-graph. (*Electricity.*) An invention of Edison by which to obtain mechanical effects with an exceedingly small electric force, and upon long circuits, without the intervention of any electric organ.

It is based upon the principle, that if a sheet of slightly roughened paper, dipped in certain solutions, be laid upon a platinized metallic plate, and there be passed over it a strip of sheet metal (lead, thallium, or platinum), on the passage of a current a certain slipperiness of the surface is produced, which makes the friction much less. A metallic bar, held by a spring, is dragged onward by the friction of the traveling paper, but springs back each time a current passes.

"*Telegraphic Journal*" . . . . * vi. 382.
"*Scientific American*" . . . . * xxxix. 17.
"*Lines' Report, Vienna Exposition.*" 1873.
See also ELECTRO-CHEMICAL TELEPHONE.

E-lec'tro Mo'tor. See DYNAMO-ELECTRIC MACHINE; MAGNETO-ELECTRIC MACHINE.

E-lec'tro-phone. A telephonic instrument devised by M. Louis Maiché, consisting of an ordinary Bell receiver and a special transmitter. The latter has a glass imbedded in wadding, and placed with its concavity opposite to the mouth tube of the transmitter. Upon the upper edge of the dish rests a ball of carbon, and upon the latter a second ball. When the sound waves set the glass dish in vibration the carbons will be sensible of varying degrees of pressure, and their conductivity will be thereby varied. The corresponding variations of resistance to the current, and consequent variations of potential in the circuit, are revealed as soon at the receiver. — "*Electrician.*"

Maiché . . . . . . * "*Scientific Am. Sup.*," 4098.
Pfeiffer, de Courbettes . * "*Scientific American*," xlii. 151.

E-lec'tro-phys'i-cal Reg'is-ter. The subject of registering phenomena of life is considered in *du Moncel's* "*Exposé des applications de l'Electricité*," * iv. 439. The memoirs on this subject, by Helmholtz, are referred to, and the apparatus of *Boeck*, called by him the Kymographion.

See CARDIAGRAPH. SPHYGMOGRAPH.
MYOGRAPH. PNEUMOGRAPH.
PLETHYSMOGRAPH. CHEILOANGIOSCOPE.
and references *passim*.

E-lec'tro Pla'ting. On porcelain: In France the object is painted with a mixture to form a basis for the electro deposit This is made by dissolving sulphur in oil of lavender to a syrupy consistence and mixing it under a gentle heat with chloride of gold or chloride of platinum dissolved in sulphuric ether. This is evaporated to the consistence of paint and applied with a brush to the parts of the china on which the plating is desired. The objects are baked to a biscuit before being plunged in the bath.

Cf.: —	"*Scientific American Sup.*," 626.
Prof. Wright	"*Scientific Amer.*," xxxvii. 177.
Leaves, etc.	"*Scientific American*," xxxv. 47.
Machinery	* "*Scientific Amer.*," xxxvii. 127.
Machinery and plant	* "*Iron Age*," xix., Jan. 25, p. 1.
Originator of	"*Scientific Amer.*," xxxv. 312.
Aluminium, etc.	"*Iron Age*," xix., Jan. 25, p. 27.
Bertrand	"*Van Nostr. Mag.*," xvii. 285.
Iron	"*Manuf. and Builder*," ix. 143.

For *aluminium*. Bath of double chloride of aluminium and ammonium; use a strong battery.

For *magnesium*. Bath of a double chloride of magnesium and ammonium in aqueous solution gives strongly adherent layer of magnesium on copper.

For *cadmium*. Use the bromide to which a little sulphuric acid has been added. An acidulated sulphate gives good results.

For *bismuth*. Deposited upon copper or brass from a solution of the double chloride of bismuth and ammonium by the current from a Bunsen element.

For *antimony*. Use double chloride of antimony and ammonium.

For *palladium*. Use double chloride of palladium and ammonium, with or without the battery.

"*Comptes Rendus*" . . . . xxxiv. 227.

Gilding. Prepare bath of

Potassium cyanide	14 to 16 ozs.
Water	1 gal.
Gold oxide	½ oz.

The gold oxide is made by digesting in a capsule over a water bath, —

Gold	1
Aqua regia	20

The *aqua regia* consists of —

Nitric acid	1
Hydrochl. acid	3

When the gold has dissolved, the solution is digested with calc. magnesia and the precipitated gold oxide washed.

Articles of copper, brass, or german silver are boiled for a few minutes in a solution of caustic potash, washed in clear water, plunged for a few minutes in an acid dip: —

Nitric acid	6 1–5 pounds.
Water	1 gallon.

"*Scientific American Sup.*" . . . . 2540.

E-lec'tro-scope. The electroscope of M. Rameaux consists of two fine fibres of white silk, each fixed at one end by means of a little wax to any support, and free to oscillate in any direction under their point of attachment, and the respective fibres so separated that they cannot foul each other during their swing, or influence each other reciprocally. One of the threads is charged by means of a glass rod with positive electricity. The other is charged by means of a stick of resin with negative electricity. Every body which attracts one of the threads so charged and repels the other is necessarily electrified. Its electricity is of the same sign as that of the thread which it repels. The sensibility of these electroscopes is greater within certain limits as the threads are made finer, longer, and less conducting.

"*Telegraphic Journal*" . . . . . . vi. 73.
"*Scientific American Sup*" . . . . . . xxxviii. 183.

E-lec'tro-sem'a-phore. (*Railway.*) A semaphore worked by electricity to give signal to approaching trains.

In the block system of railway management, for instance, the road is divided into sections and electric semaphores placed at their termini.

They are also used in the interlocking system which has attained such a great development in the railway termini of the large capitals.

The electro-semaphore is described and represented in "*Railroad Gazette*," * xxiii. 93.

E-lec'tro-si-lic'ic Light. A modification of the electric light arrangement in which one electrode is applied to a glass tube, or wall of a glass vessel containing a saline solution. A white vapor is given off, having a slight alkaline reaction. The glass is strongly attacked and devitrified. The spectrum indicates the silicic character of the light although the intense brightness renders it difficult to perceive the lines. Contact with pure silicon in the shape of crystal of hyaline quartz affords the same character of light. — *Planté.*

E-lec'tro-ther'mo-pile. (*Electricity.*) A battery in which a current is produced by the subjection of an element or group of elements to heat. See THERMO-ELECTRIC BATTERY.

E-lec'tro-typ'ing. A substitute for stereotyping. See page 791, "*Mech. Dict.*"

The bath for depositing an iron surface on electrotype plates consists of a concentrated solution of sulphate of iron and ammonium; the battery of four Meidinger cells. The anode is an iron plate with a surface eight times that of the cathode; the latter is of copper. On leaving the bath the iron is brittle and hard, but when heated to a cherry red it becomes malleable and soft. — *Klein.*

Or: Take 100 parts of ferrous-ammonia sulphate, together with 50 parts of sal-ammoniac; dissolve in 500 parts of pure water, a few drops of sulphuric acid being added to acidulate the solution. The copper plate is connected to the negative pole of a battery of 2 or 3 Bunsen elements, an iron plate of equal size being employed as an anode. The solution is maintained at 60° to 80°. The deposit of iron is of a hard, steel-like quality. — *Bottger.*

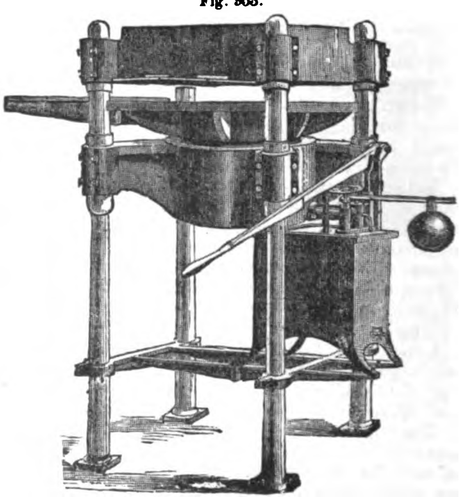
Statue, 12' high	"*Sc. Amer.*," xxxviii. 338.
Plates from drawings, *Brown*, Br.	"*Sc. Amer. Sup.*," 2242.
Iron electro	"*Sc. Amer. Sup.*," 1457.
	"*Sc. Amer.*," xlii. 184.

Article "*Galvanoplastique*," *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," tome iv., ed. 1877.

E-lec'tro-type Mold'ing Ma-chine'. A hydraulic press for taking a wax impression of a form.

The platen has a projecting table upon which the form and mold are placed before being placed in the press. The pump is supported by a frame-work on the cistern below the cylinder, and has a safety-valve graduated to give any required pressure.

Fig. 953.



Electrotype Molding Machine.

The molding case having been warmed is placed on a level table, and the melted wax poured in to make a level surface. It is then black-leaded with a soft brush; the form is put on the platen, and the molding case in reversed position on the head of the press, immediately over, but not touching the form. The bed is then raised to give the proper impression.

El′e-ments. (*Electricity.*) In a galvanic battery, the metals or carbon acted upon by the exciting fluid. See various materials in list of batteries in GALVANIC BATTERY.

El′e-va′ted Rail′way. An urban railway above the line of street travel. See Figs. 1856–1858, pp. 792, 793, "*Mech. Dict.*"

New York . . * "*Engineering*," xxix. 10, 50, 210, 240.
* "*Railroad Gazette*," xxi. 234; xxii. 125.
* "*Scientific American*," xxxiv. 25; xxxviii. 18, 62, 66, 175, 178, 367, 370; xli. 255, 310, 338.
Early examples "*Scientific American*," xliii. 281.
New York . . * "*Scientific American Sup.*," 1933.

El′e-va′tor. 1. The elevator belt with cups is the invention of Oliver Evans, of Philadelphia, 1780.

2. The elevator, as a building for the shipment, transhipment, and storage of grain is described on pp. * 794, 795, "*Mech. Dict.*" See also the following references: —

Engine, *Cooke & Beggs* * "*Manufacturer & Builder*," xi. 9.
Stokes & Parrish . . * "*Iron Age*," xxi., May 2, p. 18.
Davis . . . . . . * "*Iron Age*," xxi., May 2, p. 41.
Freight, endless chain.
Bates . . . . . . * "*Builder & Woodworker*," xvi. 239.
Grain, Canton, Md. . } * "*Engineering*," xxii. 485, 539, 523,
N. Y. Central R. R } 519.
St. Louis, Mo. . . . * "*Scientific American*," xxxvi. 390.
Erie, Pa. . . . . . * "*Scientific American Sup.*," 1256.
* "*Scientific American Sup.*," 737.
Hoist, *Mason & Co.* . . * "*Iron Age*," xviii., July 20, p. 1.
* "*Iron Age*," xxi., May 16, p. 39.
Hydraulic, *Burdon* . . * "*Manuf. & Builder*," ix. 121, 146.
Howard Iron Works . * "*Iron Age*," xx., Nov. 1, p. 1.
Lane & Bodley . . . * "*Iron Age*," xix., May 24, p. 1.
Stokes & Parrish . . * "*Iron Age*," xx., Sept. 20, p. 1.
Passenger.
Cooke & Beggs . . . * "*Iron Age*," xxi., Jan 3, p. 1.
Potter . . . . . . * "*Scientific American Sup.*," 156.
Evans . . . . . . * "*Scientific American*," xliii 24.
Trocadéro, Paris . . * "*Scientific American Sup.*," 2236.
Steam, *Bacon* . . . . * "*Manufact. & Builder*," viii. 217.
Transfer of grain by . * "*Scientific American*," xli 207.
Water Power, *Hale* . . * "*Manufact. & Builder*," viii. 49.

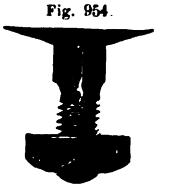
3. (*Surgical.*) *a.* An instrument for lifting an excised or depressed portion of the cranium in trepanning.

b. An instrument for replacing the uterus.

c. A forceps or screw for lifting a tooth or root.

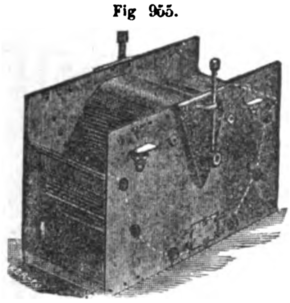
El′e-va′tor Bolt. An iron bolt with a peculiar flat head which is countersunk by pressure into the working face of the belt, while the threaded end and the nut secure the bucket to the belt. Fig. 954.

Fig. 954.



Elevator Bolt.

Fig. 955.



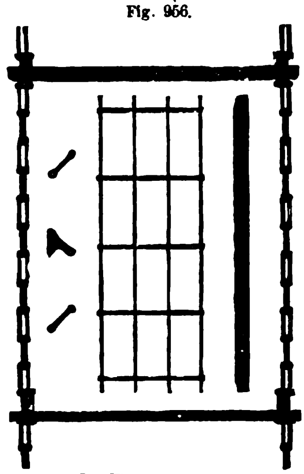
Elevator Boot.

El′e-va′tor Boot. The lower end of an elevator leg. Fig. 955. See Fig. 1863, p. 795, "*Mech. Dict.*" It is of iron and holds the lower roller, around which the elevator belt runs.

Hawkins . . . . * "*American Miller*," vii. 8.

El′e-va′tor Chain. A chain used with ice-elevators. It is flat, runs over pulleys above and below, and has jogs or bars upon it which form rests for the ice as the chain mounts the incline. Figs. 956 and 957 show several forms and detached parts. See also ICE ELEVATOR.

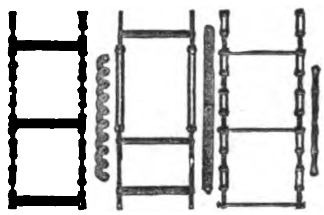
Fig. 956.



Ice Elevator Chains.

El′e-va′tor En′gine. One used in connection with a passenger cage, or platform for hoisting merchandise.

Fig. 957.

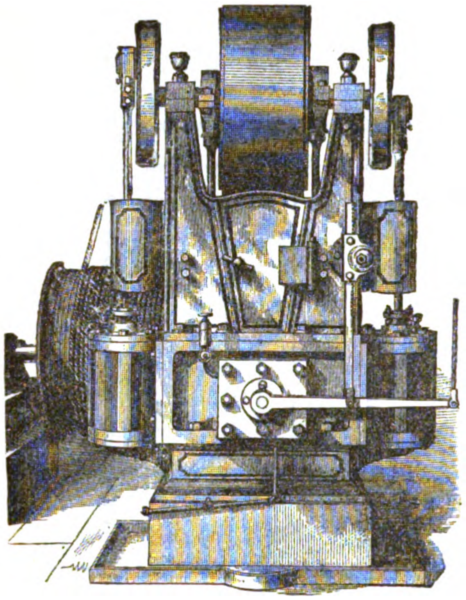


Ice Elevator and Carrier Chains.

The "Metropolitan" elevator, shown in Figs. 958 and 959 comprises (1) a double cylinder and reversible steam engine; (2) a winding drum immediately connected with the engine; (3) a safety drum placed over the hatchway; (4) guide-posts extending from cellar to roof, faced with safety-locks, ratchets, and between which (5) the safety platform is raised and lowered by a wire lifting-rope, suspending it from the safety drum, while another wire rope connects the safety drum at the top of the hatchway with the drum at the foot of the hatchway and immediately connected with the engine.

The speed of the platform is optional, from 60′ to 200′ per minute, and wherever it is stopped it is immovably held by a strong brake, combined with the engine and winding drum. The brake is so arranged as to be brought into and released from action simultaneously with the stopping and starting of the engine, but causing no friction, while the engine is running. The platform is fitted with safety-locking pawls, combined with a steel spring, and mechanism for forcing the pawls into contact with the safety-lock ratchets on the vertical guide-posts in case the rope should break. The greatest possible distance the cage should fall is 3″, the pitch of the ratchets. The safety-drum is the medium through which the motion of the engine is communicated to the platform. Its duty is to limit the rate of motion of the platform, and to stop it if any portion of the engine-gear should break. A governor, *P*, and tripping gear, *K I H*, will in the latter case bring the break *F* into action and stop the platform. An automatic stop-motion limits the distance the platform can traverse to the space between the upper

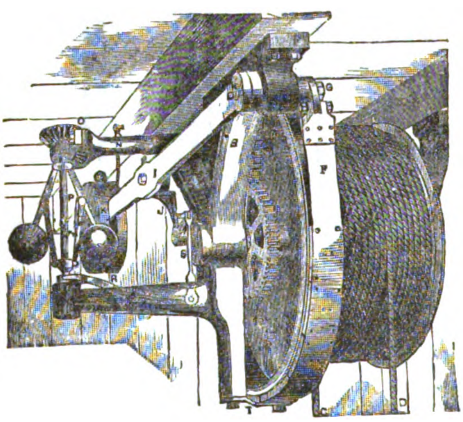
Fig. 958.



Elevator Engine.

and lower landings, automatically shutting off steam at those points.

Fig. 959



Safety Drum.

El'e·va'tor Scales. Large scales weighing 100 bushels of wheat at a time, and placed in the upper story of an elevator to weigh incoming grain before discharging into the storage bins. See GRAIN WEIGHING MACHINE, *infra*.

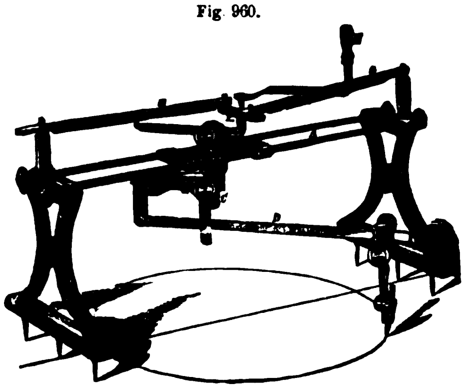
Ell. An L-shaped pipe coupling, at a bend of the circulation. An *elbow*. See BEND. The *ell* is plain, hubbed, or flanged.

El-ler-hau'sen Steel. (*Metallurgy.*) Steel made by adding iron ore (magnetic) to the bath of pig-iron, to reduce the carbon, relatively.

El-lip'so-graph. An instrument for describing ellipses. Toulmin's ellipsograph is a frame placed upon the paper on the drawing-board in a certain relation to the axes of the ellipse to be drawn.

A description of the mode of using will explain the construction: Place the center points upon a line drawn through the minor axis and equidistant from the center of the ellipse. Set the pen point at the extremity of the major axis, and clamp it by means of the binding screw on the arm, then turn the arm 90° to the minor axis and set the pen to its extremity by loosening the binding screw between the parallel rods and sliding the carriage back until the pen point comes to the required point, then clamp it firmly, turn the crank, and the ellipse is drawn perfectly. For small el-

Fig. 960.



Ellipsograph.

lipses, see that the pen point is set perfectly square with the arm *D*. When the pen is set immediately under the arm *F*, the pen will draw a straight line. When the arm *F* is outside the pen point, the motion of the pen is reversed. First start the pen on a slip of paper laid on top of the paper, then when it runs off the slip on to the paper, stretched and prepared for drawing, it will draw a figure complete, and the lines will join.

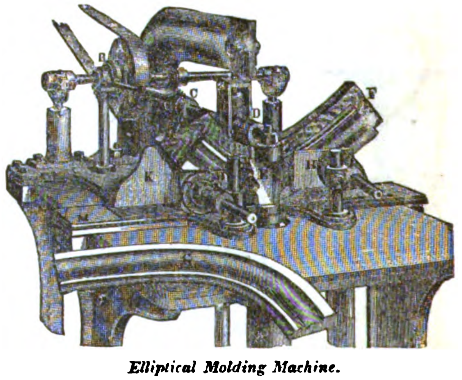
Toulmin . . . . "*Scientific American Sup.*," 689.
Balch . . . . . * "*Scientific American*," xl. 324.

The latter is an attachment to ordinary compasses, and has a double leg, which is used in rotation around the angle of a rectangular triangle laid on the paper.

El-lip'ti-cal Mold'ing Ma-chine'. An attachment to a molding for sticking elliptical or circular moldings on any radius, or, when molding ellipses, to work on a changing radius; as in finishing arches, window and door heads, and architraves.

The Boult elliptical molding attachment is shown in Fig. 961, and is used in connection with an upright spindle. The

Fig. 961.



Elliptical Molding Machine.

parts of the attachment are erected upon an independent bed-plate. The work is attached to a pattern of the desired shape which has adjustable pressure plates for holding the work to the proper position. It has an automatic worm-feed, controlled by a friction clutch matching into a loose pulley.

A is the pulley that drives the feed-works, and receives its motion by belt from a pulley on the counter-shaft that drives the main spindle. *B* is a friction clutch that connects the pulley with *A*, and drives the screw-shaft. *C* is a screw pinion that meshes into a worm on shaft above, by which means the feed roller *D* is driven. *E* shows the upright cutter head. *F* is the form or pattern used with the work attached: *H H* are adjustable pressure plates or guides for holding the work in place. *K* is an adjustable gage or fence governing the thickness of the work. *G* is a piece of the work finished.

The machine will run in either direction for feeding the stuff and working the molding, and will work moldings of any width from 1″ to 5″, and up to 1.75″ in thickness.

E-mail′ Ink. Made by Louis Müller, Leipzig.

Colored inks — black, white, red, blue — used with a quill on glass, porcelain, ivory, marble, bone, mother of pearl, or metal. Cannot be removed by any liquid.

E-maille′. (*Fine Art Metal Working.*) The process of inlaying metal with metal; an oriental process of great labor and patience, consisting of engraving, inlaying the metal which is secured by undercutting, and burnishing. Modern science has much simplified the methods.

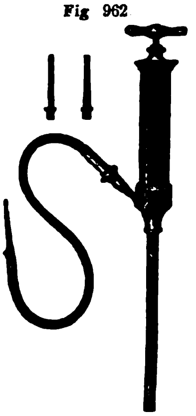
The object to be inlaid is entirely covered with varnish, portions of which are removed by a graver so as to form the design; and thus prepared, it is subjected to the action of a galvanic bath of gold or silver, which deposits the metal in the places laid bare by the graver.

Or: after the removal of the varnish, according to the pattern made by the graver, the object is plunged into a solution of cyanide of silver. The salt is deposited on the lines from which the varnish has been removed; the object is heated in a muffle furnace, and the metal appears on the black patina. Inlaid patterns of gold and silver may be obtained, either of their natural brightness or with a dead surface, the latter being effected by different processes of oxidation; so that, on the same object, by making use of the protecting varnish, designs in gold and silver of various degrees of luster may be combined. — *Morin.*

Em-balm′ing Pump. Tiemann's embalming pump, shown in Fig. 962, is made of brass nickel-plated, and with metallic valves.

Gaurei injected the veins with sulphate of alumina. Falconi injected into the body sulphate of zinc. Chloride of zinc and sulphate of soda are also sometimes used.

Fig 962



Embalming Pump.

For temporary preservation of bodies for anatomical investigations the following requisites are necessary. The body should remain in a soft and flexible condition for a period of at least three months, the tissues should not change color, the *material* should not be injurious to the health of the operator, nor spoil the instruments used in the operation, and it must be either free from or have an agreeable odor, and be cheap.

Dr. Wywodzoff, of St. Petersburg, Russia, recommends thymol diluted with water and glycerine:

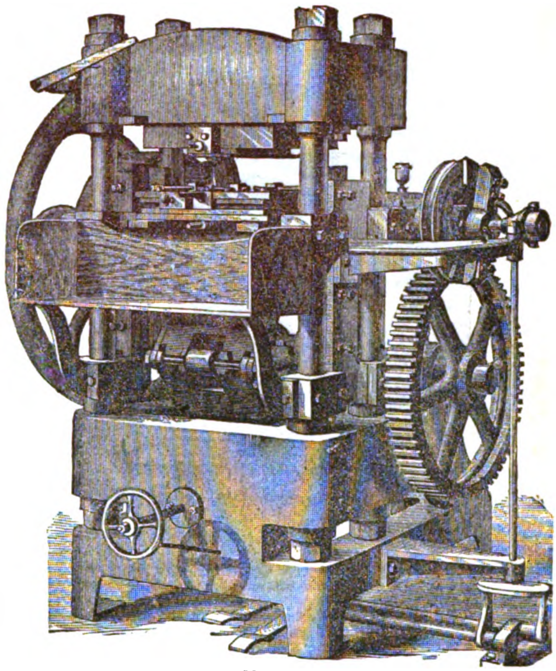
℞	Thymolis . . .	sc ij.
	Glycerine	lbs. iv.
	Aq.	lbs. ij.

The Brunelli process: —

1. Cleanse the circulatory system with cold water till the latter issues clear. Time required, 2 to 5 hours.
2. Inject alcohol to absorb water 15 minutes.
3. Ether to abstract fat. 2 to 10 hours.
4. Solution of tannin to form insoluble compound with the tissues. 2 to 10 hours.
5. Dry the body in a current of air previously passed over heated chloride of calcium. 2 to 5 hours.

The Tranchina method: Eight decigrams of arsenious acid, combined with a little cinnabar, are dissolved in 9 kilograms of spirits of wine, and injected, *secundum artem*, into the carotid artery. For more than two months the body remains fresh, inodorous, inflexible, and (thanks to the cinnabar) of its natural color. Thereafter desiccation commences, and it indurates so as to last for any time. Modifications by Gannal and others have improved upon Tranchina's method. — "*Lancet.*"

Fig 963.



Hoe's Embossing Press.

Ancient Egypt	"*Sc. Am.*," xxxvii 117.
Embalming injector, *Richardson* *	"*Sc. Am. Sup.*," 813, 2472.

See also History and Recipes: page 797, "*Mech. Dict.*"

Em-bank′ment. See —

Thames . . . . "*Van Nostrand's Mag.*," xviii. 569.
French railways, *Laboulaye*, "*Dictionnaire des Arts, etc.*," "*Chemins de fer*," 1., Fig. 81.

Em-blem′a-ta. (*Fine Art Metallurgy.*) Ornamental figures in relief, which are large and detachable from the object.

Em-boss′ing Ma-chine′. (*Add.*) 3. Embossing machine for stuffs, Fig. 1869, p. 798, "*Mech. Dict.*" See also *Laboulaye's* "*Dictionnaire des Arts, etc.*," article, "*Impressions sur étoffes*," tome ii., Figs. 61, 62.

Steinlein's machine for embossing fabrics, * "*Scientific American Supplement*," p. 229.

Em-boss′ing Press. 1. (*Bookbinding.*) A press used in embossing or gilding on card-board, leather, book covers, etc.

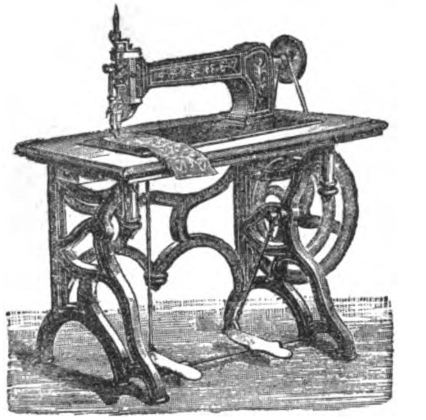
The bed is guided by the frame, so that it does not tilt in giving pressure at the corners. The feed guides or bed are adjustable in either direction. The toggle is driven by a crank within and by means of a friction clutch; the bed can be started or stopped without reverse or jar. The bed is constantly in motion and it has sufficient travel in order to allow the operator time to take off and place the work. An ink fountain and inking attachment are affixed when necessary

2. A press which takes the place of a drop-press in embossing the handles of silver spoons, forks, ladles, etc., and for stamping medals. The press will give a pressure of 1,000 tons and receive dies 2″ × 12″ or 4″ round dies. The upright steel columns that take the principal strain are 5″ diameter and the large nuts have worm gear on their

sides, operated by hand wheel, giving very delicate adjustment.

Em-broid'er-ing Ma-chine'. The Bonnaz

Fig 964



Embroidering, Overseaming, and Braiding Machine

machine is adapted to embroider cloth with a chain-stitch, and to stitch braid or chenille upon the cloth in fancy patterns.

A hooked needle is supplied with thread at each descent below the material by a rotary reciprocating thread-carrier, and the thread is drawn above the cloth. The loop so formed is held above and upon the surface of the material until the needle descends within and draws a new loop up through it. The fabric-feeding foot is universal as to the direction of its movement, and consequently moves the fabric in any desired direction from the needle, thereby permitting the stitching to follow any pattern or design printed or stamped on the fabric. A crank-handle controlled by the operator changes the direction of the feed according to the design upon the fabric to be embroidered

Rose	* "*Manufacturer and Builder*," ix. 118
Heilmann . .	* *Laboulaye's* "*Dictionnaire des Arts, etc*," tome i., article, "*Broderie*"

Em-bry-ot'o-my In'stru-ments. (*Surgical.*) Instruments for cutting a fœtus into pieces within the womb in cases of obstructed labor. Including those instruments which are fatal to the fetus, though they do not sever the parts, the following is an approximate list: —

Perforators	Craniotomy forceps.
Forceps of various kinds	Cephalotrite.
Blunt hook.	Placenta forceps.
Crochet	Vectis.
Decapitating hook	Saw forceps.

Representatives of each of which are placed under their alphabetical heads, and more *in extenso* in *Tiemann's* "*Armamentarium Chirurgicum.*" pp 103-114, Part III

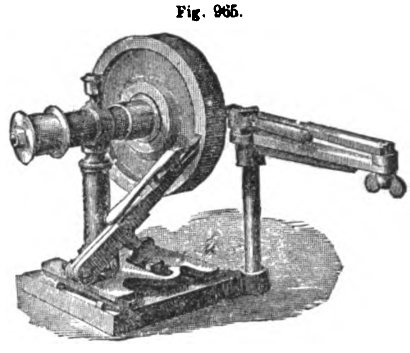
Em'e-ry Board. Card-board pulp mixed with 30 to 50 per cent. emery of the required grade and poured into cakes.

"*Manufacturer and Builder*" . . . . . ix. 269.

Em'e-ry Grind'ing Ma-chine'. Fig. 968 is a machine for sharpening chisel-bits. It has a traversing way for grinding on the flat, and a swinging rest for the face of the wheel, together with adjustable nippers. See list following: —

Band	* "*Scientific American*," xl. 278.
Band polisher, *Slack* .	* "*Engineer*," xlvii. 187.
Board	"*Manufact & Builder*," ix. 269.
Grinder.	
Berthon & Bell, Br. .	* "*Engineer*," xlvi. 248.
Dexter	* "*Iron Age*," xviii., Nov. 30, p. 1.
Tanite Co.	* "*Manuf. & Builder*," viii. 25, 36.
Thomson & Sterne .	* "*Eng'ing*," xxiv. 500; xxv. 447.
	* "*Scientific American Sup.*," 1854.
Union Stone Co. . .	* "*Scientific Am.*," xxxiv. 70, 210
Paris, 1878	* "*Scientific American*," xxxix. 67.

Fig. 965.



Bit-grinding Machine.

Lap machine, *Thomson, Sterne, & Co.*, Br. .	* "*Engineer*," xlix. 386.
Vulcanite wheel . . .	* "*Eng. & Min Jour.*," xxiii. 86.
Wheel cushioned.	
Harding	* "*Scientific American*," xxxiv. 86.
Butler, Br.	* "*Engineering*," xxi. 26.
Lehigh	* "*Scientific Amer.*," xxxviii 255.
Ransome, Br. . . .	* "*Engineer*," xliv. 4.
Manufactory.	
Tanite Co.	* "*Scientific American*," xlii. 111
Wheels, paper on, by *Bateman*, Br. . . .	* "*Scientific American Sup.*," 1989.
Wheel stand	
Shoener & Allen . .	* "*Scientific American*," xl. 294
Wheel-balancing . .	"*Scientific American*," xxxvii. 65.
Bateman	"*Van Nost's Mag.*," xviii. 502.
Wheels, celluloid . .	"*Manufact. & Builder*," ix. 125.
Wheels, on	"*Iron Age*," xx., Dec 13, p. 68.

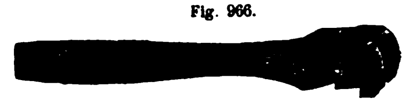
Report of J. M Safford, "*Centennial Exhibition Reports*," 1876, Group I., vol. iii., p 189.

Em'e-ry Pla'ner. A machine tool with a traversing bed, and an emery wheel which takes the place of the cutter or chisel of an ordinary planer. — *Newman.*

Em'e-ry Stone. A mixture of gum-shellac and emery. Soluble glass is substituted for the shellac in Germany, with apparent advantage. — "*Revue Industrielle.*"

Em'e-ry Wheel Dres'ser. A tool to replace diamond tools in dressing emery wheels to shape.

Fig. 966.



Huntington's Emery Wheel Dresser.

The head of the tool has independent loosely-jointed sharp-toothed cutters on a steel mandrel. The hooks on the under side of the tool are for catching upon the rest when applying the tool to the rotating corundum wheel.

The Union Stone Co.'s emery dresser is a diamond mounted in a stock.

E-nam'el. (*Fine Art Metal Working.*) Enameling on metal is of several kinds: —

1 Simple overlaying of vitreous colors which are fused in a muffle.

2. Translucent enamel colors laid over a design which has been etched on (engraved), or hammered out (*repoussé*), of the metal.

3 *Cloisonné* Pattern raised on the surface by means of wire or strips of metal welded on to it, and enamel spread in the spaces between the metal.

4. *Champ-levé.* Lines and surfaces cut out of the metal and filled with enamel. Allied to *niello*

5. Enamel is coarsely laid on, then outlined with strips of copper or gold. A Japanese imitation of true *cloisonné*.

6. A thick coat of enamel is melted on and covered while still hot with a network or shapes of thin gold which imbed in the enamel Finished with the graver. A Bengalese art.

E-nam'el-ing.

Enameling was practiced by the Egyptians, Persians, Etruscans, and Greeks. The practice was to cut out the figure to receive the enamel which was burnt in. It was practiced in Italy as far back as the time of Porsenna, and, later, Faenza and Castle Durante were famous for it. James Tontin, of Chasteaudun, in 1630, invented the opaque enamel; Mortière used it in rings and watch cases; Chartier in flowers; Petitot and Bordier in portraits; Louis Guernier in excellent miniatures.

See article "*Emaillage*," tome iv., ed. 1877, *Laboulaye's "Dictionnaire des Arts et Manufactures*," on iron, porcelain. For composition, *Ibid.*, tome ii., article "*Email.*"

(*Ceramics.*) The enameled steatite figures of the Egyptian pantheon are among the earliest examples of the use of enamel. The colors are white, yellow, blue, green, and purple, and the blue especially is of unsurpassed quality. The base is probably stanniferous.

Bricks found in the ruins of the Mesopotamian cities are also found with stanniferous glaze.

At Warka have been found great numbers of earthenware coffins, many glazed and some decorated.

The Saracens during their occupancy of Spain made great advance and the Hispano-moresque vases and dishes, as well as the tiles known as *Azulejos*, testify to the taste and skill of this remarkable people. The colors were brilliant; red, blue, green, yellow, and white, and the decorations in the style familiarly known as arabesque.

The convent of St. Paul, at Leipsic, is perhaps the earliest surviving instance in Christian Europe of the use of enameled tiles. The monument of Henry IV., of Silesia (d. 1290), in the Kreuzkirche of Breslau, is a fine instance of glazed pottery with a life-sized figure of the deceased.

The stanniferous enamel of the Saracens was rediscovered by Luca della Robbia, of Florence, in the 15th century, and largely superseded the lead glaze. Luca della Robbia ornamented with bassi-rilievi the Campanile of the Duomo, of Florence The process was again rediscovered by Bernard Palissy in the middle of the 16th century.

At the Vienna Exhibition in 1873 specimens were shown of the beautiful tea set presented to Lord Dudley on his marriage. The decoration consists of turquoise blue enamel put on in drops near together, so that the surface appears to be thickly set with turquoise. Each cup and saucer is carefully mounted in a stuffed morocco case. The small set of 6 pieces was valued at $6,000.

(*Glass.*) Wares or panes with vitrifiab'e colors baked on the surface. Glass enamel contains lead, oxide of tin, or arsenious acid, besides metallic colors.

Among other modes of enameling glass, the following is the practice with *etched enamel*: —

The enamel in paste is laid with a brush upon the glass, dried, etched in patterns or designs by tools, and the glass fired to vitrify the enamel and cause it to adhere to the glass surface.

Flocked enamel is when the surface of the glass has previously been deglazed, giving it a dull semi-opaque surface.

Among the most celebrated specimens of glass enamel are the sapphire nuptial goblet, the work of a Muranese artist of the 15th century and now in the museum of Venice: and the Tazza, of St. Mark's Treasury, Venice, blown in black glass, enameled in various colors and gold, with medallions and Coptic inscriptions divided in zones. The tazza is of the 11th or 12th century, and, though not over 6″ high, is valued at 80,000 francs. It was taken from Venice to France by Napoleon, but afterwards restored.

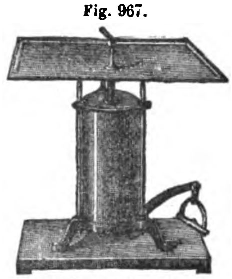
(*Cast Iron.*) Silesian process: After pickling and cleaning the vessels, they are covered with a ground made as follows: Quartz, 50; fluorspar, 7.5, and borax 22.5 parts fused together. Of this, 16 parts, 6.5 to 12.5 of quartz, 4 to 6.5 of clay, and .5 of borax, are ground in a wet mill, with an addition of 2.5 clay and .66 borax. This is laid on and burned, forming a yellowish-brown mass. For the outer coating 2.5 powdered fluorspar, 1 zinc-white, 4.75 tin oxide, .75 bone-ash, and .03 to .5 smalt are well mixed. Of this 9 kilograms are mixed with 16 of finely-ground fluorspar, 9.5 borax, 3 25 soda, and 1.25 to 1.5 niter, and the whole fused together. The product is powdered, and 30 kilograms of it are wet ground with six cups of about 140 c. c. of white clay, and .3 of zinc oxide. This is laid on and burned, completing the work. *Birsch* in "*Dingler's Journal.*"

See also ENAMEL, p. 800, ENAMELED WARE, p. 801, "*Mech Dict.*" See also GRANITE WARE, *infra.*

	"*Manufacturer & Builder*," ix. 269.
	"*Manufacturer & Builder*," ix. 245.
Cooking vessels . . .	"*Scientific American Sup.*," 749.
	"*Scientific American*," xxxvi. 21.
Hardware	"*Iron Age*," xix., June 7, p. 9; xix., June 28, p. 1.
Hollow-ware	"*Am. Manufacturer*," July 23, 1880, p. 12.
Leather	*Laboulaye's* "*Dict.*," article "*Cuirs Vernis.*"

E-nam'el-ing Forge. The enameling forge and table of *Enfer et ses fils*, Paris, is shown in Fig. 967. Beneath the table is the Chinese lantern bellows worked by the foot. The air jet is on top, the lamp or furnace is not shown in position.

Fig. 967.



Enfer's Enameling Forge. French.

En-caus'tic. Wax bleached in sea-water and steeped in natron dye was the basis of the classical encaustic painting. Encaustic tiles were first made in England by Italians settled there.

Article "*Poteries*," Figs. 3700, 3701, *Laboulaye's "Dictionnaire des Arts et Manufactures*," iv., ed. 1877.
Article "*Encaustique*," tome ii., *Ibid.*

End'less Belt Grind'er. A grinding or polishing machine having a belt running over pulleys and payed with emery, crocus, putty-powder, or what not, to grind or polish objects held against it.

End'less Bed Pla'ner. A wood-planing machine which has a roller bed, or an endless slat bed traveling on rollers.

Goodell & Waters . * "*Manufacturer & Builder*," ix. 271.

End'less-chain Horse'-pow-er. One, the inclined track of which passes over pulleys, as in *A B*, Fig. 2568, p. 1125, "*Mech. Dict.*"

En-der'mic In'stru-ments. (*Surgical.*) Instruments for the administration of medicine, etc., through the skin. See HYPODERMIC SYRINGE, Fig. 2630, p. 1160, "*Mech. Dict.*" Also called DERMOPATHIC INSTRUMENTS. See also ACUPUNCTURATOR.

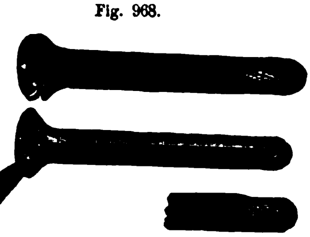
En'do-scope. (*Surgical.*) A speculum; for examination of the urethra, bladder, rectum; specifically applied to the urethral speculum; the latter is also known as a *meatoscope*.

See the following from *Tiemann's "Armamentarium Chirurgicum*:" —

Figs. 9, 10, 11 *b*	p. 2, Part III.
Fig. 548	p. 117, Part III.
Fig. 59	p. 17, Supplement.

The instrument has three parts: a glass tube with flaring

Fig. 968.



Dr. Skene's Endoscope.

mouth; a mirror with handle attached; a hard rubber sheath, with a fenestra, by which application can be made to diseased points. Light is thrown into the tube by means of a concave mirror

End Play. The allowance made for end-motion in an axle-shaft, etc. *End-shake* in watchmaking.

En'gine. A motor. See STEAM ENGINE, AIR ENGINE, GAS ENGINE, etc.

See references as follows: -

Coupling, *Haswell*, Austria	* "*Engineer*," l. 279.
Kotter, Austria	* "*Engineer*," xlvi. 164.

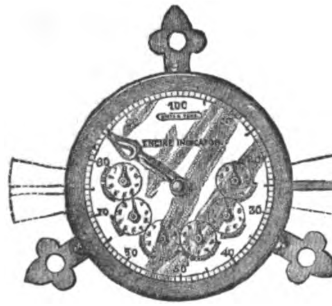
Jack, *Taylor*	* "*Scientific Amer.*," xxxv. 88.
Lathe, weighted.	* "*Engineer*," xlii. 24.
Pratt & Whitney . . .	* "*Thurston's Vienna Report*," ii. 227.

Turning lathe, *Tour à guillocher* * in article "*Tours Composes*," *Laboulaye's* "*Dict.*," iv.

See also ROSE ENGINE, p. 1983, "*Mech. Dict.*"; GEOMETRIC LATHE, 963, *Ibid.*

En'gine Coun'ter. A register for keeping account of the revolutions of a shaft, the pulsations of a beam or what not. Usually on the principle of the gas meter; a train of wheels. Illustrations may be found under ARITHMOMETER, pages 143, 144, "*Mech. Dict.*"

Fig 969.



Engine Counter.

The instrument shown is used for indicating the speed of engines, pumps, machines, shafting, printing presses, brick machines, etc. The dials register up to 100,000,000.

En'gine Cup. An oil cup for an engine shaft or cylinder. See LUBRICATOR, Fig. 3011, p. 1361, "*Mech. Dict.*"

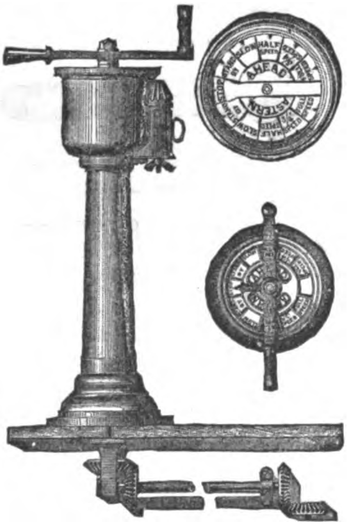
En'gine Reg'u-la'tor. A governor.

Specifically: an invention by Sterberg, of Magdeburg, in which the centrifugal motion of glycerine in a bowl-shaped vessel on a vertical shaft is made to lift a disk, and so operate a stem and governor valve.

"*Scientific American*" . . . . * xl. 195.

En-gi-neer's' Ham'mer. A hammer with one flat, round face, and a transverse edge peen.

Fig. 970.



Engine-room Telegraph. (*British Navy.*)

En'gine-room and Steer'ing Tel'e-graph. A means of communication between the officer on the bridge and the engine-room or wheel-house.

Fig. 970 shows the engine-room telegraph, which consists of a brass pillar on the bridge, with a communicator dial, index handle, and lamp.

The figure also shows the pillar dial, and engine-room dial, and a portion of the bevel-wheel and shaft arrangement for communication.

The steering telegraph is similar, with the necessary variation in the dials, showing the compass-points.

Eng'lish Knot. (*Nautical.*) A form of knot shown at 39, Fig. 2777, p. 1240, "*Mech. Dict.*"

En-graved' Glass. Glass-cutting and engraving are described on pp. 978, 979, "*Mech. Dict.*" A late process of great beauty is as follows: —

Upon a groundwork of milk-white or opal glass thin coatings of blue and rose-pink glass are spread successively. The pink colors are especially remarkable for their delicate gradations and shades of color. A great variety of small objects for decoration are made in this manner. They are handed over to the engraver, who with his wheel cuts through the outer coats of color down to the groundwork of white glass. Extremely fine lines and delicate effects may be so produced. The process invites and requires careful drawing and skilled designing. At the Paris Exposition, 1878 were exhibited services in Egyptian, Celtic, Indian, Assyrian, Persian, Arabian, Greek, and Byzantine designs.

Among the purely decorative objects were a pair of vases, each about 15″ high, upon which portions of the group upon the frieze of the Parthenon are copied by cutting in miniature, — on one vase in intaglio and on the other in relief. Two years were required for the engraving. They are valued at about $2,000 each. One two-handled vase, about 20″ high, is a most elaborate work, representing Pluto and Proserpine in intaglio on the body of the vase, with Grecian and Pompeian ornamentation on the handles and neck.

En-gra'ver's Glass. A lens placed in a small horn tube, and held by the muscles of the eye orbit. Similar to a watchmaker's glass. Fig. 708, p. 2734, "*Mech. Dict.*"

En-gra'ving Ma-chine'. See p. 804, "*Mech. Dict.*"

And chasing, *Atchison*.	* "*Scientific American*," xxxiv. 274.
Electric	"*Scientific Am. Sup.*," 448, 2434.
Bellet	"*Telegraphic Journal*," vii 100.
Machine, *Königslow* .	* "*Am. Manufact.*," Jan. 3, 1879.
Photographic, *Scamoni*	"*Scientific American*," xxxix. 82.
Process	"*Scientific American*," xxxv 134.
Cleaning engravings .	"*Scientific American*," xxxvii 339.
	"*Scientific American Sup.*," 1975.
Transferring to glass .	"*Scientific American*," xxxvii. 342.

Barrère, *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," tome iv., ed. 1877, article "*Epicycloides*."

See also article "*Gravure*," *Ibid.*, tome ii., Figs. 1107, 1107 *bis*.

Also article "*Tours Composés*," *Ibid.*, tome iv.

Barrère.	*Gallet.*
Perkins.	*Perreaux.*
Conté.	*Collas.*

See also ELECTROGRAPH, *supra*.

En'si-lage Cut'ter. A machine for cutting green corn stalks or other green feed, to be stored in pits (*silos*) for winter feed.

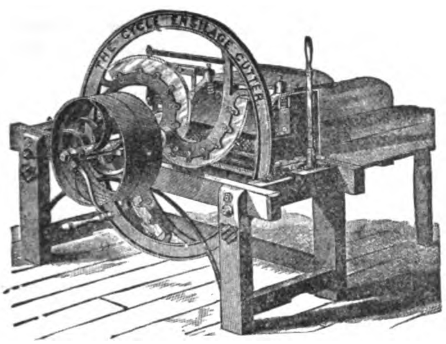
The process of keeping reminds one of *sauer krout*, the material being cut small, pounded, pressed, and placed in a vessel, the sides and bottom of which are air and water-tight. The corn-stalks gathered at the time of silking are cut to a length of say 4-10″, deposited at once in the silos, spread, tramped, covered with boards upon which a heavy weight is placed to condense the ensilage. In winter it is taken out in such a way as to expose but moderate surface to the air, operating in the manner indicated by Fig. 972. The pit becomes charged with carbonic acid, and excludes air when there is no agitation.

The process is the invention of *M. Auguste Goffart*, of Burtin, Sologne, France.

See Dr. Knight's report on agricultural implements at Paris Exposition, in 1878, vol. v., pp. 243-254, cuts of *Goffart's* silos.

The best cutter for the purpose is that of the New York Plow Co., the President of which, Mr. J. B. Brown, has translated M. Goffart's pamphlets and been chiefly instru-

Fig. 971.



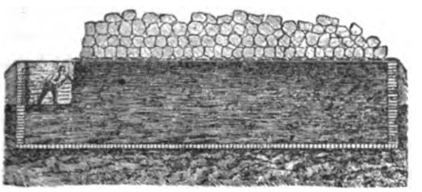
Brown's Ensilage Cutter.

mental in introducing the ensilage of maize to the American farmer

The cutter shown in Fig. 971 has three curved blades on a wheel, rotating in a plane across the throat of the machine. The knives have a long draw-cut, so arranged that the cut is continuous and steady, a following knife commencing to cut before the previous one concludes its cut. The machines are adjusted to cut ⅜'' or ½'', or to ¼'' and 1''.

The feed is stopped and started instantly by a lever. The cover over the knife is not shown. The curve of the knife

Fig. 972.



Emptying a Silo.

is such as to slip away any stones. The steel cutting-plate is separated from the face-plate. The rollers are combed. An endless band elevator raises the cut stuff and drops it into the silo. The cutting power is from 2 to 10 tons of green stalks per hour, according to size of machine. The speed of wheel, 300 to 400 revolutions per minute. The power, from 2 to 4-horse.

Ensilage pits, *Potter* . . "*Sc. Am. Sup.*," 3846, 3861, 3926.

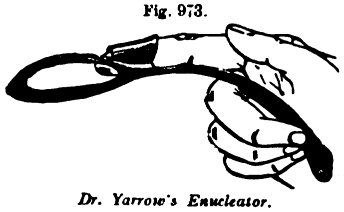
The British Hache-mais, for the French market, is made by Richmond & Chandler, and French machines are also made for the same purpose. See CHAFF CUTTER, page 158, *supra*.

En'to-mo-log'i-cal Pin. A delicate thin pin for impaling objects.

E-nu'cle-a-tor. (*Surgical.*) An instrument, the name of which is derived from the act of uncovering and removing, as a nut from its kernel.

The figures refer to *Tiemann's* "*Armam. Chirurgicum.*"

Fig. 973.



Dr. Yarrow's Enucleator.

1. An instrument with a loop end for removing uterine and ovarian tumors, *Sims'*, Fig. 467, Part III.

2. A sharp comb or claw attachable in manner of a thimble to the end of the finger, to detach and remove a sac or tumor. *Emmett's*, Fig 102, Part V.

In *Yarrow's*, Fig. 55, Supplement, the thimble carries a loop to place over the object: it is practically a serrated scoop on an extension of the index finger. See Fig. 973.

3. An instrument to grasp and extract the eye-ball in the operation of extirpation, p. 25, Part II.

See ÉCRASEUR for an instrument for a somewhat similar purpose, but of different construction.

En'vel-ope Ma-chine'. The machines of Cohen, Lockwood, and Raynor & Co. were shown in operation at the Centennial Exhibition.

Cohen's uses blanks previously made on cutting press. It folds, gums, and finishes 48 envelopes per minute.

Lockwood's machine works from the web of paper, wasting very little stock and making the square pocket envelope, pasted up each side, and with a gummed flap. It cuts from the roll, folds, gums, and counts 120 per minute, delivering in bunches of 25 each, equal to 72,000 per day. It has worked to 160 per minute.

Raynor & Co.'s machine gums and folds envelope blanks, previously cut upon a press. *Ball's* patent; making 48 per minute.

"*Scientific American*" . . . . xxxvi. 281.

Ep'i-cy'cloid-al Mil'ling En'gine. A machine for forming templates to be subsequently used as guides in shaping the cutters for gear-cutting machines. In these machines it is essential that the contour of the milling cutter conform precisely to that of the space between two teeth. The machine is somewhat intricate, very ingenious, and is made by *Pratt & Whitney*.

Ep'i-glot'tis Pin-cette'. (*Surgical.*) A long, delicate forceps, having curved prongs with hooked ends for introducing into the epiglottis to remove foreign substances.

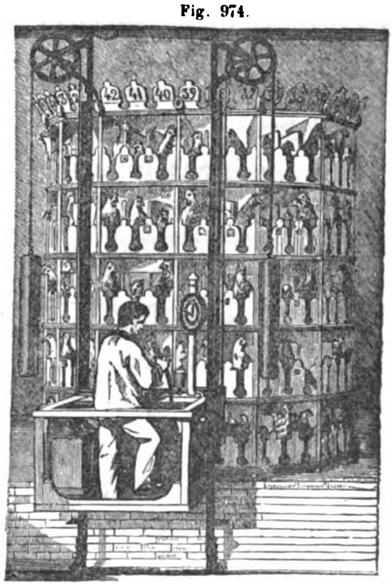
Brun's, Fig. 330, Part II., *Tiemann's* "*Armamentarium Chirurgicum.*"

Throat forceps, laryngeal forceps, and probangs for the same purpose, are shown on pp. 82, 83, *Ibid.*

Ep-i-nette'. A chicken-feeding arrangement used in France.

A cylinder with 5 stories and 14 faces, with 3

Fig. 974.



Epinette (Jardin d'Acclimatation), Paris.

compartments each, is mounted on a vertical axis, so that either face may be presented towards the attendant. The box of the attendant (*gaveur*) is counterweighted so that he can bring himself and his feeding apparatus opposite either of the stories. The capacity is 210 fowls.

On the box of the operator is the feed cylinder, the contents of which are ejected by pressure upon a pedal; a dial shows the amount of food passing. The *gaveur* seizes a chicken by the head, presses upon each side of the beak to open the mouth, introduces the nozzle of the feed pipe, presses upon the pedal and injects the required quantity of food, keeping his eye upon the dial. He then takes the next fowl, completes the round by turning the cylinder one face, winds himself up to the next story, and so on. Duty: 400 chickens per hour. The time required for fattening: chickens, 18 days; geese, 20; ducks, 15; turkeys, 25. Food is a thin paste of barley and corn meal mixed with milk and water. Quantity from 10 to 20 centiliters = 0.7 to 1.4 of a gill at a feed, the maximum being gradually reached.

Epinette on a smaller scale . . * "*Sc. Am. Sup.*," 1295.

Ep'i-la-ting For'ceps. (*Surgical.*) The instrument for transplanting hairs in the skin-grafting process.

Piffard's, Fig. 85, Part V., *Tiemann's* "*Armamentarium Chirurgicum.*"

E-pi-stax'is In'stru-ments. (*Surgical.*) Instruments to avert bleeding of the nose. Among such are the following: —

Nasal clamp.	Rubber tampon (inflatable).
Epistaxis plug.	Laryngeal and posterior nares syringe.
Nasal douche.	Rhinoscope.
Canula.	

E-prou-vette'. An instrument for testing strength of cartridge heads by explosion of powder, is shown in Plate XXIV., Report on "*Metallic Cartridges*," by Major Treadwell, U. S. Army, 1873.

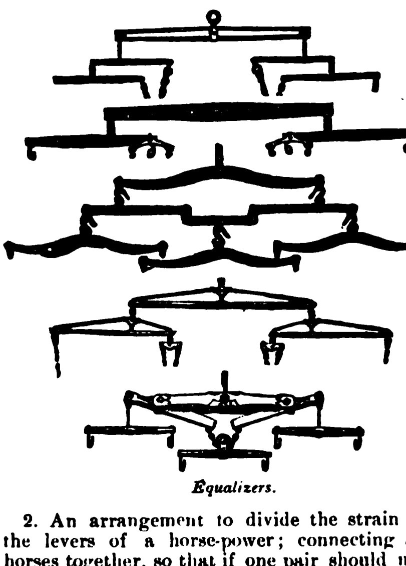
See also article *Poudre*, Figs. 2194, *bis et ter*, *Laboulaye's* "*Dictionnaire*," iii.

E'qual-bar Nest Spring. (*Railway.*) A multi-coil spring in which each coil has a resistance proportioned to its diameter. *S*, Fig. 1143, p. 483, "*Mech. Dict.*"

E'qual-i-zer. 1. A three-horse evener, to throw the strain equally upon three horses abreast.

The illustration, Fig. 975, shows American, British, and French forms, in the order named.

Fig. 975.



Equalizers.

2. An arrangement to divide the strain on all the levers of a horse-power; connecting all the horses together, so that if one pair should make a sudden pull, it draws upon the other horses instead of upon the power, and so does not transmit the irregularity of motion to the machine driven.

E'qual-i-zing Bar. (*Railway.*) A bar, the ends of which rest upon the upper boxes of the axle bearing, and upon which rest the springs supporting the truck frame, seen at *f*, Fig. 1159, p. 488, "*Mech. Dict.*"

E-qua'tion Ap'pa-ra'tus. Electric apparatus for determining the personal equation of astronomical observers is described in *Comte du Moncel's* "*Exposé des Applications de l'Électricité*," iv. 294, 3d edition.

Professor Langley's apparatus for eliminating personal equation by suitable devices during the act of observation, is described in the "*American Journal of Science and Arts*," and reproduced in "*Scientific American*," xxxvii. 170.

E'qua-to'ri-al. A telescope mounted for adjustments in altitude and azimuth; clock-work gives the motion in right ascension.

Reflector (mirror 0.80 m.), by Foucault, at Marseilles, * *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," iv., ed 1877, article "*Instruments d'Optique*," Fig. 37.

Telescope, 8″, Grubb, Br. . * "*Engineering*," xxviii. 278.
Vienna . . . . * "*Engineering*," xxx. 425.
27″, Vienna . . . . . . * "*Engineering*," xxix 7, 200, 310, 391, 409, 467.
Stand, home-made, *Simonton* * "*Sc. Amer. Sup.*," 1241.

E'qui-bus. A name applied to a proposed form of carriage, which spans the horse, and has two wheels.

"*Scientific American*" . . . . . . * xxxviii 265.
"*Manufacturer and Builder*" . . . . * x. 115.

E'qui-lat'e-ral Prism. (*Optics.*) An equal angled prism mounted upon a stand, and used for throwing oblique light upon an object under examination with the microscope.

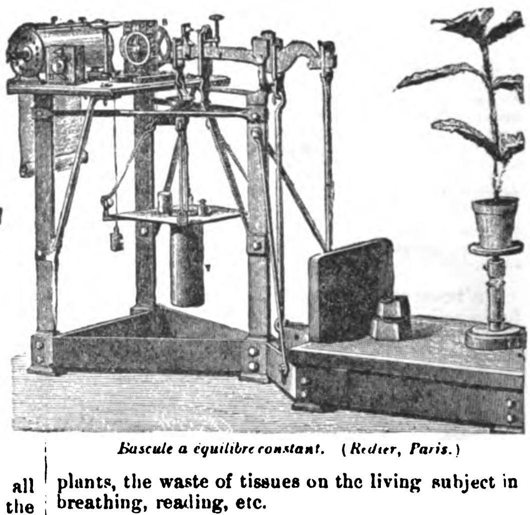
E'qui-lib'ri-um. Equilibrium cock. See EQUILIBRIUM VALVE.

Equilibrium balance. See EQUILIBRIUM SCALE.

Equilibrium couch, *Anderson*, Br., * "*Engineer*," xliv. 42

E'qui-lib'ri-um Scale. A scale which keeps itself in constant equilibrium, and records all changes in the weight of the object, such as the growth of a plant, the evaporation of soil or of plants, the waste of tissues on the living subject in breathing, reading, etc.

Fig. 976.



Bascule a équilibre constant. (*Redier, Paris.*)

On a stand next to the platform are placed the registering cylinder, the clock-work, which rotates slowly, and the double wheel-work, which determine the state of constant equilibrium. The principle by which the equilibrium is restored, as soon as it has been disturbed by some cause or other, is this: If we place on an ordinary balance a glass full of water, counter-balanced by a weight, and if we dip into that glass a mass, whatever it may be, hanging from a thread, the equilibrium will be destroyed: in proportion as the plunger penetrates more or less into the liquid, it will more or less disturb the equilibrium. It is such a plunger which Mr. Hervé Mangon has made use of to establish the state of constant equilibrium on the platform scale in question.

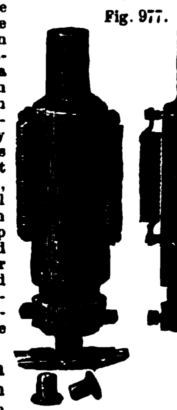
Under the little platform of the instrument is a cylindrical vase, three fourths filled with water; a cylindrical plunger, of which the supporting thread is rolled over a pulley, is lowered or hoisted by the wheels of the pulley as soon as the large platform experiences any augmentation or diminution of weight. The equilibrium restores itself immediately, and the motions of the pulley are transmitted to the lead pencil which passes over the surface of the registering cylinder, leaving on the unrolled paper traces of all its movements. The wheels of the pulley are the same as those used in the registering barometer of Redier; the one goes constantly to the right, with an escape; the other to the left, with twice the speed of the first, and the extremity of the balance, by its motions, determines the freedom of the fan of the second wheel-work, which makes the pulley turn in the desired direction.

"*Manufacturer and Builder*" . . . . * x. 206.

E'qui-lib'ri-um Tool. A drilling or boring tool for metals; having a center steadying pin and a ring of cutters which make an annular groove.

The case holding the cutters is a hydraulic cylinder which is fitted into the drilling-machine spindle socket, being, in fact, an annular ram carrying cutters, inside of which is a steadying pin, with a piston at its upper end working in the cutter ram. The cylinder is charged with soapy water, and when the tool is at rest the cutter ram is kept up by two exterior springs, and the center pin is full out. When the center pin is placed on the center-pop the pressure is transferred by the piston to the outer ram with the cutters, and when the pressure is withdrawn the cutters again retire, being elevated by the springs.

Fig. 977.



Equilibrium Tool.

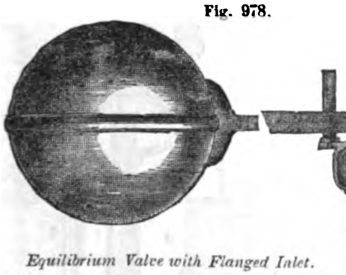
E'qui-lib'ri-um Valve. 1. A valve in which the pressures on the respective sides are in equilibrio; this much decreases the labor of moving them, especially in large stop valves of water mains.

Bagshaw & Sons (Br.), equilibrium sluice valve has balancing pressures above and below, the escapes being bi-lateral.

"*Scientific American Supplement*" . . . . . * 1472.

Booker's (Br.), equilibrium blow-off cock, has a small valve in the center of the larger one. The former being easily and promptly lifted by a quick screw, the water above the valve

Fig. 978.



Equilibrium Valve with Flanged Inlet.

escapes and reduces the pressure so that the water from the boiler forces the valve upward and opens the outlet. Conversely, by closing the small valve the operation is reversed.

"*Scientific American Supplement*" . . . . . * 1441.

Fig. 978 is an equilibrium ball valve for boilers with equal pressure upon the inner faces of the two valves upon the same stem.

2. The equilibrium valve in the Cornish engine opens a communication between the top and bottom of the cylinder, to render the pressure equal on both sides of the piston, Fig. 1884, p. 808, "*Mech. Dict.*"

See also article "*Tiroirs Équilibrés*," * *Laboulaye's* "*Dict. des Arts et Manufactures*," iv., ed. 1877.

E-quip'ment. (*Railways.*) The running stock to make up a train. The passenger train equipment includes the baggage, mail, express cars, and passenger coach; with parlor coach or sleepers in many cases.

Fig. 979.

Lister's Erecting Glass.

E-rect'ing Glass. (*Optics.*) A tube with lenses placed in the draw tube of the microscope to erect the image of the object under view. See Draw Tube.

Erg. (*Electricity.*) The unit of work done by one *dyne*. — *Gordon.*

Es-cape'ment Reg'u-la'tor. A contrivance of Breguet in which the escapement is controlled by a tuning-fork.

The tuning-fork is about a foot long, and gives one hundred vibrations in a second. About midway upon one of the prongs there is a sliding-weight, by which the number of vibrations can be regulated. Projecting from the end of the prong is a small pin, which acts in the fork of a lever. The lever makes one hundred vibrations in a second, corresponding to the tuning-fork. Attached to this lever is a pair of pallets, which act upon an escapement-wheel having ten teeth, and making four revolutions in a second. The tuning-fork in this case regulates the speed of the train. The pallets and escapement-wheel act in a manner similar to the escapement of the striking-train in a repeating-watch. It was found by experience that the vibrations of the fork should be confined to about one degree to give the best results. These vibrations are so completely isochronal that an increase of power, from 4 pounds to 60 pounds on the train, made no difference in its time-rate. The second-hand made a complete revolution in one second. The dial being divided into one hundred parts, with a proper contrivance for starting and stopping, it might be of service in recording time to the hundredth part of a second. — *Carpenter.*

E'so-pha'ge-al Ins'tru-ments. (*Surgical.*) The term includes: —

Throat forceps	Throat lancet.
Throat scoop.	Dilator, etc.
Probang.	Sponge holder.

See list under surgical instruments, "*Mech. Dict.*," *et infra.*

E-soph'a-gus Bou'gie. A spiral flexible instrument for dilating strictures of the esophagus. Made in a variety of sizes. — *Dr. Crawcour.*

Fig. 980.

Esophagus Bougie.

Es'pou-line. (*Fr.*) The peculiar India texture of the Cashmere shawl.

Es-ther'mo-scope. An instrument invented by J. W. Osborne, of Washington, D. C., a thermoscope of peculiar construction to give expression to the aggregate of the climatic influences which tend to affect the normal temperature of the body.

See Fig. 6368, p. 2530, "*Mech. Dict.*" Also paper by Mr. Osborne in the "*Proceedings of the American Association for the Advancement of Science*," Detroit meeting, August, 1875. See also Climatometer, p. 200, *supra.*

Es'the-si-om'e-ter. See Æsthesiometer.

Etched E-nam'el. (*Glass.*) A process of ornamenting glass by laying the enamel on the surface in the form of paste, and then etching it into designs or patterns by means of tools.

Etch'ing. (*Glass.*) Etching on clear and dead white ground is done by means of hydro-fluoric acid.

Combined with modern photographic processes which allow copies of prints to be thrown upon grounds, reproductions may be made at slight expense and of remarkable beauty.

Etching on glass . "*Scientific American*," xxxv. 199.
"*Scientific American*," xlii. 149.

A fluid made by *Kessler* of Paris, is used with a common pen in etching on glass. Shown at Paris in 1878. *Kessler* is said to be the inventor of etching on glass in depolish with fluoric acid.

For steel: concentrated acid	40
Absolute alcohol	10
Nitric acid	10
	60
Or: dissolve soda	20
Iodide of potassium	50
In water	400
	470
For copper: fuming nitric acid	100
Water	700
Add a boiling solution of chloride potassium	20
In water	200
For zinc: crushed galls	40
Water	560
Strain and add nitric acid	2
Hydrochloric	3 — *Herrburger.*

For Fichtner's etching proc., see "*Sc. American*," xxxiv. 200.

(*Ceramics.*) A mode of ornamenting ware in which the glazed surface is covered with a varnish, the pattern etched with a point, the exposed glaze "bitten" with fluoric acid, the varnish removed, the etched lines filled with some strong color or gold, and, finally, the piece re-fired; the glaze softening covers and holds the color.

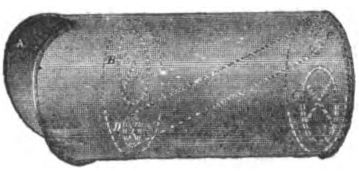
Practiced by Mr. W. Goode, and exhibited by Minton, at Paris Exposition, 1878.

E'ther In-ha'ler. (*Surgical.*) For administration of the vapor of ether as an anæsthetic.

Squibb's, Allis's, Chisolm's, Cheatham's, Speir's, Morton's, Junker's. Figs. 400–406, pp. 115 118, Part I., *Tiemann's "Armamentarium Chirurgicum."*

See also p. 1184, "*Mech. Dict.*"

Fig. 981.



Ether Inhaler.

Fig. 981 is Dr. Morton's ether inhaler. It has a gaping mouth-piece, *A*, and valves *B C* to allow air to pass through the sponge chamber. Also valves *D E* for direct passage of air through the instrument without being impregnated with ether. This valve is used when the breathing becomes stertorous, and obviates the necessity of removing the instrument from the mouth.

Eu'di-om'e-ter. A gas testing apparatus. See EUDIOMETER, p. 810, "*Mech. Dict.*"

Gas testing apparatus, or eudiometer test.
"*American Gas-light Journal*" . . . July 3, 1876, p. 3.
See also FIRE-DAMP TESTER; GRISOUMETER, *infra;* COAL GAS TESTER, *supra*, and references *passim*.

Eus-ta'chi-an Ca-nal' In'stru-ments. (*Surgical.*) For treating the canal. Air bag for inflating the canal. See AIR BAG.

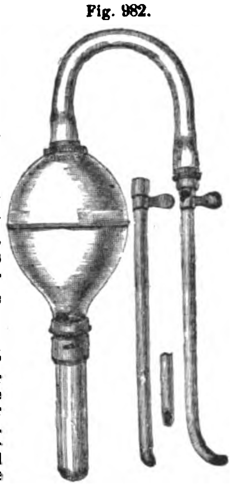
Inhaler for forcing vapors into the canal.
Eustachian spray instrument.
Eustachian catheter.
Nose clamp for holding the catheter.

Eus-ta'chi-an Tube Cath'e-ter. (*Surgical.*) A tube for following the course of the eustachian tube, acting as a dilator and discharger.

E-vac'u-a-ting Ap'pa-ra'tus. (*Surgical.*) An instrument for discharging the debris of calculi after lithopaxy, Fig. 982.

Bigelow's instrument consists of a large catheter, preferably straight with a distal orifice, the extremity of which is shaped to facilitate its introduction and during suction to repel the bladder wall. The elastic exhausting bulb acts partly as a siphon. Below the bulb is a glass receptacle for débris.

Fig. 982.



Bladder Evacuating Apparatus.

Fig. 983 shows Dr. Joseph Warren's vermicular pointed evacuating tube. Its shape facilitates introduction, as it rotates when passing through the urethra.

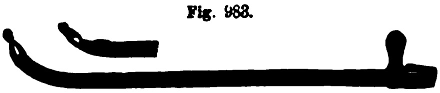
E-vap'o-ram'e-ter. An instrument for determining the evaporation at a given place.

It consists of a flat vessel of known area and capacity, in which rain, etc., is collected, and which is either measured or weighed to determine the loss by evaporation.

The apparatus shown at Fig. 1892, p. 813, "*Mech. Dict.*," is perhaps better adapted for reservoir, river, or tide gage and recorder, than strictly for the purpose of an evaporameter.

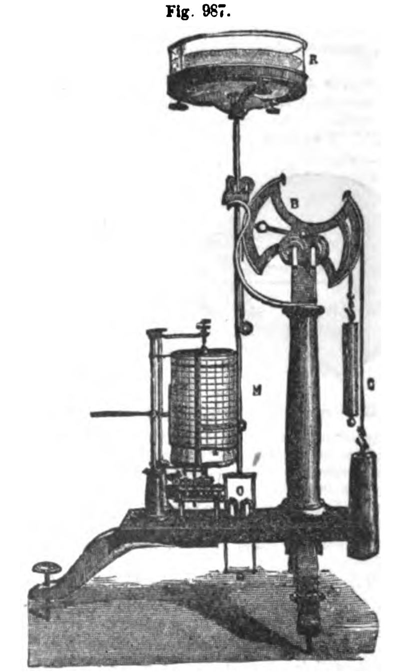
Erkman, of Stockholm, Sweden, showed at the Centennial Exhibition in 1876 a portable evaporameter, and a fixed one resembling that in use at the Käringö Station in the Skager Rack, where the wind has free access from all quarters. These evaporameters are circular, shallow, straight-sided cisterns of Portland cement, showing a surface of 50' square (Swedish). The observer has to register not only the linear sinking of the surface, but also the quantity of water which in the course of the year is poured into or drawn off from each evaporameter. A small channel at the bottom is provided

Fig. 983.



Evacuating Tube.

Fig. 987.



Ragona's Registering Evaporameter.

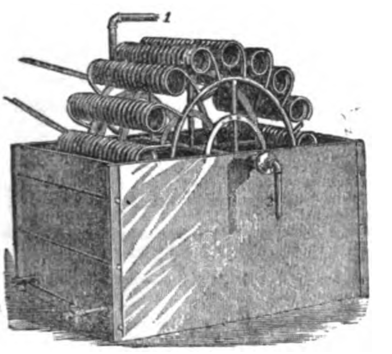
for the latter purpose. The tests for height of water are by a graduated tubular glass stem, or a plunger rod

The registering evaporameter of Sig. Ragona, director of the Modena Observatory, consists of a glass vessel, *R*, Fig 984, containing water; it is placed on the platform of a balance of which the arm is represented by *B*. A counterpoise suspended by the cord *C* holds the vessel in equilibrium; but this equilibrium is equitable, as the contents of the vessel are continually diminishing by evaporation, so a second counterpoise, adapted to an eccentric, is disposed (as shown in the figure) in such a way as to support the vessel while it diminishes in weight. This counterpoise does not prevent the vessel containing water from rising with the rod *M*, which supports it, in proportion to its diminished weight. While ascending, the rod *M* carries with it a lead pencil, which traces a curve on the surface of a paper cylinder, which is rotated slowly by means of the clock-work *O*.

E-vap'o-ra'tor. See illustrations of many forms in "*Mech. Dict.*," * pp. 811–813.

Badoux's evaporator has a wheel made of circulating tubes and carrying series of coils which dip into the liquid and raise it to be evaporated by the air. It exposes a greater surface than *Schroder's*, shown at D, Fig. 1887, p. 811, "*Mech. Dict.*" They both act upon the same principle. The *Badoux* evaporator is used in sugar and glue work.

Fig. 985.



Badoux's Evaporator.

Cook's,* with portable furnace *Mallet's* Report on Group III., vol. iv., "*Centennial Exhibition Reports*," p. 55.
Badoux's evaporator, *Ibid.*, p. 56.
Rillieux's and Cail's apparatus for sugar-house, see *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," article "*Evaporateur*," tome iv., ed. 1877.
App. for salt, *Piccard*, Fr., * "*Sc. Amer. Sup.*," 2336, 2448, 3982.
Moistening air, *Parmenter*, * "*Iron Age*," xix., April 12, p. 7

E'ven Scales. Scales, the beam of which is suspended at mid-length, so that the poise and the object are of equal weight.

E-ver'sion Ap'pa-ra'tus. (*Surgical.*) 1. Feet eversion apparatus. See CLUB-FOOT APPARATUS; CURVATURE APPARATUS.

2. *Entropium forceps;* also called *Trichiasis forceps*, Fig. 1877, p. 805, "*Mech. Dict.*"

Ex'ca-va'ting Pump. 1. A form of dredging machine in which the water pumped draws up with it silt, mud, sand, etc., from a bar or shallow river bottom. See DREDGE.

2. A vault emptier, Fig. 584, p. 187, *supra*.

Ex'ca-va'tor. A dredge, digger, scoop, borer, pump, as the case may be. See p. 814, "*Mech. Dict.*"

See also the following references: —

Ball . . . . "*Min & Sc. Pr.*," xxxvi. 49.
Calais Harbor . . . . . . * "*Engineer*," xlix 405.
* "*Sc. American Sup.*," 3787.
Chaplin, Steam, Br. . . . * "*Engineer*," xlii. 378.
* "*Sc. American Sup.*," 1009.
"*Van Nostr. Mag.*," xvi. 288.
Courreux, Danube . . . * "*Sc. American Sup.*," 814.
Diack, borer and bag, Japan * "*Engineer*," xliv. 291.
* "*Sc. American Sup.*," 1681.
Dunbar & Ruston, Steam, Br. * "*Engineering*," xxiii. 360.
* "*Sc. American Sup.*," 1378.
Fouracres, India . . . . . * "*Engineering*," xxviii. 158.
Fowler, scoop, Br. . . . . * "*Engineering*," xxv. 446.
* "*Sc. American*," xxxix. 51.
Kind-Chaudron, Belgium . * "*Sc. American Sup.*," 1296.
Ghent ship canal . . . . * "*Engineering*," xxvi. 314.
* "*Sc. American*," xxxix. 367; xl. 54.
Price . . . . * "*Min. & Sc Pr.*," xxxiv. 347.
Priestman, Br. . . . . . * "*Engineer*," l. 74.
Reeves, pump . . . . . . * "*Sc. American*," xxxviii. 8.
* "*Sc. American Sup.*," 1617.
Ruston & Procter, Br. . . . * "*Engineer*," xliii. 80.
* "*Sc. American Sup.*," 1075.

Ex-change'. (*Telephone.*) A central office in which the wires of any two telephone stations are connected, on call of either.

Ex-ci'sing For'ceps. (*Dental.*) Gnawing forceps, for cutting off projecting parts of carious teeth.

Fig. 986.

Straight Beak Excising Dental Forceps.

Ex'er-ci-sing Ma-chines'. The Centennial Exhibition of Philadelphia, 1876, and the Paris Exposition of 1878, had remarkable, varied, and ingenious appliances for the exercising of the muscles of the body.

The Mechanico-Therapeutic Institution, of Stockholm, established by *Dr. G. Zander* in 1836, led the way in the variety of its apparatus, a part only of which was shown in Philadelphia. The full set consists of 67 machines.

17 machines for active arm movements.
18 machines for active leg movements.
9 machines for active body movements.
23 machines for passive movements.

The passive movements are worked by a steam-engine, and consist of movements as follows, applied to body, head, limbs, abdomen, etc.: —

Shaking.	Rubbing.
Chopping	Swinging.
Tapping	Balancing.
Kneading	Expansion of the chest.

The Mechanico-Therapeutic Institution is open from the 1st of October to the 1st of June, 4½ hours daily for gentlemen, and 2 to 3 hours for ladies. Every patient receives a prescription in which the movements to be performed are enumerated, and the number of the graduated scale of the machine corresponding to the force or the need of the patient is fixed. 12 movements are generally performed daily; after 12 days all or a part of the movements are changed according to the nature of the case treated.

The following is from a spectator: "One machine, when its handles are grasped by the patient, twists the arms; another exercises the flexor and extensor muscles of the wrist, a third pulls the arms back; a fourth exercises the knee muscles; a fifth exercises the muscles which carry the leg outward; and a sixth exercises the ankle muscles. On the seventh the patient lies down and is shaken up so that the extensor muscles of the back are exercised. Another machine is very complicated, and calculated to excite some dismay in the patient, whose 'thorax is pulled upward by means of two levers, while a pad makes a horizontal pressure on the back. The trunk is thereby elongated a few inches, and the spine and walls of the chest are stretched.' There is something about all this dismally suggestive of the rack. In another machine the patient is put through all the misery of horseback riding without any of the accompanying pleasures. He is seated on a saddle, and the latter then becomes possessed of a desire to shake him off. 'This causes the abdominal viscera to be kneaded and rubbed together against each other and the abdominal walls.' There is still another machine, consisting of a couple of wheels having peripheries of padded bars. These, when revolved, serve to warm the feet, the latter being pressed against them. Lastly there is a hammering machine, which has a number of vertical beaters which are set in rapid vibration, so as to hammer the patient in the small of the back or at any desired point."

Another elaborate display in Paris was from the Grand Gymnase of Eug. Pas. The apparatus is very complete, each of the 14 machines being capable of many different applications (Eugène Paz, 34 Rue des Martyrs, Paris).

Ex-haust' Cham'ber. A chamber in the smoke-box of a locomotive, so placed as to prevent the unequal draft of the tubes. A modification of the *petticoat pipe*. *Pollock & Williams.*

"*Scientific American Supplement*" . . . . . . * 2286.

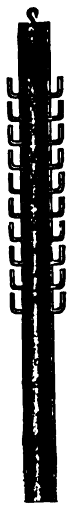
Ex-haus'ter. An aspirator, exhaust-fan, suction-fan, known by many names according to construction or purpose.

For planing mills . * "*Manuf. and Builder*," ix. 125–129.

Ex-haus'ter Gov'er-nor. (*Gas.*) An arrangement for governing the speed of a gas-exhauster engine by the pressure of the gas within the governor, *i. e.*, the governor is self-acting, the make of gas being made to regulate the speed of the engine. When the charges are being drawn from the retorts the production is small and the speed of the engine reduced. When the gas is generated rapidly the pressure of the gas increases the speed of the engine. See GAS EXHAUSTER, and citations *passim*.

Ex-haust' Noz'zle. Shaw's quieting arrangement for exhaust nozzles of locomotives is shown in Fig. 987. The lower end is screwed to the safety-valve pipe, the upper is closed with a cap; the sides are bored for numerous small tubes to equal in their sum the total outlet required. The effect is to prevent the loud sound of escaping steam.

Fig. 987.



Quieting Blast Nozzle.

Brainerd's exhaust nozzle for locomotives has a sleeve upon the nozzle pipes to confine the steam to issue axially and create full draft through the cone beneath or by opening side ports to deflect the relief steam into the cone chamber and decrease the effectiveness of the draft.

"*Scientific American*". . * xxxviii. 98, 262.

Ex-haust' Pu'ri-fi-er. A machine for sorting grain, or purifying middlings by a *suction draft*, as distinct from a *blower*. An *aspirator*, which see.

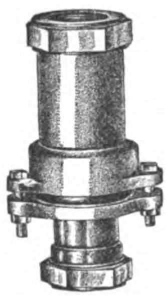
Ex-hi-bi'tion. The following figures are given as to the number of exhibitors and visitors on the occasions named: —

	Exhibitors.	Visitors.
London . . 1851	13,917	6,039,195
Paris . . . 1855	23,954	5,162,330
London . . 1862	26,653	6,211,103
Paris . . . 1867	50,236	8,805 969
Vienna . . 1873	20,205	6,740,500
Philadelphia 1876	-	9,857,625
Paris . . . 1878	-	16,159,719

Ex-pand'ing Chuck. A chuck, the jaws of which are opened or closed to admit objects of varying sizes. See DRILL CHUCK for instances, though other chucks have similar adjustment.

Ex-pand'ing Cul'ti-va'tor. One with hinged bars, capable of being spread apart at the rear, so as to adjust the width of tilth.

Fig 988.



Expansion Pipe Joint.

Ex-pan'sion En'gine. A steam engine working steam expansively. The invention of *Wolff.* See CUT-OFF; EXPANSION VALVE.

Ex-pan'sion Hang'er. A suspended hanger for radiator pipes, permitting the changes in length due to expansion by heat.

Ex-pan'sion Joint. A slip joint, to allow the contraction or extension of tubes incident to the changes of temperature. Applied to coils or lines of steam, hot water, or condenser pipes.

In ordinary instances, it has a cast-iron body, with brass sleeve and screw ends.

Ex-pan'sion of Met'als Ap'pa-ra'tus. An instrument devised by Prof. A. M. Mayer, of Stevens Institute, for the purpose of determining experimentally the co-efficient of expansion of metals and alloys.

The bar, whose co-efficient of expansion is to be determined, is supported on standards in a brass tube, which is made about ¼" shorter than the bar. Against the ends of the bar are placed rubber washers, which are perforated so as to allow the ends of an abutting screw and a rod connecting with the moving mirror of the comparator to come in contact with the ends of the bar. Arrangements are provided which hold the washers perfectly water and steam tight against the ends, while the bar is perfectly free to expand or contract in the tube. Inside the tube are supporting springs, which relieve the standards in some degree from the weight of the bar.

"*Scientific American*" . . . . * xxxvii. 351.

See also DEFLECTOMETER, p. 249, and reference there cited.

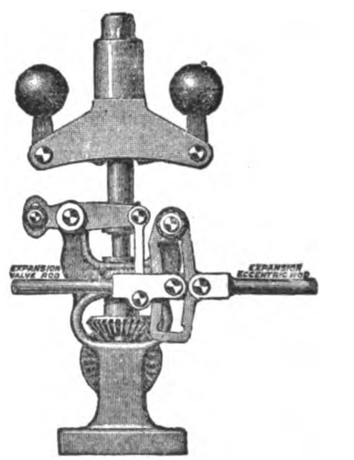
Ex-pan'sion Valve Gear. An automatic apparatus to cut off live steam from the cylinder at any required portion of the stroke.

The Corliss system has been very largely adopted in this country and in Europe, and, to follow the words of M. de Wilde, may be defined —

"As consisting of an assemblage of parts, acting as one upon the cylinder valves under the impulse of an eccentric or cam, while the governor of the engine at the desired moment causes the separation of the assemblage into two distinct portions, of which one continues to obey the action of the eccentric or cam, while the other, which is in immediate contact with the valves, escapes from its influence and closes the steam-port."

Hartnell's expansion-valve gear consists of a sensitive governor acting through a link and die upon an expansion cut-

Fig. 989.



Hartnell & Guthrie's Expansion-valve Gear.

off valve working at the back of the main slide valve, the ordinary throttle valve is dispensed with, and the speed of the engine controlled by means of the expansion valve which regulates the admission of steam into the cylinder exactly in proportion to the duty performed by the engine.

See also CUT-OFF, *supra*.

Ashworth	* "*Sc. Amer. Sup.*," 438
Berghof, Hungary	* "*Engineering*," xxix. 35
Brown, Br.	* "*Engineering*," xxx. 271.
Calow, Ger.	* "*Engineering*," xxx. 483.
Crohn, Br.	* "*Engineering*," xxi. 516; * xxx. 179.
Collmann, Ger.	* "*Engineering*," xxiv. 472.
De Negri	* "*Engineer*," xlviii. 451.

Galloway, Br.	* "*Engineer*," xlvi. 241.
Guinotte, Fr.	* *Thurston's* "*Vienna Rept.*," iii. 63.
Hartnell, Br.	* "*Engineering*," xxii 474.
Joy, Br.	* "*Engineer*," l. 114.
	* "*Engineering*," xxx. 179.
Kaiser, Br.	* "*Engineering*," xxx. 271.
Knuttel	* "*Engineering*," xxx. 348.
Marshall, Br.	* "*Engineering*," xxx. 127, 271.
Melvin, Br.	* "*Engineering*," xxx. 149.
Proell, Ger.	* "*Engineering*," xxix. 416.
Rigg, Br.	* "*Engineer*," xlvi. 423.
Thompson, "Buckeye"	* "*Engineer*," xlii. 262.
Winding engines, Essen	* "*Engineering*," xxx. 258.
Walschaert, Belg.	* "*Engineering*," xxx. 159.
Weatherhogg, Br.	* "*Engineering*," xxii. 362.
	* "*Sc. American Sup.*," 962.
Zimmermann-Waldmann, Ger.	* "*Engineering*," xxx. 205.

Lemounier & Vallée (Fr.) * *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," vol. iv., ed. 1877, article "*Détente, Soupape à.*"

Ex-pan'sive Hol'low Au'ger. One having an adjustability for cutting round tenons of varying sizes. See page 185, "*Mech. Dict.*"

Ex-plor'ing In'stru-ment. 1. (*Surgical.*) A diagnostic instrument, various in kinds and applications. For instances: —

Eustachian canal	Fig. 189, Part II.
Exploring trocar	Fig. 181 c, Part III.; 288–290, Part I.
Small trocar and acupuncture for rectal explorations	Fig. 608, Part III.
Uterine probes and sounds	Page 73, Part III.
Bougies for exploring urethral strictures	Page 9, Part III.
Exploring director for bistouries	Page 135, Part I.

All in *Tiemann's* "*Armamentarium Chirurgicum.*"

See also BULLET SEEKER; PROBE; SOUND; BOUGIE, etc.; see List under SURGICAL INSTRUMENTS, "*Mech. Dict.*," *et infra*.

2. (*Dentistry.*) A fine-pointed probe, right, left, straight, bent, bayonet-shaped, etc., for testing the depth or existence of caries in teeth.

Ex-plo'sion Ma-chine'. A motor which depends for its force upon the explosion of substances generating a gas which is used under pressure in an engine or apparatus.

Several gunpowder engines are noticed on p. 1041, "*Mech. Dict.*"

The gunpowder pile driver on same page.

The gas engines on pages 948, 949, *Ibid.*

See also GAS ENGINE, *infra*.

Laboulaye's "*Dictionnaire*," ii., article "*Explosion*," mentions *Brown's* machine, 1830, and that of *Selligue*, 1834; the latter for moving boats without the intervention of mechanism, the gases issuing at the stern and impinging on the water.

Ex-plo'sives. These may be classed generally as follows: —

Gunpowder.
Gun cotton.
Nitro compounds:
  Nitro-cellulose.
  Nitro-glucose.
  Nitro-starch.
  Nitro-glycerine and its compounds.
Picric acid:
  A trinitro-phenol.
Fulminates:
  Fulminating mercury.
  Fulminating silver.
  Chlorate of potassium and sulphide of antimony; needle-guns of Germany.
  Sulphur and chlorate of potassium.
  Red phosphorus and chlorate of potassium. *Armstrong's*.

The mixture of nitro-glycerine with dry pulverized absorbent substances has given rise to a variety of explosives of which the name *dynamite* is perhaps generic. The following names have been given to various compositions, or the article furnished by various manufacturers. Many of these names are found in their alphabetical places in the present volume. The difference between the articles is largely in the proportions of the materials: —

Dualin.	Jupiter powder.	Titanite.
Giant powder.	Lignose.	Titan powder.
Hercules powder.	Mica powder.	Vigorite, etc.
Neptune powder.	Rendrock.	Vulcan powder.
Potentia powder.	Sebastine.	
	Thunderbolt powder.	

The report of the United States Board of Army Engineers presents the following table as the result of two years' trial of the relative efficiency of the various modern explosives, taking ordinary dynamite as the standard: —

Dualin	111
Hercules powder, No. 1	106
Dynamite, No. 1	100
Rendrock	94
Gun cotton	87
Dynamite, No. 2	83
Hercules powder, No. 2	83
Mica powder	83
Vulcan powder	82
Nitro-glycerin	81
To which may be added for comparison: —	
Blasting gunpowder, No. 1	30

See also table by Bertholet on p. 818, "*Mech. Dict.*"

Explosive by Prof. Emerson Reynolds, Dublin: —

Chlorate potassium	75
Sulphurea	25

The latter is a product of gas manufacture.

The articles may be stored and carried separately without any danger, and the article produced instantaneously by a comparatively rough mixture of the components.

See *Abbot's* report "*Centennial Exhibition Reports*," vol. vi., Group XVI., p. 52 *et seq.* Including: —

Nitrates.	Pebble and pellet powder.
Chlorates.	Nitro-glycerine.
Gun cotton.	Picrates.
Fulminates.	

Dussauce's "*Treatise on the Fabrication of Matches, Guncotton, and Fulminating Powder.*"

Burgoyne, "*Blasting and Quarrying of Stone, and Blowing-up of Bridges.*"

Cf: Exploders, etc., Austrian	* "*Engineering*," xxvi. 369.
Explosives, paper by C. Rice	"*Scientific Am. Sup.*," 2329.
Comp. energy of	"*Man. & Builder*," xii. 206.
Comparative values, *Drinker*	"*R. R. Gazette*," xxii. 14.
	"*Sc. Amer.*," xxxiv. 2, 102; xxxviii. 210; xxxix. 191, 360; xl. 259; xlii. 276.
	"*Sc. Am. Sup.*," 134, 2018, 3874.
	"*Eng. & Min. J.*," xxv. 346, 361.

See under the following heads: —

Azotine.	Nitro-glycerine.
Blasting gelatine.	Papyroxyline.
Breaking-down machine.	Pebble powder.
Carbo-azotine.	Pebble-powder machine.
Cube powder.	Pellet powder.
Diorrexine.	Pellet-powder machine.
Drying house.	Petralite.
Drying stove.	Potentite.
Dualin.	Poudre brutale.
Dusting machine.	Powder dusting machine.
Dynamite.	Powder paper.
Explosive gelatine.	Powder-pressing machine.
Gelatine, blasting.	Priming machine.
Glazing barrel.	Prismatic powder.
Granulated-wood powder.	Pyrophore.
Granulating machine.	Pyrophorus.
Gravel powder.	Pyroxyline.
Gun cotton.	Saltpeter and sulphur-grinding mill.
Gunpowder.	Saltpeter, sulphur, and charcoal mixing mill.
Gunpowder machine.	Sebastine.
Herakline.	Squib.
Jelly powder.	Tonite.
Johnite.	Vigorite.
L. S. G.	Vulcan powder.
Lignose.	
Nitro-gelatine.	

Ex-plo'sive Bul'let. Two explosive bullets are mentioned under BULLET, p. 401, "*Mech. Dict.*" These were intended for war, but the military service of civilized nations has not been disgraced by their use to any extent.

Fig. 990.

Explosive Shell.

The Dougall explosive bullet for heavy game is made thus: in pouring the bullet a small copper bottle is suspended in the center of the mold, so that it is inclosed by the lead except at the front where a tige holds the bottle and forms the future charging opening. It is charged with equal parts of sulphuret of antimony and chlorate of potassa, or with common powder, and primed with a fulminate. It is used for elephant, lion, tiger, and alligator shooting especially.

Ex-sec'tion In'stru-ments. (*Surgical.*) Instruments for removing sections of bone by sawing in two places, or by circular incision.

Special bow saw.	Trephine.
Metacarpal saws.	Elevator.
Chain saw.	Raspatory.
Interosseous saw.	Sequestrum forceps.
Circular saw.	Antrum drill.
Chisels.	Rongeur.
Bone drills.	Retractors.
Bone forceps.	Subcutaneous saw.

Ex'sic-ca'tor. A dessicator, which see.

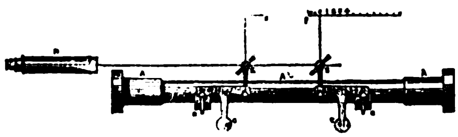
Ex-ten'sion Ap'pa-ra'tus. To extend a fractured limb in order to maintain the coaptation of parts. See COUNTER-EXTENSION APPARATUS; EXTENSION APPARATUS, "*Mech. Dict.*"

Dr. Levi's adjustable-weight leg-extension apparatus.
"*Scientific American Supplement*" . . . . . * 2101.

Ex-ten'sion Meas'ur-ing Ap'pa-ra'tus. An instrument for measuring minute extensions, deflections, and compressions by means of a multiplying optical arrangement.

A A is the test-piece; *B B* clips on the test-piece carrying

Fig. 991.



Willis's Measuring Apparatus.

pins; *C C*, weighted drop pieces forming connecting rods; *D*, a telescope fitted with a cross hair: *E E*, two mirrors turning on axes These have each a line across them for adjustment. *F F* are two scales carried on rails on a beam fixed to the roof, so that they can be adjusted to zero for any length of specimen. In looking through the telescope both scales are seen at once reflected in *E E*, and the figure on each covered by the cross hair is that which is read off for each strain. If both readings alter, the sum of the change is the extension of the bar. The short scale is for the end of the specimen next the lever of the machine, which should not move sensibly, but which does move small amounts due to the take-up of collars, and to differing positions of the steel-yard. The distance from the scales to the mirrors is about 11′. The radius of the levers *G G*, which cause the partial rotation of the mirrors as the specimen lengthens, is about 1½″ with the doubling of the angle caused by reflection; this gives a total magnifying power of about 140 to 1. The extension between certain definite points only on the bar is measured which eliminates errors due to the taking up of the bearings of collars, etc. The reading is, by estimation, up to 1-4000″. See also TASEOMETER.

Extension measuring app., *Willis*, Br. * "*Engineer*," xlvii. 385.
See also EXPANSION OF METALS APPARATUS, p. 320, *supra*.

Ex-ter'nal and In-ter'nal Gages. Standard caliper, ring, plug screw, and nut gages made to exact size and used for measurement and testing accuracy of templates, taps, etc.

Fig. 992.

Standard Caliper Gage.

The system may be said to have originated with Whitworth, but is now carried to great accuracy in several countries. In one case the instruments are of 3 classes, on a scale of precision.

Class *A* guaranteed to 1-25,000″.

Class *B* guaranteed to 1-10,000″.

Class *C* guaranteed to 1-5,000″.

Class *A* adjusted at 75° Fah.; *B* and *C*, 60° to 80°.

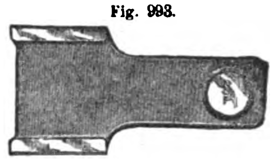
They have a parallel fit from ⅛″ to ¾″ in length; are arranged by sixteenths of an inch from ⅛″ to 2¼″; by eighths to 4″; by fourths to larger sizes. Made also in millimeters.

Fig. 992. External caliper gage for turning: crescent pattern.

Fig. 993 is the flat-bar pattern, internal gage: for boring.

Plain external and internal gages are shown under CYLINDRICAL GAGE, Fig. 772, p. 244, *supra*.

Fig. 993.



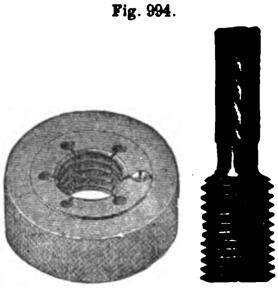
Standard Internal Gage.

Fig 994 shows screw-thread gages, external and internal.

Ex'tir-pa'tion For'ceps. (*Surgical.*) Forceps having on each arm double claws for reaching around and grasping the eye-ball in the operation of extirpation.

Blitz's, Fig. 80, *f*, Part II., *Tiemann's* "*Armamentarium Chirurgicum.*"

Fig. 994.



Screw-thread Gages.

Ex-tract'or. (*Fire-arm.*) The device which withdraws the spent cartridge capsule in the motion of uncovering the breech for reloading.

Ex'tra Cur'rent. (*Electricity.*) The *appreciable* current in the primary coil, which is due entirely to induction.

Eye. (*Add.*) 1. (*Nautical.*) A sheave for a rope; see DEAD-EYE; BULL'S EYE; HEART, "*Mech. Dict.*"

2. (*Vehicles.*) The socket on a shaft or pole which connects with the clip on the axle.

Fig. 995.

Pole and Shaft Eyes.

a. Pole eye.
b. Shaft eye.
c. Shaft eye plain.
d. Completed coupling.

Eye, Ar'ti-fi'cial. A false eye for persons, stuffed animals, etc., and dolls.

The material for the artificial eye is a rod of glass about the size of a pencil. On the end of this a bulb is blown of the size of the eyeball with which it is to match, and having a slight ovality. At the place for the iris and pupil the little sphere is flattened, and a circular patch of black pigment placed in the center to form the pupil. The painting of the iris is a very delicate matter, and the colors and proportion are studied from the sound eye of the patient. With enamel colors from a palette the zone around the pupil is colored, and then a bulb of clear crystal glass is placed over it to form the cornea, flat side down, and is fastened by fusing its edge by the blow-pipe flame. The red veins of the ball are imitated from the sound eye, being fine films of red glass laid on, and subsequently fused. The fitting to the *stump*, as the remaining portion of the ball is termed, is a matter of great nicety.

Eyes for birds, etc., are made in great quantity, both for museums and for the dressing of ladies' hats. Finch, humming-bird, partridge, pheasant, blue creeper (African), and scarlet tanager, are among the most common. Eyes for foxes, stags, rocking-horses, wax figures, prize animals and winners, trophies of the chase, dolls, are also made in large quantities, varying from 1 cent per dozen to 75 cents per pair.

Siemens' sensitive artificial eye, * "*Sc. American*," xxv. 874.

Eye Bar. An iron bar, with a round eye at each end usually. Much used in iron bridge building. Machine for drilling eyes; Fig. 854, p. 269, *supra*.

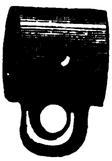
Eye Block. A tackle block with an eye or loop above, for shackle or lashing.

Eye Douche. (*Surgical.*) An apparatus for sending a fine shower of water upon the eye. Agnew's has an elevated pan, hung upon a hook, and a caoutchouc tube with spray nozzle.

Fig. 95, p. 27, Part II., *Tiemann's "Armamentarium Chirurgicum."*
See also Eye Cup, p. 819, "*Mech. Dict.*"

Eye Fer'rule. A thimble with an eye loop. Used with swingle trees, and for many other purposes.

Fig. 996.



Eye Ferrule.

Eye Glass. (*Add.*) A single myopic or presbyopic glass worn in the eye.

A double glass with a spring in a *pince-nez*. See Fig. 1909, p. 819, "*Mech. Dict.*" Also Spectacles, Fig. 5355, p. 2258, *Ibid.*

Blethen's eye-glass.
* "*Scientific American*," xlii. 5.

Eye In'stru-ments. (*Surgical.*) These are for diagnosis and exploration, operation, prothesis. See under the general heads, *b, e, f, g, h*; and under the special titles in following list: —

a. Instruments for operating on the lids and lachrymal ducts: —

Entropium forceps.	Depilating forceps.
Trichiasis forceps.	Eye speculum.
Eyelid tourniquet.	Eyelid retractor.
Cilia forceps.	Lachrymal duct dilator.
Eyelid compressor.	Drop glass.
Canalicula dilator.	Lachrymal syringe.
Probe.	Subpalpebral syringe.
Eye syringe.	Lachrymal gouge.
Conjunctiva forceps.	Fistula knife.
Cauterizing canula.	Canalicula syringe.
Bistoury caché.	Needle forceps.

b. Strabismus instruments.

c. Fixation and extirpation instruments: —

Fixation hook	Extirpation forceps.
Fixation forceps.	Double hook.
Tumor Forceps.	Ophthalmostate.
Pamard's pique.	Lid forceps.

d. Instruments for removing foreign bodies from the eye:

Spud.	Spatula.
Needle.	Curette.
Gouge.	Spoon.
Hook.	Eye douche.
Couching needle.	Forceps.

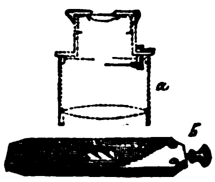
e. Conjunctiva instruments.
f. Corneal instruments.
g. Cataract instruments.
h. Iris instruments. Iridectomy Instruments.

Eye'let Grom'met. A worked hole in a sail, reënforced by an eyelet. See Grommet.

Eye'-piece In'di-ca'tor. A small pointer with lateral movement in the eye-piece of the top lens, for pointing out any particular portion of an object under view.

The eye-piece micrometer is adjusted across the line of sight, and its cross markings divide the field into squares of known size.

Fig. 997.



a. Eye-piece Indicator.
b. Eye-piece Micrometer.

Eye-piece, microscopic.
* "*Manuf. & Builder*," xi. 37.
Telescopic, *Nystrom.*
* "*Sc. American Sup.*," 101.

Eye Pro-tec'tor. Glasses, goggles, or gauze worn over the eyes.

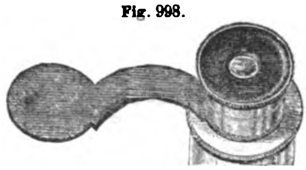
Smoke, or other colored glasses, to moderate the light; goggles to exclude side light; gauze, to exclude dust and cinders. See Spectacles, p. 2358, "*Mech. Dict.*"
The *coquille* glass is egg-shell shaped.
Millers' and turners' glasses are merely white panes of glass or mica, to protect the eyes from chips. See also Goggles, Fig. 2263, p. 991, *Ibid.* Also Iris Diaphragm, Fig. 2697, p. 1195, *Ibid.*

Eye Shade. (*Optics.*) *a.* A hood or vizor over the eyes to protect from upper light.

b. A hood fixed on the eye-piece of a microscope to prevent lateral rays from entering the eye.

c. A piece fitted around the cap of the eye-piece of a microscope, and intercepting the view of that eye which is not in use; in order to prevent the distraction of the attention, or obviate the necessity for the muscular closing of the unused eye.

Fig. 998.



Eye Shade (c).

F.

Fab'ric. (*Fabric.*) A woven or felted goods.

The character depends upon the material and the *armure* or character of the weave.

Varieties of armure: —

1. *Taffeta* with 2 harnesses.
2. *Twilled* with 4 harnesses.
3. *Serge* with 3 harnesses.
4. *Satin* with 5 or more harnesses.

Different effects are produced —

By derivatives from these fundamental tissues.

By greater or less torsion of the threads.

By the direction in which the yarns are twisted.

By variations in the relative sizes of the warp and weft threads.

By causing the weft to pass alternately over two threads and one thread of the warp; making a *rep* or corded tissue.

By different materials of warp and weft.

By colors.

By mixtures of materials in the yarn.

By printed threads making *hit-or-miss*, or *mixtures*.

By looping threads, to make *pile* fabrics; and cutting or non-cutting the loops.

By printing.

By dyeing.

By floating the weft to make dots, spots, stripes, or figures.

By character of material, as of soft and fine wools or of hard and lustrous combing wools.

By two or more warps which are brought to the surface as required by the figure.

By setting up bands of colors or varying yarns in the warp to form stripes.

By adding to the last mentioned a similar arrangement in the weft to make checks or plaids.

By combinations of the crossing threads which occur at variable places.

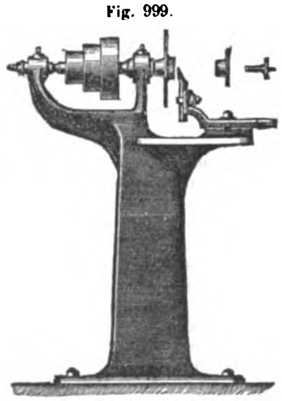
See Aino cloth.	Arras.
Algerine.	Australian crape.
Alpaca.	Baize.
Alpaga.	Barége.
Alpine.	Basket.
Anacostia.	Batavia weave.
Armure.	Baudekin.

Biaretz.
Bolivar.
Bombazine.
Bourdalisandre.
Brilliantine.
Brocade.
Buckram.
Burlaps.
Calico.
Cambric.
Camel's hair.
Cannel.
Cashmere.
Cashmere de beige.
Challis.
Chambery gauze.
Chinchilla.
Chintz.
Circassienne.
Cordwain.
Cotton.
Cramoisy.
Crape of Spain.
Cretonne.
Cypresse.
Damask.
Debeige.
Delaine.
Diagonal.
Diaper.
Dimity.
Drap d'Alma.
Drap d'Alpes.
Drap d'Nationelle.
Drap d'Été.
Drugget.
Duck.
Empress.
Épengline.
Épinglé.
Frieze.
Fustian.
Gauze.
Gingham
Grenadine.
Grisaille.
Henrietta cloth.
Hernani.
Imperial silk serge.
Jean.
Jupon.
Kerseymere.
Knickerbocker.
Lindsey-wolsey.
Llanos.
Luster.
Manteau.
Metelasse.
Melango.
Merino.
Merino tulle.
Mexican cloth.
Mohair.
Mohair glacé.
Moire.
Moulleton.
Mousseline.
Mousselin de beige.
Mozambique.
Muslin.
Nankeen.
Palampore.
Paramatta cloth.
Pongee.
Poplin.
Punjam.
Rayne.
Rep.
Salampore.
Sarsnet.
Satin.
Satine.
Satin weave.
Sendal.
Serge.
Serge armure.
Sicilienne.
Siclatoun.
Sindon.
Taffeta.
Taffetas.
Taffetas armure.
Tamise
Tamise rep.
Tars.
Tissue.
Toile de Saxe.
Turenne cloth.
Turquoise.
Tusser silk.
Twilled armure.
Valencia.
Velours.
Veloutine.
Velvet.
Vigogne.
Vode.
Worsted.

Face. (*Mining.*) The end of a drift or tunnel.

Face Ham'mer. (*Masonry.*) One with one blunt and one cutting end. The latter used for roughly squaring stones preparatory to the use of finer tools.

Fig. 999.



Face Lathe.

Face Lathe. 1. A pattern-maker's lathe for turning bosses, core prints, and other face work. The instance shown works up to 16″ diameter, and stands on 2′ × 2′ on the floor. The spindle is of steel, with brass bearings.

2. A lathe with a large face-plate and a slide rest adjustable in front on its own shears. Transverse usually but not necessarily.

Fetu & Deliege, Fr. . . . * "*Engineering*," xxix. 117.

Face'-plate. (*Add.*) 2. A covering plate for an object to receive wear or shock.

Fa'cing Ma-chine'. (*Milling.*) A machine for dressing the faces or lands of mill stones; that is, the spaces between furrows. A furrowing machine. See MILL-STONE DRESSER.

Fa'cing Tool. See CORUNDUM TOOL; MILL-STONE DRESSER.

Fac-sim'i-le Print'ing Pro'cess. A term including the various systems of printing from a pad — usually of glycerine and gelatine — upon which the original writing in aniline ink has been transferred. See COPYGRAPH; COPYING PENCIL; HECTOGRAPH; and other titles there cited.

Fac-sim'i-le Tel'e-graph. One reproducing autograph messages.

Sawyer's autographic telegraph; also called *copying telegraph, pantelegraph, pantographic telegraph*, was described and illustrated in "*Telegrapher*," 1876; reproduced in "*Scientific American Sup*," * 802. See also "*Iron Age*," xviii., July 20, p. 3.

It operates by placing the thin plate containing the transferred message upon a cylinder at the transmitting end and a sheet of chemically prepared paper around a similar cylinder at the receiving end. As the cylinders are moved along by threads, the synchronous styles are carried around the cylinders and make the synchronous contacts as the transmitting style crosses the lines of writing. See AUTOGRAPHIC TELEGRAPH, "*Mech. Dict.*," *et supra*. See also ELECTRIC WRITING APPARATUS, *supra*, and PANTELEGRAPH, *infra*.

D'Arlincourt . . "*Jour. Soc. Telegr. Eng'rs.*," viii. 15.

Fa'ger-sta Steel. Steel made by the partial decarbonization of crude cast iron containing a considerable portion of manganese, by running the molten iron direct from the blast furnace into a Bessemer converter, where the carbon and manganese are partially removed by being burned out by the oxygen of the air used in the Bessemer process. This leaves in the metal the required amount of carbon and manganese to render it suitable for use. The usual Bessemer practice is first the removal of all the carbon and afterward to recarbonize with spiegeleisen, which is a compound of iron, carbon, and manganese.

"*Iron Age*" . . . . xix., Feb. 1, p. 15.

Fag'got-ed Ax'le. One made of a pile of bars or rods tilted.

Faïence (pr. *fa-iān-s*). (*Ceramics.*) Enameled pottery. There are two species of faïence. the common faïence (*faïence commune*) which is a soft paste, and the fine faïence (*faïence fine*) which has a hard paste.

1. COMMON FAÏENCE is supposed to have originated in Persia, having been brought thence by the Saracens and introduced into Africa and Spain.

The stanniferous glaze which distinguishes faïence (*poterie émaillées*) from the ordinary pottery with plombiferous glaze (*poterie tendre vernissées*) was known to the Egyptians and to the Mesopotamian nations; but the art of enameling ceramic ware and tiles seems to have been again invented by successive persons.

The stanniferous enamel ware of the Saracens of the 12th century is very famous, being in extremely brilliant colors. The tiles known as Azulejos, and the Hispano-Moresque plaques and vases are also celebrated. The Saracenic pottery of the island of Majorca gave a name to the ware *majolica*. The *mezza majolica* of the 15th and 16th centuries had a leaden glaze. See MEZZA MAJOLICA.

The name *faïence* comes from Faënza, in Italy, a town celebrated for its wares, and the most famous potter on the peninsula is Luca della Robbia, of Florence, who flourished about the middle of the 15th century. He rediscovered the stanniferous enamel which soon largely superseded the previously used lead-glaze, which still, however, held its place for common ware, as it does to this day; the third order in the first class of Brogniart's classification. See POTTERY.

French *faïence* took its rise with the admirable Bernard Palissy, of Saintes, about 1535. His work had raised decorations, principally of aquatic subjects, such as fish, lizards, shells, and water plants. He died in the Bastile for his faith.

Common faïence has a soft body (*pâte tendre*), and a tin glaze, colored with various metallic oxides, and is twice fired. The body is composed of plastic clay, argillaceous marl, and sand. The clays are washed.

The following proportions are those of M. Bastenaire d'Audenard: —

	White Faïence.	Brown Faïence.
Silex	0.35	0.38
Ferruginous clay	0.58	0.57
Carbonate of lime	0.07	0.05
	1.00	1.00

The fashioning is done by molding or on the wheel, according to the character of the object. The baking of the green ware is done in a kiln at a temperature from a cherry-red to a black-red, and the subsequent firing after enameling at a somewhat higher temperature. The first firing is frequently done in the same kiln at a point more remote from the ingress of the flame.

The ware in the kiln is inclosed in some way; the modes differ. The style known in France as *l'enfournement en échappade*, consists in building up within the kiln a series of stories with refractory flat tiles and perpendicular supports, the ware being thus in cells, where it rests on the tiles directly, or on the points or edges of little prisms, or tripods (*colifichets*) of refractory clay. See SEGGAR.

See Figs. 3882, 3926, 3927, "*Mech. Dict.*" Also, Figs. 2169, 2180, *Laboulaye's* "*Dictionnaire*," ed. of 1877, tome iii., caption "*Poterie.*" For the system of inclosure in the kiln, see SEGGAR, p. 2089, "*Mech. Dict.*"

Another system is called *l'enfournement en cazette à pernettes*, and consists of a seggar in which the dishes or plates are supported by shifting ledge pieces which fit into grooves around the inside of the *cazette*, or fire-clay box. See SEGGAR.

The enamel for brown faïence is composed of: —

Minium	0.52 to 0.58
Peroxide of manganese	0.07 to 0.05
Common brick, pulverized	0.41 to 0.42
	1.00 1.00

The enamel for white faïence is of two kinds, differing principally in the proportion of tin in the metallic oxides which form an ingredient in the frit.

	Hard Enamel.	Soft Enamel.
Oxide of lead	No. 1. 0.77	No. 2 0.82
Oxide of tin	0.23	0.18
	1.00	1.00

Take of:		
No. 1	0.45	
No. 2	-	0.45
Minium	0.02	
Washed quartz sand	0.45	0.45
Marine salt	0.05	0.07
Soda of Alicante	0.03	0.03
	1.00	1.00

Color is given by Naples yellow, lasuli, manganese, or copper scales.

The ingredients are brought to an impalpable powder and then to a fine creamy condition in which the slip is aspersed over the object, or the latter is dipped into it.

Common faïence is much employed for wall and floor tiles, stoves, chimney plaques, etc., for which purpose any tendency to crack with the heat may be avoided by giving more fusibility to the paste by the addition of lime or alkali, but the addition of lime in any great quantity makes them apt to split with sudden variations of temperature.

2. FINE FAÏENCE, otherwise known as English *faïence*, or *English china*, is a ware of an entirely different description from common faïence; it is an English discovery, and the best quality is still made there. It is the invention of William Wedgewood, born at Burslem, in Staffordshire, in 1730.

Fine faïence is characterized by an opaque white paste, fine dense texture, and sonorous quality. It is essentially composed of a washed plastic clay, calcined flint, or finely ground quartz.

The glaze is a fritted compound of silex, soda, oxide of lead, with the addition sometimes of boracic acid

There are three principal compositions, the names of which signify the use of notable quantities of certain ingredients in the respective pastes.

a. Calcareous or pipe-clay faïence. (Schumann.)

Pipe-clay	0.854
Silex	0.130
Chalk	0.016
	1.000

b. Flint faïence. (Oppenheim and Bastenaire.)

Pipe-clay of Montereau or Dreux	0.87
Silex	0.13
	1.00

Or: (Oppenheim and St. Amans.)

English pipe-clay	0.87
Silex	0.13
	1.00

c. Feldspathic faïence. (St. Amans.)

English pipe-clay	0.62
Kaolin	0.16
Silex	0.19
Feldspar	0.03
	1.00

Or: for "Cream color." (St. Amans.)

English pipe-clay	0.82
Silex	0.16
Feldspar	0.02
	1.00

Or: (Aiken.)

English pipe-clay	0.64
Kaolin	0.16
Silex	0.16
Feldspar	0.04
	1.00

Chalk is present, however, in all the pastes, as it is an incident to the clay and the flint.

The materials are washed, ground extremely fine, sifted, made into a slip which is strained, the pulp condensed by heat, and laid in cellars to ripen; after the manner of the Chinese, who use the clay prepared by their fathers, and prepare a new batch for the coming generation.

The paste is fine, plastic, and easily worked, and the pieces are made on the wheel with templets, gage slips, etc.; but many parts, such as handles, are made in molds and attached. Objects not symmetrical are either molded, or, as in convoluted work, thrown and then pressed to form.

The green ware is baked in the faïence kiln, and the biscuit is treated with the glaze slip either by immersion or sprinkling. The following are some recipes for the glazes of the respective wares cited above as *a*, *b*, *c*.

a. Glaze for pipe-clay faïence. (Schumann)

Calcined feldspar	0.07
Sand	0.31
Minium	0.30
Litharge	0.27
Borax	0.03
Flint glass	0.02
	1.00

Or: (Bastenaire-d'Audenard.)

Quartzose sand	0.36
Minium	0.45
Carbonate of soda	0.17
Niter	0.02
Cobalt blue	0.00001
	1.00

b. Glaze for flint faïence.	(Aiken.)	(Bastenaire.)
Feldspathic sand	0.40	0.42
Minium	0.23	0.26
Borax	0.23	0.21
Carbonate of soda	0.14	0.11
Cobalt blue	0.00001	0.00001
	1.00	1.00

c. Glaze for feldspathic faïence. "Cream color." (Aiken.)

Flinty kaolin	0.25
Silex	0.13
Oxide of lead	0.52
Flint glass	0.10
	1.00

For printed faïence. (Shaw.)

Flinty kaolin	0.28
Silex	0.16
Carbonate of lime	0.04
Oxide of lead	0.30
Boracic acid	0.06
Carbonate of soda	0.16
	1.00

The small quantity of cobalt blue in some of the above glazes is merely to correct the yellow color.

The degree of heat in the final firing of the three classes of fine faïence above noted are respectively: —

	Pyrometric.
a. The pipe-clay biscuit and glazed ware	25° to 30°
b. The flinty biscuit	60°
The flinty ware	12°
c. The feldspathic biscuit	100°
The feldspathic ware	20° to 30°

The setting of the green ware or the glazed article in the kiln is by the same means as described under common faïence (2). See SEGGAR.

The faïence kiln of Staffordshire, Fig. 3926, p. 1779, "*Mech. Dict.*," is inclosed in a large dome, which serves to conduct upward the smoke and flame issuing at the openings of the kiln proper. The furnaces are *à alandier*, so called, probably, from the way the fuel is supported on the grate. The furnaces are placed around the base of the kiln, and the draft is downward through a furnace hole into the fire, and thence by ducts below the floor and chimney to the kiln chamber. See Fig. 36, p. 20, *supra*.

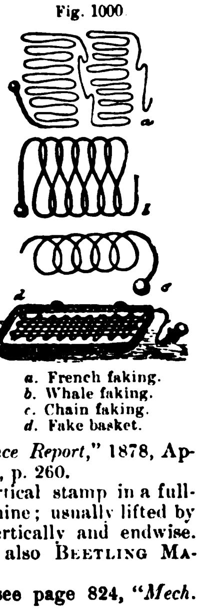
Faïence d'Oïron. (*Ceramics.*) Also known as *Henri Deux ware.* Attributed to a private pottery establishment, the atelier of Hélène de Hange-t-Genlis, widow of Arthur Gouffier, and afterwards carried on by her son. Evidently a labor of love and art devotion.

Biscuit of fine clay is graven and the lines filled in with colored clays, the object glazed and fired. It is very rare. See HENRI-DEUX WARE.

Faïence Stan'ni-fere. (*Ceramics.*) Ware with glaze of oxide of tin.

Fake. A coil or disposition of rope in zig-zag, so as to run free when let go, or when a shot attached to one end of the line is fired, as in life-saving apparatus for stranded vessels.

Fig. 1000



a. French faking.
b. Whale faking.
c. Chain faking.
d. Fake basket.

Fak'ing Box. (*Life-saving Apparatus.*) A box to contain the lines for shot firing to communicate with stranded vessels. A *fake* is a coil of rope; it is usually a helix, and a number of such built one upon another form a tier. In the faking of ropes, however, in the life-saving apparatus the fakes assume another form to enable the rope to pay out with the least impediment, so as to allow good range of the projectile without excessive charge and also avoid breakage of the shot line. "*Ordnance Report,*" 1878, Appendix P, p. 200 *et seq.* Also, p. 260.

Fall'er. (*Add.*) 2. A vertical stamp in a fulling, milling, or stamping machine; usually lifted by cams and allowed to drop vertically and endwise. See STAMPING MILL. See also BEETLING MACHINE, *supra*.

Faller motion (spinning), see page 824, "*Mech. Dict.*"

Faller motion (mule) . * "*Engineering,*" xxx. 511, Figs. 13 to 17.

Fall'er Ma-chine. A machine with vertical stamps or fallers, used in milling goods.

False Joint Ap'pa-ra'tus. (*Surgical.*) Apparatus for ununited fractures.

Femur, *Smith's*	Figs. 170, 180.
Humerus	Figs. 51, 172.
Tibia	Figs. 80, 171.
Forearm	Fig. 173.

Tiemann's "*Armamentarium Chirurgicum,*" Part IV.

Fan. A form of blower or ventilator.

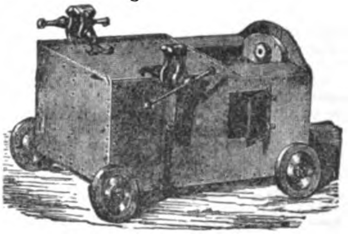
See the following references: —

Automatic, *Meyer*	* "*Sc. Am.,*" xxxix. 38.
Blower, "Eclipse," *Landis* . . .	* "*Iron Age,*" xix., May 17, p. 3.
Sturtevant	* "*Iron Age,*" xxv., Feb. 12, p. 1.
Exhibition (Liverpool)	"*Sc. Am. Sup.,*" 1559.
Guibal, *Sacre Madame Colliery*, Fr.	"*Engineer,*" xlvi. 368.
Japanese, mode of making . . .	"*Sc. Am.,*" xxxvii. 138.
Mill and elevator, Engl.	* "*Sc. Am Sup.,*" 2476.
Foot bellows	* "*Sc. Am. Sup.,*" 1382.

Fan'cy Broad Loom. An efficient loom for weaving fancy goods, worsted coatings, fancy cassimeres, etc. It is made up to 92″ wide, 27 harnesses, and 4 × 4 shuttle-boxes. — *Crompton.*

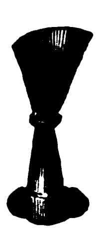
Fan Forge. A transportable form of forge and fan is shown in Fig. 1001. It has tool-chest, two vises, and weighs 800 pounds. See BLOWER; FORGE; BELLOWS, etc.

Fig. 1001.



Fan Forge.

Fig. 1002.



Fan Jet.

Fan Jet. A form of nozzle for watering-pots and engines having a fan or spoon shaped lip which deflects the stream of water into a wide and thin expanding film.

Far'ad. (*Electricity.*) The *capacity* of a condenser which holds one *weber* at a potential of one *volt.* — *Gordon.*

Far-a-da'ic Cur'rent. (*Electricity.*) An induced current, as contrasted with a voltaic or direct constant current.

Far-a-da'ic Gen'e-ra'tor. A generator of electricity named by its inventor after Prof. Faraday.

The armature below revolves between the iron blocks on which the electro-magnets stand. It consists of a cylinder of wood which is wound around with iron wire (see DYNAMO-ELECTRIC MACHINE, Fig. 900, Plate XII.), like a spool. Around the whole spool are numerous loops of insulated copper wire running lengthwise of the armature. The ends of these loops are taken to the cylindrical commutator which is on the armature shaft, and from this brushes made of copper wire take the current from the machine to line.

Edison . . . * "*Scientific American,*" xli. 239, 305.

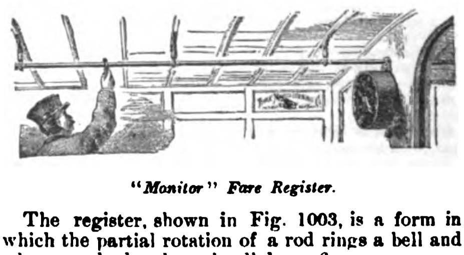
Fare In'di-ca'tor. 1. A device for counting and registering fares. The wicket-gate, ticket-punch, conductor's passenger register, etc., are familiar instances.

2. A device for indicating distance traveled. See ODOMETER, p. 1544, "*Mech. Dict.*"

See FARE PUNCH; TICKET PUNCH.

Fare Reg'is-ter. A device to keep a record of the number of passengers carried in a public vehicle. The conductor's ticket-punch is one form.

Fig. 1003.



"*Monitor*" *Fare Register.*

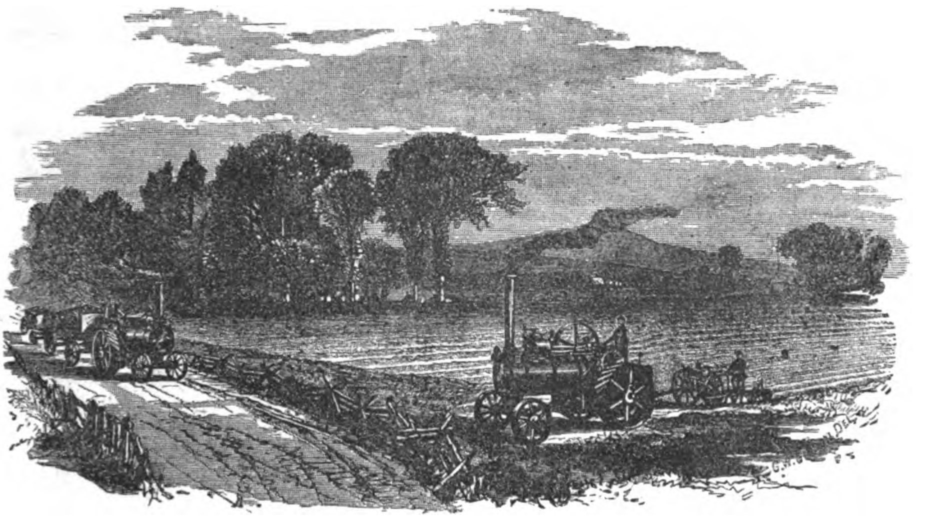
The register, shown in Fig. 1003, is a form in which the partial rotation of a rod rings a bell and advances the hand on the dial one figure.

Fare register, Johnson .	* "*Scientific American Sup.,*" 3.
Sketch of various devices	"*Scientific Amer.,*" xxxvii. 144.

Fare Wick'et. 1. A gate at which the passers-by are counted and registered, as at toll-bridges, exhibition grounds, etc. A *turn-stile.*

The turn-stiles used at the Centennial grounds, Philadelphia, 1876, are shown at pp. 576, 577,* vol. i., "*Report of the U. S. International Exhibition, 1876.*"

Fig. 1004.



Aveling & Porter's Farm Locomotive.

2. An opening in the door of a street-car for purchasing tickets of the driver, or for passing of fares to the conductor.

Fa-ri'na Boil'er. A saucepan with double chamber, the inner portion being in a bath of water. A double boiler.

Farm Lo'co-mo'tive. A traction engine, with adaptations to the operations of plowing, threshing, etc. See Fig. 1004.

See TRACTION ENGINE; ROAD ROLLER; PORTABLE ENGINE; STEAM PLOW, etc., "*Mech. Dict.*," *et infra.*

Aveling & Porter, Br. . . . . * "*Sc. Am.*," xxxvii. 162.
Farm machinery, on, *Knight* . . * "*Sc. Am.*," xxxix. 244.
Steam culture machines, *Knight*, * "*Paris Exposition Reports*," v., pp. 53-89.

Farm Mill. A mill for coarse grinding feed for stock. See GRAIN MILL, and various other titles, *passim.*

Fas-cine'. (*Hydraulic Engineering.*) A bundle of brush, bound into a cylindrical bundle, and secured with withes. Used in fortifications; in revetments for river-banks; in making mats for dams, jetties, etc. The fascine for mat-making is about 10″ in diameter, 12′ long, and bound with 3 withes. Six of such fascines are secured by poles to form a mat. See MAT.

For fascine making, see "*Report of Chief of Engineers of U. S. Army*," 1876, vol. ii., Part II., p. 404, and Fig. 2.
River-bank protection.
Chaplin . . . . . * *Van Nostrand's Mag.*," xix. 129.

Fast and Loose Pul'leys. The loose pulley has a smaller diameter than the fast pulley, in order that the belt may run slack when shifted to the loose pulley. — *Crafts & Filbert.*

Shinn, Philadelphia, Cooper's "*Belting*," 168.

Fau'cet. See "*Mech. Dict.*," * p. 827, and following references: —

Lempert . . . . * "*Sc. American*," xxxvii. 351.
Aud vent, *Talley* . . . . * "*Sc. American*," xxxiv. 198.
Bushing, *Manley* . . . . * "*Sc. American*," xxxiv. 38.
Hose attachment, *Trembley* * "*Scientific Amer.*," xxxv. 182.

Faure Bat'te-ry. (*Electricity.*) One in which the carbon is made in form of a cell filled with nitric acid and closed with a stopper; the pressure due to the evolution of the fumes in the vessel forces the acid through the walls of the cell, which thus performs the double function of a porous pot and a negative pole.

Niaudet. American translation . . . . 174.
See also SECONDARY BATTERY.

Feath'er, Ar'ti-fi'cial. Artificial ostrich feathers are made in New York of celluloid, rattan, and silk, and are an excellent imitation of the original. Patented machines make the silk, the flue, the quill, and combine the flue and silk. The quill-making machine takes an ordinary piece of rattan or celluloid and produces the quill in 15 seconds; the material is drawn between two grooved rolls. In the manufacture of the flues, the silk is stretched between two machines 75 feet apart, which wind, twist, cut, and spin it into a flue.

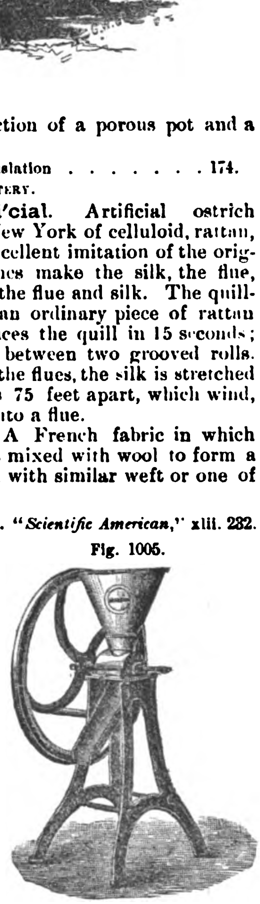
Feath'er Plush. A French fabric in which the down of feathers is mixed with wool to form a warp to be interwoven with similar weft or one of wool alone.

"*Textile Manufacturer*" . "*Scientific American*," xlii. 282.

Feed Boil'er. See AGRICULTURAL BOILER, *supra.*

Feed Crush'er. A mill for flattening grain to render it more easily masticated. A substitute for grinding. The *aplatisseur* of the French. See GRAIN CRUSHER.

Fig. 1005.



Feed Crusher.

Feed Cut'ter. A straw or chaff cutter.

Straw, *Silver & Deming.* * "*Iron Age*," xix., Jan. 4, p. 5.
Fodder, *Dick.* * "*Sc. Amer.*," xxxvii. 115.
* "*Mining & Sc. Press*," xxxv. 225.

See CHAFF CUTTER, ENSILAGE CUTTER, STRAW CUTTER, etc.

Feed Door. A furnace door for entry of coal. For automatic feed, see FURNACE DOOR, etc.

Feed'er. 1. A portion of an apparatus at which the material enters to be treated.

In many machines the feeder is merely a hopper such as in various mills. In other cases the feeder is a definite portion of the machinery which conducts the material in regulated quantities. See BOLT FEEDER; GIN, COTTON.

2. (*Mining.*) A small vein adjoining a larger one.

Feed'ing Tube. (*Surgical.*) These have various applications: for use in cases of lock-jaw, mania, choking paretics, paralysis of the throat, fractured jaw.

The instruments are introduced by the mouth, nose, or anus.

The mouth instruments are gags, spoons, and tubes

The nasal operation may be by a simple funnel, a tube in the pharynx, a tube directly into the stomach. The latter introduced by Dr. Tuke. A soft rubber Nelaton catheter is now used.

The rectal administration is by enema.

Feed Mill. See GRINDING MILL.

Feed Pump. A boiler supply pump. It assumes many forms. See list under PUMP; STEAM ENGINES AND APPARATUS, "*Mech. Dict.*" See the following references: —

Clegg	* "*Scientific American*," xl. 358.
Garrett, Br.	* "*Engineer*," xlviii. 430
"Eclipse," *Schultz* . .	* "*Iron Age*," xxi., May 16, p. 1.
"Economic," *Davis* . .	* "*Iron Age*," xxii., Dec. 12, p. 11.
	* "*Scientific American*," xii. 150.

Feed Reg'u-la'tor. A device for graduating the feed to the necessity of the object, as of fuel to a furnace, water to a boiler, material to a machine. See FEED WATER REGULATOR.

Feed Wa'ter Clean'er. See FEED WATER HEATER.

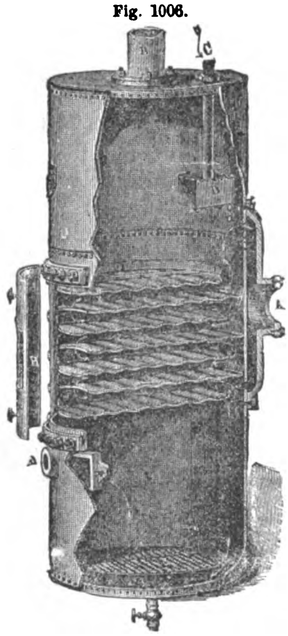
Feed Wa'ter Heat'er. An apparatus to use escaping steam or flue heat in raising the temperature of the water destined to feed the boiler.

These apparatus are of many forms, but of two general classes: —

1. Those in which the steam comes in direct contact with the feed water, as in the common *open heater*.

2. Those in which the feed water circulates through pipes which course through a chamber heated by the exhaust steam, or through a flue heated by the volatile products of combustion.

Fig. 1006.



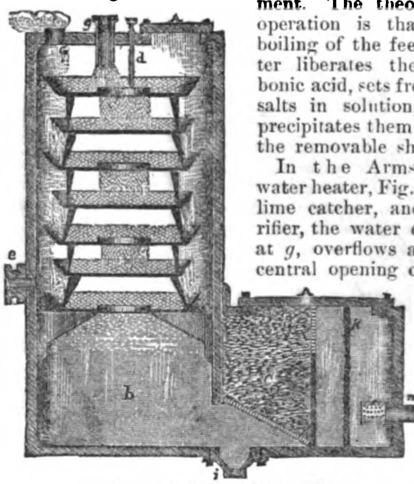
Stillwell Lime-extracting Feed Water Heater.

1. The feed water and exhaust steam mingled.

The Stillwell combined lime-extracting heater and feed-water filter is shown in Fig. 1006.

Steam enters the heater at A, is divided into two currents, upward and downward, and escapes at B. Cold water enters at C, pours over the edge of the over-flow cup D upon the corrugated depositing shelves, and then passes through chamber E, which is filled with a filtering material, and issues at a side opening. The bottom cock is for drawing off sediment. The theory of operation is that the boiling of the feed water liberates the carbonic acid, sets free the salts in solution, and precipitates them upon the removable shelves.

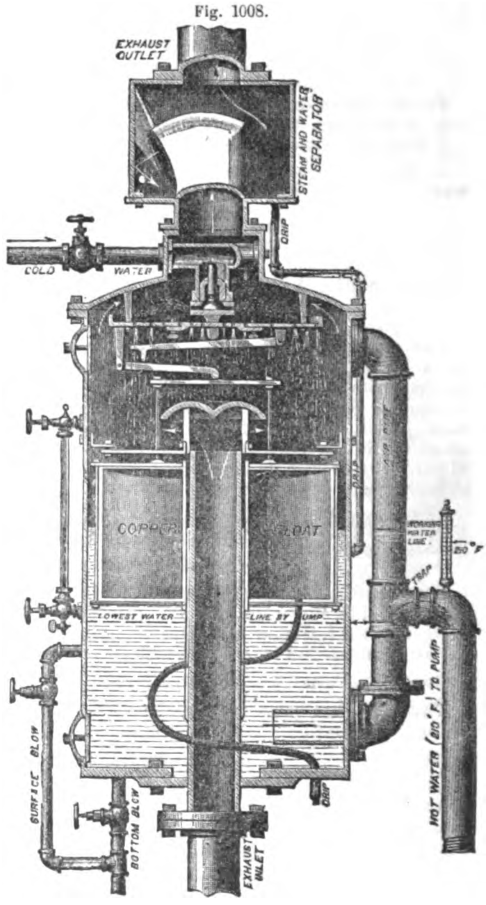
Fig. 1007.



Armstrong's Feed Water Heater.

In the Armstrong water heater, Fig. 1007, lime catcher, and purifier, the water enters at g, overflows at the central opening of the pan, thence into the second pan, over the margin

Fig. 1008.



Green Feed Water Heater.

of which it drips, and so on through the series of six pans, eventually reaching the settling chamber *b*. The water then passes upwardly through a filter, and then through an oil absorbent, *k*, made of burlaps. *m* is the outlet hot-water pipe, *e* inlet steam pipe, and *G* outlet; *A*, movable caps, to allow examination and cleaning; *i*, mud valve.

In the Jasper apparatus, instead of catching the lime and other impurities on shelves or in pans, these matters are detained in the mass of charcoal in the filters.

In the Green feed water heater, Fig. 1008, the water entering by the cold-wa'er pump passes through a valve-way, the position of the valve being regulated by a float below operating through levers, its own position being determined by the water level which corresponds to that in the boiler. The exhaust steam is admitted below, and parts with its heat to the water which trickles in rain through the perforations in the plate beneath the valve. The surplus steam then passes to the separating box above.

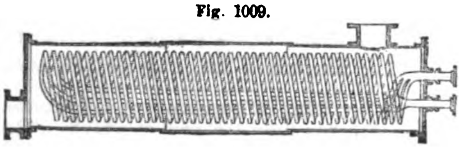
The Waters heater operates also by bringing the spray of exhaust steam in contact with a shower of water in a chamber.

The feed water heater of MM. Legris & Choisy, *Laboulaye's "Dictionnaire,"* iv., Fig. 3458, article "Chaleur Perdue," ed. 1877, is also founded upon the principle of introducing the water of alimentation in a fine spray in a pipe traversed by the exhaust steam of the engine.

2. The other class of feed water heaters consists of apparatus in which the heat of the exhaust steam is transferred by conduction through metallic walls to the feed water.

This is an old form of condenser; also long common on

Fig. 1009.



Feed Water Heater.

the Western rivers for heating feed water for boilers of non-condensing engines.

In Wetherill's, Fig. 1009, the iron exhaust steam cylinder has bonnets at the ends, and the feed water is heated by passing it through numerous coils of copper pipe 1″ in diameter. It is used directly in non-condensing engines, and in condensing engines occupies a position between the cylinder and the condenser.

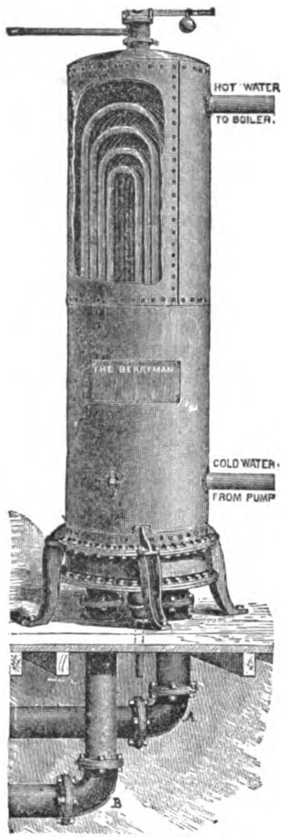
The Hawksley & Wilde (Br.) apparatus is similar in principle.

In Atkinson's apparatus (Br.) the steam passes by a circuitous route, ascending and descending in vertical pipes surrounded by water in a cylindrical chamber.

The Berryman heater is also of this class. The apparatus is placed between the engine and condenser, *B* being the exhaust steam-pipe from the engine, and *A* the steam-pipe to the condenser. Cold water from the pump enters the lower part of the cylinder surrounding the pipes, and departs at the upper end to the boiler. The number of pipes is such as to exceed by 20 per cent. the area of the exhaust steam-pipe *B*.

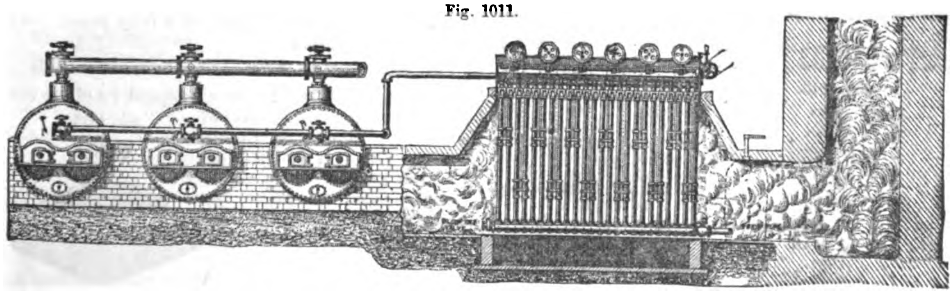
In another form of feed water heater the system of coils containing feed water is placed in the chimney. Such are some of the arrangements where the departing heat of a blast furnace is caused to heat the boiler driving the blast-engine.

Fig. 1010.



Berryman Feed Water Heater.

Fig. 1011.



Green's Fue' Economizer.

Of this class are the Twibill, Babcock & Wilcox, and Green fuel economizers; the last mentioned of which is shown in Fig. 1011. A number of upright water-pipes are placed in the main flue, beyond the boilers, and have scrapers or cleaners which move up and down the tubes to prevent the deposit of soot, which acts as a non-conductor. See Fuel Economizer; Fire Box.

Heater, *Atkinson*, Br. . * "*Engineer*," xlvi. 57.
* "*Engineering*," xxv. 436.
* "*Scientific American Sup.*," 2289.

Filter, *Babcock & Wilcox* * "*Iron Age*," xxiii., May 1, p. 9.

Heater and purifier.
Baragwanath & Pim * "*Am. Manufacturer*," Oct. 3, 1879, p. 12.

Heater, *Berryman* . . * "*Iron Age*," xxi., Jan. 31, p. 1.
* "*Engineering*," xxix., Feb. 6, p. 188.
* "*Scientific Amer.*," xxxviii. 467.
* "*Manufact. & Builder*," xi. 57.

Carvalho . . . . . * "*Scientific Amer.*," xxxviii. 118.
* "*Scientific American Sup.*," 1777.

Davies & Dawson, Br. * "*Engineer*," xliv. 454.

Green . . . . . . * "*Scientific American*," xxxv. 358.

Hayes . . . . . . * "*Scientific American*," xxxiv. 242.

Hawksley & Wilde, Br. * "*Engineering*," June 11, 1880.

Lime catcher, locomotives, Ill. Centr. Ry. * "*Engineer*," xlviii. 466.
* "*R. R. Gazette*," xxiii. 279.

Heater and purifier.
Lovegrove . . . . * "*Scientific Amer.*," xxxviii. 319.

Heater, *Martin* . . * "*Scientific American Sup.*," 2519.

Locomotives, *Mazza*, It. * "*Engineering*," xxvii. 24.

Northcott, Br. . . . * "*Engineering*," xxi. 169.
* "*Scientific American Sup.*," 298.

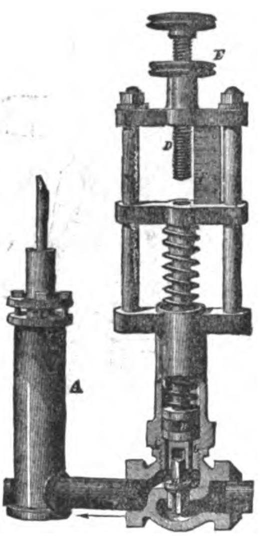
Norton . . . . . * "*Engineering*," xxii. 103.

Norton . . . . . . * "*Scientific American Sup.*," 244.
Purifier, *Paucksh* . . . * "*Scientific Amer.*," xxxiv. 130.
Heater, *Poole & Hunt* . * "*R. R. Gazette*," xxi. 5.
* "*Manufact. & Builder*," x. 31.
(7 Figs.) . . . . . * "*Engineer*," xlvii. 161.
Robertson & Henderson, Br. . . . . * "*Engineer*," xlvii. 171.
Robey . . . . . . * "*Scientific American Sup.*," 4090.
Stillwell & Bierce . . * "*R. R. Gazette*," viii. 543.
Heater and purifier.
Strong . . . . . . * "*Manufact. & Builder*," xii. 124.
Tretheway . . . * "*Iron Age*," xxv., March 18, p. 9.
Locomotives, *Waters* . * "*R. R. Gazette*," xxi. 335
Counterpoised float . . * "*Mech. Dict.*," Fig. 761, p. 320.

Feed Wa'ter Pu'ri-fi'er. A filter or lime catcher to purify water for steam boilers, to prevent incrustation. Usually combined with a heater. See FEED WATER HEATER.

Feed Wa'ter Reg'u-la'tor. One which proportions the feed to the need of the boiler.

Fig. 1012.

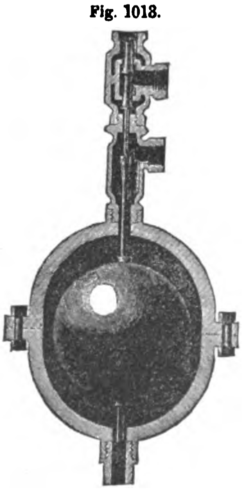


Maxim's Feed Water Regulator.

The Maxim feed water regulator was designed for steam yachts. *A* is an ordinary feed-pump, and the regulator on the right is placed between the pump and the suction. *B* is a piston-valve, pressed down by a coil spring, the valve stem rising and falling in the bar *C*. *D* is a limiting screw, and *E* a set screw. *H* is a feed-valve, and *G* holes communicating with chamber beneath the valve *B*. When the screw *D* is close down the valve *B* is inoperative and the boiler receives water due to the full stroke of the pump. When the screw *D* is up to *O*°, the water simply passes to and fro between the regulator chamber and the pump cylinder which are of equal sizes. The screw *D* is regulated against gage *F* for any quantity between full stroke and *O*°.

In the "Peerless" feed water governor, steam for operation enters the outer chamber of the valve casing, through the upper pipe, and circulates around the valve chamber which is closed by the valves. These are cone-shaped and to their stem is suspended the hollow copper float which rises and falls with the water in the boiler, and thus regulates the valve opening. The valves are balanced and upon one spindle. (Fig. 1013.)

Fig. 1013.



"*Peerless*" *Water Regulator.*

Berryman's feed water regulator is simply a hollow sphere suspended from a steelyard balance, and is connected with the water-space by two pipes of small diameter, one of which terminates just above and the other just below the proposed water-line. When the water falls, steam enters the upper pipe and fills the globe. The weight of the unloaded vessel is insufficient to counterbalance the opposite weight, and it falls, putting on the feed as it descends. When the feed has entered in sufficient quantity to raise the water-level above the mouth of the upper tube, water ascends through that tube into the globe, taking the place of the steam as the latter condenses, and the weight of the now filled vessel causes it to descend, shutting off the supply of feed.

The F. A. Pratt boiler feeder and return steam trap (patent Oct. 31, 1876) has a sphere suspended on one end of a lever in a receiving vessel above the level of the boiler, the other end of the lever being fast to a spindle which goes through a stuffing box to the outside of the receiver and carries a counterpoised lever. A tilting lever actuated as the feeder fills and is emptied of water, actuates the steam valve.

See also, for counterpoise and float actuating a valve, Fig. 761, p. 320, "*Mech. Dict.*" See also LOW-WATER ALARMS, Fig. 3008, p. 1359, *Ibid.*

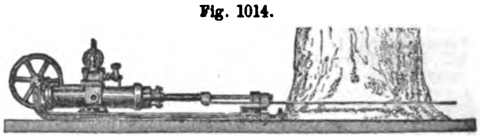
In the Nathan & Dreyfoos regulator the injector of the locomotive works freely, untrammelled by adjusting contrivances: but the actual feed to the boiler is regulated by a controlling cock, the handle in the cab, by which means a portion of the feed water passing through the delivery pipe from the injector to the boiler is diverted and turned through a pipe to the tender.

British . . . . . . * "*Engineer*," xlix. 228.
Finney, Br. . . . . * "*Engineer*," xlix. 259.
Pope, Br. . . . . . * "*Engineer*," xlv. 288.
Maxim . . . . . . * "*Engineer*," xlv. 289.
* "*Scientific Amer.*," xxxviii. 198.
Stead . . . . * "*Manuf. & Builder*," xii. 226.

Fel'ler. A machine for felling trees. See Figs. 1935–1937, pp. 831, 832, "*Mech. Dict.*"

Fig. 1017 shows Ransome's portable horizontal engine, dogged to the tree, which it is engaged in sawing down.

Fig. 1014.



Ransome's Portable Felling Engine.

* "*Scientific American Sup.*," 1277.
Electric feller . . . . * "*Scientific Amer.*," xxxvi. 370.
Felling engine, *Smyth* . * "*Min. & Sc. Press*," xxxviii. 97.

Fell'ing Engine. See FELLER; FELLING SAW.

Fel'ly Bend'ing Ma-chine'. A machine for bending timber to form the rims of wheels. The heavier classes of fellies are sawn; lighter ones are bent.

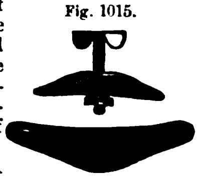
See p. 832, "*Mech. Dict.*," for FELLY MACHINERY, and WOOD-BENDING MACHINE, Figs. 7311-7814, pp. 2803, 2804, *Ibid.*, for machinery not exactly for fellies, but exhibiting the principle.

Fel'ly Hold'er. A plate at a felly joint. See FELLY-JOINT BOLT.

Felly plate, *Cremer* . * "*Scientific American*," xlii. 274.

Fel'ly-joint Bolt One adapted to clasp the joining portions of the rim of a wheel. Shown at Figure 1015. The bolt is halved into the abutting ends of the junction, and the plates embrace the exterior and interior periphery respectively of the rim.

Fig. 1015.



Felly-joint Bolt and Plate.

Fel'ly Ma-chine'. A machine for bending, boring, dressing, planing, rounding, sawing, etc., fellies for wheels.

See p. 802, "*Mech. Dict.*," and list of WOOD-WORKING TOOLS, p. 2814, *Ibid.* Also RIM-PLANING MACHINE, Fig. 4330, p. 1944, *Ibid.*

Fel'ly Pla'ning Ma-chine'. One for dressing the edges of rims for carriage wheels. See * FELLY DRESSER, p. 832, "*Mech. Dict.*," and * RIM-PLANING MACHINE, p. 1994, *Ibid.*

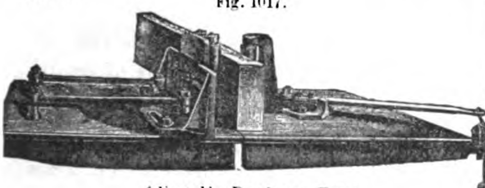
Fel'ly Round'ing Ma-chine'. A machine, Fig. 1016, for rounding the inner peripheries of rims for carriage wheels. It is a species of chamfering machine, planing off the salient edges and giving the required curve.

Fig. 1016.

Felly Rounding Machine.

Fence. A guide on a machine to direct the stuff to the tool, or maintain it in line while passing the tool. Fig. 1017 shows the Arbey adjustable fence and self-regulating roller for band-saw tables.

Fig. 1017.



Adjustable Band-saw Fence.

Fen'cing Ma-chine'. Hall's machine for making fence works upon poles and second growth timber, cutting the posts and rails to proper length, making the mortises in one and the tenons on the other. The posts are straightened in the line of bearings, and countersunk to parallel sides in the process of boring. The rails are sawed to uniform length, tenons and shoulders formed in their extremities fitting the bearings on the posts; all parts are interchangeable.

Flat iron fence . . . . * "*Iron Age*," xxii., Oct. 31, p. 18.
Iron fence post, *Carpenter* * "*Scientific American*," xli. 149.
Fencing machine, *Hall* . * "*Engineer*," xli. 463.
Iron fence, *Martin* . . . * "*Sc. American*," xxxix. 57.

See also machine for making combined wood and wire fence, Fig. 7280, p. 2792, "*Mech. Dict.*"

Fend'er. A screen against a carriage or car step, to keep dirt or mud from being thrown upon it by the wheels. A *fender board.*

Fender for vessels, *Hulster*, * "*Scientific American*," xl. 230.

Fen'es-tra'ted In'stru-ments. (*Surgical.*) Said of instruments such as some forceps, scoops, enucleators, etc., the grasping ends of which have openings, or loops which engage and partially embrace the object.

Fenestrated artery forceps.
Fenestrated ear scoop.
Fenestrated lens scoop, etc.
Obstetric forceps are fenestrated in the largest sense.

Fer'men-ta'tion Bung. One adapted to allow the carbonic acid gas to pass away from the cask or vat, but at the same time excluding the vital air.

Bung, beer (Fig. 27), Austria, * "*Engineer*," l. 303.
Vat, article "*Bière*" . . . * *Laboulaye's* "*Dict.*," etc., i., Fig. 229.

Fer'ro-chrome. The invention of Berthier. Chromium augments the hardness and tensile resistance of iron, but cannot take the place of carbon.

Chromized steel is manufactured in Brooklyn from Baltimore chromite as follows: The pulverized ore, mixed with charcoal dust, is fused with a suitable flux, in graphite crucibles, to obtain a white chromium alloy, corresponding to that of Berthier, and called ferro-chrome, after the analogy of ferro-manganese. — "*Engineering and Mining Journal.*"

"*Mining and Scientific Press*" . . xxxvii. 178.
"*Iron Age*" . . . . xix., June 14, p. 9.

Fer'ro-man'ga-nese. A mineral compound of iron and manganese, of which spiegeleisen is the most prominent example.

Ferro-manganese ores contain from 5 to 40 per cent. of metallic manganese, and varying quantities of silicon.

As manufactured for steel works, in the Bessemer process, for example, ferro-manganese contains up to 95 per cent. of manganese.

The method used at Terre Noire, for the manufacture of ferro-manganese, is as follows: Metallic iron, finely divided, is well mixed with finely ground manganese ores. This mixture is moistened with a weakly ammoniacal or acid solution, and is pressed into forms. The material thus made is smelted in a blast furnace blown at a high pressure with very hot blast. The ore used seems to be a carbonate of manganese. — *M. Emil Huwaldt.*

See under the following references: —

"*Iron Age*," xx., Sept. 6, p. 11; xxii., Aug. 29, p 20; xxv., April 1, p. 1.
Imports of . . "*Iron Age*," xxii., Dec. 26, p. 20.
At Terre Noire "*Iron Age*," xxiii., May 15, p. 24.
"*Eng. and Min. Jour.*," xxi 419; xxiv. 127.
In England . "*Engineering and Mining Journal*," xxi. 62.
In Austria . . "*Eng and Min. Journal*," xxi. 418, 419.
Manufacture . "*Eng. and Min. Jour.*," xxiii. 217, 398, 451.
Carbon in . . "*Eng. and Mining Journal*," xxiii. 457.
At Terre Noire "*Eng. & Min. Journal*," xxiii. 109; xxv. 41.
American . . "*Eng. and Mining Journal*," xxiii. 215.
In France . . "*Eng. and Mining Journal*," xxv. 63.
"*Mining and Scientific Press*," xxxvi. 99.
Uses . . . . "*Engineering*," xxi. 253.
Manuf. in U. S. "*Engineering*," xxv. 235.
Uses . . . . "*Van Nostrand's Eng'ing Mag.*," xiv. 529.
"*Scientific American*," xxxv. 367.
In Italy . . "*Scientific American*," xxxvii. 197.
"*Scientific American Sup.*," 323, 1121.
Paper by Lockert . . . . "*Technologiste*," xxxviii. 322.

Fer'ro-phos'phide. A compound: iron associated with phosphorus.

At the Hörde Works in Germany, instead of blowing gray pig rich in silicon, it was found possible to treat white pig, if it contained a sufficient amount of phosphorus. Far from being afraid of phosphorus, about 2 per cent. of that body is required in the pig, in order to give a sufficient degree of heat to the bath. Hörde has begun to make ferro-phosphide with 20 per cent. of phosphorus, and will presently make this alloy to contain 50 per cent. phosphorus. This will be sold to mix with white pig, since the crude metal must contain phosphorus or silicon enough to carry up the bath to the heat required. At Hörde all sorts of pig, even cinder pig, with 3 per cent. phosphorus and 0.5 per cent. silicon are treated. The presence of 0.2 to 0.3 per cent. sulphur could also, it was found, be tolerated. The steel made contained under 0.1 phosphorus and no silicon. — "*Journal de Liége.*"

Fer'ro Si-li'ci-um. A metallic compound used in steel processes, the Bessemer, for example.

The use of *silicon*, iron ore, and *silicon-pig*, is mentioned in a whole series of patents by Nes, of York, Pa.,

Numbers 104,873,	108,287,
109,752,	112,068,
123,191,	145,005,

but not under the name of *ferro silicium*. See also Silicon Steel.

Fer'rule. A tubular coupling in a service pipe. Fig. 1018.

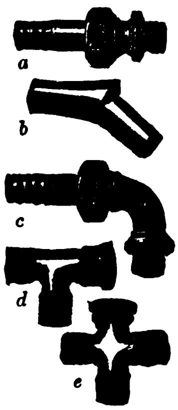
a and *c* have ground union joints tinned for lead pipe.
a, *c*, *d*, *e*, have screwed joints for iron pipe.
Fig. 1019 has a screw plug in the upper part of the stem, and this may be screwed down into the part *k*, in which position it acts as a stop valve.

Fer'ry-boat. See the following references: —

Fulton's	"*Sc. American*," xli. 182.
	* "*Transactions, Am. Soc. of Civil Engineers*," clxxiv. p. 71, *et seq.*
Thames	* "*Engineer*," xlii. 210.
Thames	* "*Engineering*," xxi. 165.
Steamers, Br.	* "*Engineering*," xxix. 252.
"Solano," San Francisco	"*Sc. American*," xli. 82.

Fer'ry Push-car. A platform car which is made very long and used for pushing or pulling other cars on or off a ferry-boat when the latter must be approached by an incline which is too steep for locomotives. The ferry cars are used to connect those cars which are to be taken on or off the boat with the locomotive, so that the latter can push or pull the cars on the boat without running on the incline. — *Forney.*

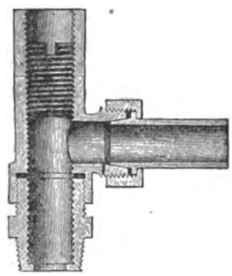
Fig. 1018.



Pipe Ferrules.

a. Straight ferrule.
b. Driving ferrule.
c. Elbow ferrule.
d. Three-way ferrule.
e. Four-way ferrule.

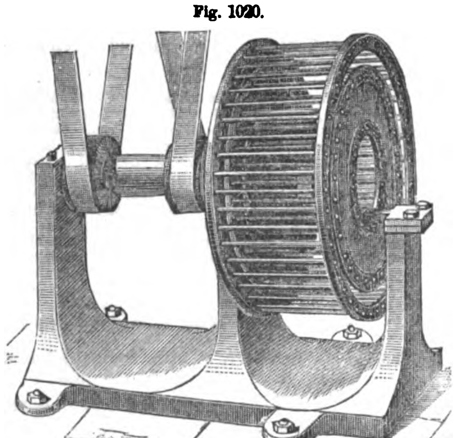
Fig. 1019.



Morris's Stop-valve Ferrule.

Fer'til-iz-er Mill. Fig. 1020 shows a mill for grinding and mixing materials for artificial fertilizers. It is constructed on the principle of the Carr disintegrator.

Fig. 1020.



Fertilizer Mill.

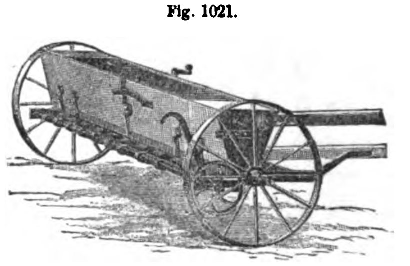
The double operation may be performed with advantage in the machine shown, which is formed of two cylindrical cages of iron bars, which are rotated rapidly in contrary directions. The materials thrown in fragments in at the central opening issue mixed and in a fine powder at the circumference.

See also Bone Mill.

Fer'til-iz-er Sow'er. The machines for sowing dry fertilizers resemble those for sowing grain, and in many cases are combined therewith. See Grain Drill, pp. 1002, 1003, and Wheat Drill, Fig. 7163, p. 2761, "*Mech. Dict.*"

When the fertilizer is long and damp a different mode of discharge becomes necessary. British and French fertilizer sowers are made on the principle of the machine shown in Fig. 1021. It is made by *M. Josse*, of Ormesson, France, and is particularly adapted to damp and deliquescent fertilizers, which are discharged by endless revolving chains passing through the hopper and drawing out the pulverulent material which is disengaged and dropped upon the ground.

Fig. 1021.



French Fertilizer Sower.

See also Liquid-manure Cart, p. 1326, "*Mech. Dict.*"

Fi'ber-faced Pa'per. A means of security against the restoration of the surface of check or draft-paper after it has been tampered with.

It consists in imbedding in the pulp, on one or both sides thereof, a layer of fibers, the outer ends of which are then raised in the form of a nap, confused or intermingled by rotary brushes or other suitable means, and sized to form a surface for printing or writing. — *Anderson.*

Fi'ber Test'er. A means for determining the strength of fiber by dynamometer. See Cloth Tester, *supra*; Yarn Tester, "*Mech. Dict.*"

Fischer	"*Technologiste*," xli. 533
Irlande	"*Technologiste*," xxxvii 28.

Methods of testing to distinguish jute, phormium tenax, flax, hemp, etc., are devised to determine purity of sample. The method of M. Vétillard requires a good microscope, and is as follows: —

The object being a piece of the fiber, is colored according to its nature by means of two solutions: one of iodine, dissolved in a solution of iodide of potassium; the other glycerine, mixed with sulphuric acid, and the process is as follows: —

a. From the tissue, perfectly washed, lixiviated, and cleared of all impurities, threads are drawn from warp and weft, and are observed separately.

b. Dip the thread in the iodic liquid, and dry it with a piece of linen, or, better still, white blotting or filtering paper.

c. Lay it on a piece of glass, such as is used for microscopic observation, and divide and spread out the fibers with the aid of the point of a needle.

d. Place another glass on the fibers, set the whole in the microscope, and then introduce a single drop of the sulphuric solution between the two pieces of glass, and observe the color which the fibers assume when the acid touches them: flax turns blue, mixed more or less with yellow; hemp, green, mixed with gray; jute and phormium, yellow; China grass, gray; flat-rib of gray-blue color. With a little practice of this method it is easy to see the difference between jute and phormium on the one hand, and flax and hemp on the other, which is of itself of great importance when there is a question of adulteration; but it is very difficult to distinguish jute from phormium and flax from hemp, as, according to the manner in which they have been prepared, they assume each other's tints, or so nearly as to deceive the eye. By means of nitric acid, in which the fibers are steeped, the distinction between flax and hemp and jute and phormium is clearly shown, the former not being affected at all, while the latter takes a fine red tint.

Testing Mixed Silk and Wool.

If a piece of tissue of mixed wool and silk is plunged in hydrochloric acid, the silk is soon dissolved, while the wool remains, so that by careful weighing before and after the operation, the proportion of the two fibers is easily ascertained. See also SEPARATOR, 5, p. 2094, "*Mech. Dict.*"

Field Cam'e-ra. See CAMERA.

Field Gun. A transportable gun for operations in the field. See CANNON; also:—

French breech-loader, Fr.	* "*Scientific Amer. Sup.*," 2178.
Steel, Fr.	* "*Engineer*," xlv., 421.
Breech-loader, 13 dr., Br.	* "*Engineer*," l. 323.

Moffatt breech-loading field-piece, Plates I., II., III., p. 86, "*Ordnance Report*," * 1876.
Sutcliffe breech-loading field-piece, *Ibid.*, * 94.

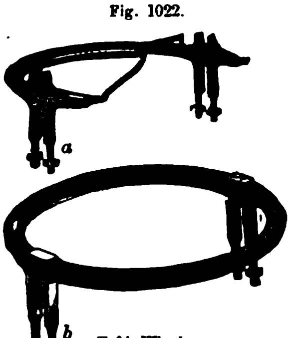
Field Rol'ler. See CLOD CRUSHER; ROLLER.

Field Tel'e-graph. A military telegraph, for use in field operations.

Wire wagon and barrow .	"*Telegraphic Journal*," viii. 121.
	"*Scientific Amer. Sup.*," 1815.

Fifth Wheel. A wheel or segment above the fore-axle on which the bed swivels in turning the carriage.

Fig. 1022.



Fifth Wheels.

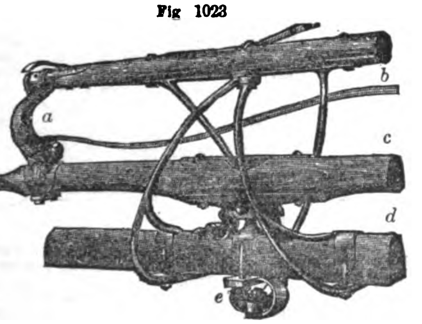
Fig. 1022 shows two forms: one full-plate and one part-plate.

Fig. 1023 is the Dexter fifth wheel, which is so constructed as to steady the axle by three centers: one under the upper spring bar, one about the clip king-bolt, and one under the axle.

a. Larkin's anti-rattler fifth wheel.
b. Full circle fifth wheel.

Fifth'-wheel True'ing Plate. A swage-plate with a number of circles of varying diameter on which fifth wheels are made true by hammering. See Fig. 1024.

Fig 1023



Dexter Fifth Wheel.

a. Spring link. *c.* Head block.
b. Spring bar. *d.* Axle.
e Lower center

Fight'ing Lan'tern. A lantern for ships of war, having a revolving shade to instantaneously screen the light, if required. That shown in Fig. 1025 is the British Admiralty pattern, made to burn candles.

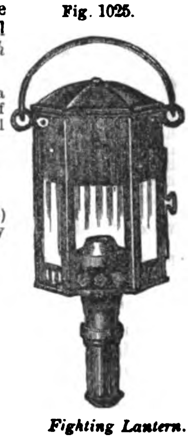
Fig'ure-of-8 Knot. (*Nautical.*) A form of knot. See 7, Fig. 2777, p. 1240, "*Mech. Dict.*"

Fi'lar Sus-pen'sion. (*Electricity.*) Said of a magnetic needle, which is suspended by a filament of silk, as distinguished from one poised on the point of a stud.

Bi-filar suspension is when the needle is suspended by two slightly separated extremely delicate filaments of raw silk, by which the needle is caused to more promptly resume its normal position; *i. e.*, is given a normal tendency to zero.

File. Files have been made of separate pieces of steel clamped together. — *English "Ironmonger,"* 1880.

Fig. 1025.



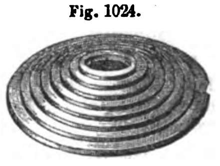
Fighting Lantern.

Mentioned also by Kirkwood at a meeting of the Royal Scot. Soc. of Arts. Shown, however, in several American patents.

Harston . . .	Jan. 19, 1858.
Cubberley . . .	June 2, 1868.
Clark	July 5, 1870.

The Hapstontall file (Patent, 1875) has an abrading surface formed by successive series of diagonal teeth in alternate sections and at opposite angles.

Fig. 1024.



Fifth Wheel Trueing Plate.

See the following references:—

Files, American	* "*Scientific Amer. Sup.*," 860.
File-cutting machine.	
Dobson & Mudge, Br. . .	* "*Engineer*," xlvi. 351.
File holder	* "*Scientific Amer. Sup.*," 161.
	* "*Eng. & Min. J.*," xxvi. 328.
File, *Hapstonstall*	* "*Scientific Am.*," xxxiv. 291.
How to use a, *Rose* . . .	"*Scientific Am.*," xxxix. 53.
Filing, a wrinkle in, *Rose* .	* "*Scientific Am.*," xxxix. 245.
Files *vs.* Emery wheels, etc.	"*Scientific Amer. Sup.*," 995
Files. Paper by *Rose* . .	"*Eng. & Min. J.*," xxvi. 328.
Files and handles	* "*Man. & Builder*," xii. 84.
Guide, *Roth*	* "*Scientific Am.*," xxxiv. 6.
Sharpening by sand-blast.	
Tilghman	* "*Man. & Builder*," x. 228.
Richardson	* "*Eng. & Min. J.*," xxvi. 149.
	* "*Sc. Am.*," xxxviii. 406.
Tilghman	* "*R. R. Gazette*," xxii. 394.

File Card. A tool for cleaning the metallic dust out of files. It is a section of card clothing, such as is used in carding-machines for wool or cotton.

File Guard. A grooved wooden holder in which a file is inserted, so that the file may be used without abrading the fingers. * "*Scientific American*," xl. 131.

File Hold'er. A helve for a file.

See FILE CARRIER, Fig 1966, p 841, "*Mech. Dict.*," and * "*Scientific American*," xxxix. 117.

Fil'i-form Bou'gie. (*Surgical.*) One of the most delicate (hair-like) proportions.

Fil'ing Vise. A clamp in which a saw is held while being filed. See VISE; also BAND-SAW SETTING AND FILING MACHINE.

Fil'ter. See list on p. 846, "*Mech. Dict.*"

Adolph Le Tellier's filter, made at St. Gilles, near Brussels, has a raised bottom in which are inserted a number of removable vertical tubes, with perforated walls, and with handles at the top. These tubes are surrounded with flat felt filtering rings, through which the liquid must pass before escaping through the perforations in the tubes. The supply-pipe has a compression shut-off, actuated by a float and lever.

Weiskopf, of Morchenstern, Bohemia, employs spun glass as a filtering material.

See the following:—

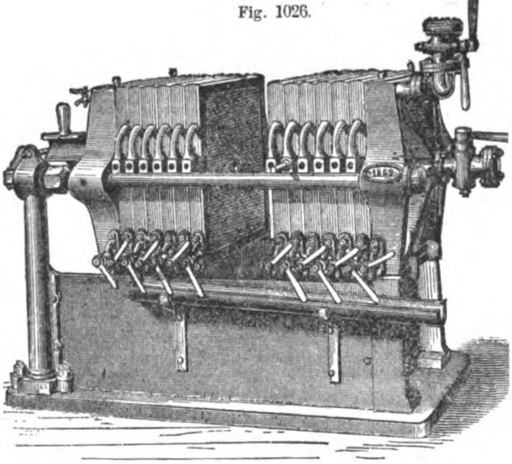
Intermittently drying, *Denton*, Br	* "*Engineer*," xlii. 357.
Denton, Engl.	* "*Sc. Amer Sup.*," 883.
Press	*Laboulaye's* "*Dict.*," iii., art "*Sucre*," Figs 36, 56.
Rapid (Laboratory), *Hindley* . .	* "*Sc. Am. Sup.*," 1786.

Rapid, *Holthof*	"*Sc. Am. Sup.*," 1363. "*Sc. Am. Sup.*," 1671.
Filtration, on, "*Inst. Civil Eng.*," Br. *Higgin*	* "*Van Nostrand's Mag.*," xxii. 72.
System, *Jennings*	* "*Man. & Build.*," x. 169. "*Sc. Am.*," xxxviii. 65.
Cloth stretcher, *Johnson* . . .	* "*Engineer*," l. 265.
Floating well, *Lindsay*	* "*Sc. Am.*," xlii. 20.
Water (Montreal)	"*Sc. Am. Sup.*," 472.
Rotary, *Perrett*, Br.	* "*Engineer*," xiii. 101.
Universal, *Platt*	* "*Sc. Am. Sup.*," 2581.
Rotary clearing, *Pulsometer Co.* .	* "*Engineer*," xlviii. 124.
Engl.	* "*Sc. Am. Sup.*," 1060.
Sugar	*Laboulaye*, "*Sucre*," Fig. 50, vol. iii.
Water, *Snook*	* "*Min. & Sc. Press*," xxxvi. 321.
Filtering Apparatus	* "*Sc. Am. Sup.*," 2471.
Stock	* "*Sc. Am. Sup.*," 2689.

Fil'ter Press. (*Sugar Manufacture.*) One in which the liquid is pressed from a mass — beet-root-pulp in the present instance — and the solid portion retained by a straining device.

The Farinaux press, shown in Paris, 1878, has a series of gridiron-shaped frames, the faces of which are covered with a filtering surface of linen or jute cloth. These frames are arranged parallel to each other upon a strong support, and are brought into close contact by means of a screw-press fixed to one end of the support. The material to be filtered is forced between the frames through a passage along the side or through the center, and distributes itself over the filtering surface; the liquid portion, finding its way into

Fig. 1026.



Farinaux Filter Press.

the interior of the frame, is drawn off at the bottom by means of a stop-cock attached to each one, while the solid portion is held back between the filtering surfaces. When the press is fully charged, the pressure holding the frames together is removed, the frames separated, and the pulp allowed to fall into a recipient underneath. If necessary, the cloth is cleaned by means of a rush.

Press, Fr *Farinaux* . .	"*Dept. Agric. Sp. Rept.*," xxviii. Plate XXV.
Centrifugal	*Ibid.*, xxviii., Plate XXIX.
Beet-press, *Poizot* . . .	*Ibid.*, Plate XVI.
Lebée	*Ibid.*, Plate XVII.
Dujardin	*Ibid.*, Plate XX, and page 141.
Champannois . . .	* p. 87, *supra*.
Manuel et Socin . .	* p. 87, *supra*.
Pieron	* p. 88, *supra*.

Find'er. (*Optics.*) *a.* As applied to the telescope, a small low-power glass fitting on the side of the large one for finding an object.

b. As applied to the microscope, a means for registering the position of an object on a slide so that it can be readily found again. The *Maltwood* finder.

Fine Art Met'al-work. See under the following heads: —

Antique bronzing.	Incrusted work.
Applique.	Inlaying.
Bidiri work.	Irisation.
Bronze coloring.	Japanese bronzes.
Champ levé.	Kuft-work.
Chasing.	Milling.
Cire perdue.	Niëllo.
Cloisonné.	Orugo.
Damasceening.	Parcel gilt.
Damasking metals.	Patina.
Electro-bronzing.	Pearl inlaying.
Emaille.	Repoussé.
Enamel.	Satining.
Flat chasing.	Snarling.
Frosting.	Spinning.

Fin'ger Mir'ror. A small mouth-mirror attached to a finger clasp; used by dentists.

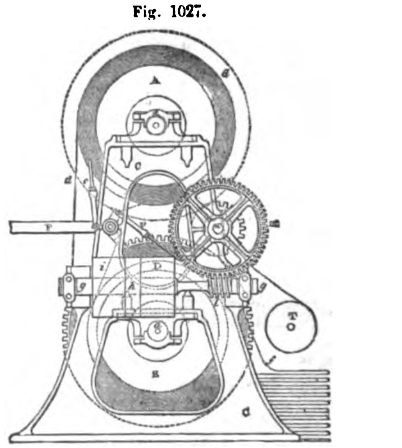
Fin'ger Steel. (*Leather.*) A steel instrument like a skewer or awl used for restoring the edge of the currier's knife while in use.

Fin'ger Tray. A small pan attached by a clasp to the finger; used by dentists for carrying amalgam or plastic filling.

Fin'ish-ing Press. A machine for pressing fabrics.

A and *B* are steam drums having toothed wheels acted upon by cam wheels on the shaft *n*, which is turned by an endless screw and toothed wheel, receiving their motion from a belt and pulley. The cam wheels turn the drums in oppo-

Fig. 1027.



Houston's Cloth Finishing Press.

site directions; one cam wheel only works at a time, the drum not acted upon by the cam wheel being carried along by the friction pulley. Thus the operator is enabled to change the motion of the drum as often as necessary. From the drum *A* to the drum *B* a long sheet or band of copper or steel extends, and alternately winds and unwinds round both drums, carrying the goods along. The fabric is unrolled from a cylinder, *T*, moved solely by the tension of the goods as they are rolled on the cylinder *B*. The copper band is heated on the cylinder *A* and catches in descending the sheet of fabric, and rolls up along with the same on the cylinder *B*. Thus the entire surface of the goods comes in contact with the heated metal, and is equally exposed to the pressure exerted by the concentric sheets of copper. The goods are not strained, but subjected to heat and pressure only, removing all folds. — *Musée de l'Industrie.*

Fire A-larm'. See the following references: —

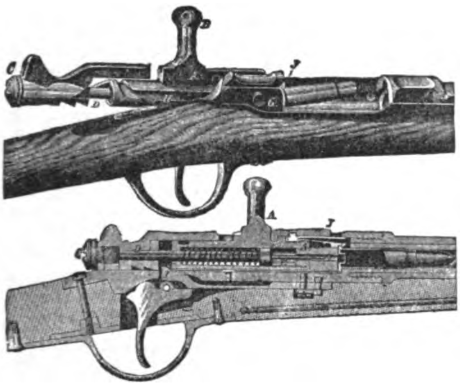
Indicator, electrical, *Bright* .	* "*Teleg. Jour.*," vii. 56.
Electric, *Gaulnier*	* "*Sc. Amer.*," xxxv. 246
And bell pull, electric, *Gaulnier*, ...	* "*Sc. Amer.*," xxxvi. 4.
Gong, German	* "*Sc. Amer.*," xxxviii. 403.
And water indicator, *Gérard* .	* "*Sc. Amer.*," xl. 102.
Ships holds, *Higgins*	* "*Teleg. Jour.*," vi. 271.
Tell-tale, Electric, *Leblanc*, Fr.	* "*Engineering*," xxvi. 445. "*Sc. Am. Sup.*," xxiv. 34
Signals, London	* "*Engineering*," xxiv. 135.
Telegraph, Spanish	"*Teleg. Jour.*," iv. 199.

German . . . . * "*Sc. Am.*," xxxviii. 402.
Telegraph, Prague . . . . * "*Engineering*," xxx. 225, 287.
Telegraphs, various systems * "*Engineering*," xxiii. 223, 402.

Fire Arm. Fig. 1028 shows the new service gun of Capt. Gras, adopted for the French army.

The upper figure shows the piece in the position as the cartridge is being extracted, and the lower figure as it is ready

Fig. 1028.



The Gras Rifle. The French Service Arm.

to fire. *A* is the movable breech piece operated by the lever. *C* is the dog, at the end of which is a button, to which the rod *D* of the firing pin *E* is attached. *F* is the coiled spring, which throws the pin forward. For loading the gun, the parts are drawn back as shown in the upper figure. The cartridge is inserted and the bolt *A* by the lever *B* is drawn forward. While this is being done, a stop, *G*, enters a cam groove, *H*, in the side of the bolt *A* so that the latter is forced to turn as it is brought forward. In the lower figure it will be noticed that the notch on the dog *C* is almost in contact with the spring stop *I* governed by the trigger. By pulling on the latter, this stop is withdrawn, and the needle is thrown forward by its spring, striking and exploding the cartridge. At *J* is the extractor, the part containing which, though drawn back, does not turn with the movable breech, so that the spring hook always grasps the rim of the cartridge case from above. With this gun it is stated that 45 shots can be fired in three minutes, effective at a range of 5,120 to 5,440 feet.

Breech-loader, *MacNaughten* * "*Engineer*," l. 400.
Royal . . . . . . * "*Scientific Amer.*," xl. 56.

See also MAGAZINE FIRE-ARM, *infra*.

Fire'-arms, Ord'nance, Ex-plo'sives, etc.

Action.
Air gun.
Air pistol.
Ambulance.
Ambulance cot.
Ambulance stretcher.
Anchor shot.
Anvil.
Anvil cupper.
Aperture sight.
Armored gun.
Armor plate.
Armstrong gun.
Army wagon.
Assembling.
Balloon musket.
Balloon torpedo.
Ball seater.
Ball trimmer.
Bar and bead sight.
Bar and slit sight.
Barbed shot.
Barrel.
Barrel-boring machine.
Battery gun.
Bayonet.
Bayonet manufacture.
Beach combination sight.
Bead sight.
Blasting apparatus.
Blasting compound.
Blasting gelatine.
Blow gun.
Bolt.
Bomb lance.
Brake.
Breaking-down machine.
Breech.
Breech-loading fire-arm.
Breech wrench.
Buck-horn sight.
Bullet.
Bullet machine.
Bullet-making.
Bullet-patching machine.
Bump.
Burgoyne.
Butt lathe.
California sight.
Camp cot.
Cannon.
Cannon lock.
Cannon revolver.
Cap.
Capper.
Carbine.
Cartridge.
Cartridge-block.
Cartridge-capper.
Cartridge-heading machine.
Cartridge-head tester.
Cartridge loader.
Cartridge making.
Cartridge scales.
Cartridge varnishing machine.
Case.
Casemate.
Case-trimmer.
Chamber.
Charcoal-grinding machine.
Charger.
Circle.
Clamp milling machine.
Clover leaf sight.
Coiling machine.
Comb.
Conversion.
Countersink.
Covered sight.
Cross-bar.
Crusher gage.
Cube powder.
Cup anvil.
Cupping machine.
Decoy.
Deringer.
Dice.
Diorrexine.
Direct fire.
Disk anvil.
Drawing machine
Drying house.
Drying stove.
Dualin.
Dusting machine.
Dynamite.
Éprouvette.
Explosive bullet.
Explosive gelatine.
Explosives.
Extractor.
Field gun.
Field-piece.
Fire-arm.
Fog gun.
Fore-end.
Fort.
Front sight.
Fuse.
Gas check.
Gas gun.
Gatling gun.
Gelatine, Blasting.
Glacis.
Glazing barrel.
Globe sight.
Graduating sight.
Granulated-wood powder.
Granulating machine.
Grapple shot.
Gravel powder.
Grenade.
Guard.
Gun.
Gun barrel.
Gun barrow.
Gun brush.
Gun carriage.
Gun cotton.
Gun flint.
Gunpowder.
Gunpowder machine.
Gun-stocking machine.
Gun-stock lathe.
Gunwale gun.
Gyro-pigeon.
Hammerless gun.
Hand.
Hausse.
Heel-plate.
Herakline.
Hind sight.
Hoop-heating furnace.
Hoop-shrinking apparatus.
Howitzer.
Hydraulic buffer.
Hydro-pneumatic gun carriage.
Impression machine.
Incorporating mill.
Indirect pointing apparatus.
Infernal machine.
Intrenching spade.
Jacketed gun.
Jack lamp.
Jelly powder.
Jerk snare.
Lead-wire apparatus.
L. G. R.
Leaf sight.
Level.
Lever.
Life-saving rocket.
Lignose.
Limber.
Line-throwing gun.
Loading machine.
Loading plug.
Loop.
Lubricator.
Lump.
Machine gun.
Magazine.
Magazine gun.
Magazine rifle.
Maneuvering wheel.
Mantlet.
Mat.
Match.
Mitrailleuse.
Mixing machine.
Mortar.
Mortar carriage.
Mortar truck.
Mountain gun.
Mountain howitzer.
Muzzle.
Muzzle-pointing gun.
Muzzle sight.
Nail gun.
Needle gun.
Nitro-gelatine.
Nitro-glycerine.
Oblique fire.
Obturator.
Open bead sight.
Open sight.
Pack saddle.
Palstave.
Papyroxyline.
Pebble powder.
Pebble-powder machine.
Peep sight.
Pellet powder.
Pellet-powder machine.
Percussion fuse.
Pin-ball sight.
Pistol.
Pistol grip.
Pistol handle.
Pistol rifling machine.
Plain sight.
Plate.
Plunger.
Potentite.
Poudre-brutale.
Powder-dusting machine.
Powder paper.
Powder-pressing machine.
Pressure gage.
Primer.
Primer extractor.
Priming machine.
Prismatic powder.
Pyrophore.
Pyrophorus.
Pyroxyline.
Racer.
Rear sight.
Rebounding gun-lock.
Recapper.
Recoil check.
Reflecting sight.
Reïnforce.
Reloading tool.
Repeating rifle.
Re-primer.
Rest.
Revolver.
Revolving cannon.
Rib.
Ring.
Rifle.
Rifle battery.
Rifle cane.
Rifling machine.
Rocket.
Safety pin.
Salpeter and sulphur grinding-mill.
Saltpeter, sulphur, and charcoal mixing-mill.
Sear.

Sebastine.
Set trigger.
Shell.
Shell reducer.
Shell truck.
Shot.
Shot-gun.
Side action.
Sight (varieties, see list.)
Skate.
Sling wagon.
Slit-bar sight.
Small arm.
Snap action.
Spar torpedo.
Spear-head.
Spirophorus.
Sporting sight.
Squib.
Stacking swivel.
Stock.
Straightening stand.
Strap
Stretcher.
Submarine gun.
Sword.
Syringe gun.
Tapering and crimping machine.
Target.
Telescopic sight.
Tent.
Throwing-stick.
Thumbing.
Time gun.
Toe.
Tonite.
Torpedo.
Torpedo boat.
Torpedo carriage.
Torpedo catcher.
Torpedo depot ship.
Torpedo launch.
Torpedo vessel.
Training gearing.
Traveling forge.
Traverse circle.
Traverse rack.
Traverse wheel.
Trowel bayonet.
Tube.
Tumbler.
Turret.
Turret gun.
Twisting rod.
Uncapping knife.
Vernier scale sight.
Vest-pocket pistol.
Vigorite.
Volley-gun.
War engine.
Whale gun.
Whaling rocket.
Whitworth gun.
Wind gage.
Wind-gage sight.

Fire Bar. See the following: —

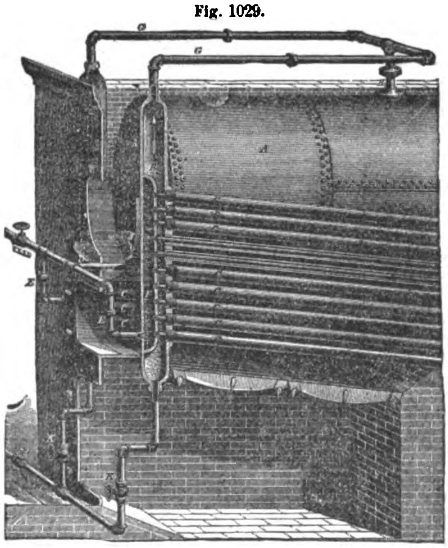
Chain, *Welch*, Br.	* "*Engineer*," l. 72.
	* "*Scientific American Sup.*," 3881.
Revolving, *Schmidt*	"*Revue Industrielle*."
Rocking	* "*Scientific American Sup.*," 2050.

See also GRATE; GRATE BAR, *infra.*

Fire Box. The chamber of a furnace. In the instance shown in Fig. 1029, the sides of the furnace are made up of, or rather lined with, flat congeries of pipes, which act as feed water heaters. Known as *economizers*. See FEED WATER HEATER; FUEL ECONOMIZER; HOT BLAST APPARATUS; REGENERATOR, etc.

Fire boxes in the present instance consist of two sections. each made of ten wrought-iron tubes, *C*, 3″ diameter and 10′ long; one end of each of these tubes is secured to a larger

Fig. 1029.



Fire-Box and Economizer.

chamber *B*; the other end is closed with a cap and reaches beyond the bridge-wall. The chamber *B* is divided by partition *F*, and into this partition ten brass tubes are secured which are open on both ends and reach to near the end of the iron tubes beyond the bridge wall. When two of these sections are placed one on each side of a boiler, and the top of chamber *B* is connected with the top of the boiler by means of the pipe *G*, and a water connection is made with the lower part of the boiler and the section by the pipes *D* and *E*, then the water from the boiler will flow through the ten brass tubes to the end of the iron tubes, and when fire is applied the steam will rise through the space between the brass and iron tubes into the chamber *B* and through the pipe *G* into the boiler, producing a rapid circulation, not only in the tubes but also increasing the circulation in the boiler.

See the following references: —

Locomotive, *Belpaire*, Belg.	* *Thurston's* "*Vienna Report*," ii. 79.
	* "*R. R. Gaz.*," xxiv 365.
Engine, *Fox & Greig*, Br	* "*Engineering*," xxx. 45.
Tubular flue boilers, *Kaselowsky*, Ger.	* "*Engineer*," xlii. 418.
Locomotive, *Kaselowsky*, Berlin.	* "*Sc. Amer. Sup.*," 934.
Locomotive, Penn. Railway	* "*R. R. Gaz.*," viii., 139.
Crown arch, *Rajputna State Ry.*	* "*Engineer*," xlviii. 378, 414.
Locomotive, *Ten-brink*	* "*Eng'ing*," xxvii 455.
Staying, *Wehrenfennig*, Aust.	* "*Engineer*," xlviii. 455.
Locomotive, *Wootten*	* "*R. R. Gaz.*," xxiv. 495.
Wootten	* "*Engineer*," l. 282.

Fire Brick. Usually made of silica and refractory clay, with a small proportion of cementing material.

Some fire bricks are made into which clay does not enter as an ingredient.

In England quartz is ground and freed from iron by sulphuric acid. It is considered better than sand. In Wales bricks are made of ground quartz with one per cent. of lime and water sufficient. The brick is pressed in iron molds, and the lime acts as a flux to cement the quartz.

The composition of good fire bricks is indicated by three analyses: —

Carter County, Kentucky, Clay.

Silica	45 to 64
Alumina	23 to 43
Oxide of iron, a trace.	
Lime, a trace.	
Potash	0.212 to 2.098
Soda	0.283 to 0.728

Belgian Fire Clay.

Silica	64.2
Alumina	32.2
Oxide of iron	2.4
Lime	0.0
Alkalies	1.2
	100

Clays of Forges-les-Eaux and Ardennes, in France; Belgium; Stonebridge, England; Klingenberg, Germany, vary between the following proportion: —

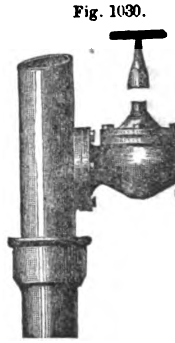
Silica	64 to 71
Alumina	22 to 38
Oxide of iron	0.2 to 4
Lime	trace to 1
Alkalies	trace to 1

Fire bricks, see on, "*Blake's Reports on Ceramics*," "*French Exposition* (1878) *Reports*," vol. iii., 215 *et seq.*

Fire bricks, *Dunnachie* on, "*Van Nostrand's Mag.*," xvi. 6.

Fire Cock. A cock attached to a stand pipe in a building, one cock to each floor, and having a hose attached capable of reaching any part of that story of the building, or the part destined to be within range of that particular stand pipe. In the illustration the apparatus has a cap to be removed and the hose coupling attached.

Fig. 1030.



Fire Cock.

Fire-damp' A-larm'. One for automatically giving notice of presence of fire-damp in a mine.

See also FIRE-DAMP DETECTOR.

Fire-damp' De-tect'or. An instrument for detecting the presence of proto-carbide of hydrogen in a mine. Coquillon's test for quantity is considered under GRISOUMETER.

Forbes's test for presence is founded on the facts that sound travels quicker in light gases than in denser ones, and that air containing fire-damp is lighter than pure air. The instrument detects 0.5 per cent. of impurity.

The test for fire-damp by the observation of the blue fringe of the Davy safety-lamp is only practicable where the atmosphere contains at least 3 per cent. of the explosive gas. M. Galloway has shown that 0.75 per cent. is explosive in presence of fine coal-dust.

MM. Mallard and le Chatelier propose a safety-lamp in which a jet of hydrogen gas is burned instead of the ordinary oil. The flame is hot, gives but little light, and in burning the explosive gas elongates and exhibits freely the blue fringe. 0.25 per cent. is detectable by this means.

Another instrument by Prof. Forbes for detection of fire-damp consists of a resonator of variable dimensions and a tuning-fork of definite pitch. The resonator is a metallic tube, 1″ in diameter and 14″ long, in which a piston slides, so as to regulate the length of the tube. This tube is fixed to a block of wood, to which is attached a tuning-fork whose points are just above the open end of the tube. The tuning-fork is sounded and the piston is moved until the proper length is found, which is indicated by the resonator intensifying the sound of the tuning-fork. Barometric pressure produces no difference on the instrument. The temperature correction is made by reading off a thermometer of the proper dimensions instead of reading off a fixed mark on the piston. The only error is by the presence of dense carbonic acid gas, but the carbonic acid gas tends to destroy the explosive character of fire-damp, and it appears that if the presence of carbonic acid prevented the instrument from indicating fire-damp it would certainly be sufficient to prevent the explosive character of fire-damp.

See the following references: —

Coquillon, Fr. . . * "*Engineer*," xlix. 83.
* "*Scientific American Sup.*," 4060.
Forbes, Br. . . . * "*Engineering*," xxviii. 213.
"*Scientific American Sup.*," 2803.
Liveing . . . . . * "*Scientific American Sup.*," 4030.

See also GRISOUMETER; FIRE-DAMP PHOTOMETER.

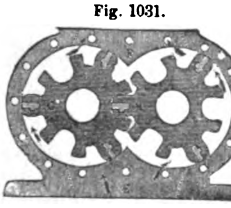
Fire-damp Me′ter. An instrument for determining the amount of proto-carbide of hydrogen in a mine. Coquillon has contrived several forms: one for use in a mine and the other for the laboratory. Both depend on the principle that hydrogen and its gaseous carbides are completely burned in presence of oxygen and a palladium wire heated to white redness See GRISOUMETER.

Fire-damp′ Pho-tom′e-ter. An apparatus by Liveing, of London, for the detection of the presence of proto-carbide of hydrogen in air. It acts upon the principle of using the electric current for causing the combustion of the fire-damp and a photometer for observation of the luminous intensity.

A platinum wire rendered incandescent by the passage of an electric current, is more brilliant in air contaminated with the fire-damp, and proportionally so by increasing the quantity of the proto-carbide. The comparison is made by the photometer of the incandescent wire in pure air and the wire in mixtures of definite proportions of air and fire-damp, and thus a scale is obtained. — "*Transactions Physical Society of London.*" "*Scientific American Supplement,*" * 4030.

Fire En′gine. The Silsby fire engine, Plate XV., has a steam rotary pump, shown in section in Fig. 1031. The boiler is tubulous and vertical, and is shown in Fig. 1032. The engine and the pump are substantially similar, in the former case, however, the pressure of steam drives the three-toed pistons, and in the latter, the pistons drive the water. Steam piston and pump pistons are coupled and connected. The boiler, shown in Fig. 1032, has depending tubes and vertical flues giving a large heating surface. One of the water tubes is shown separately at the left of the boiler. Plate XV. shows the complete engine.

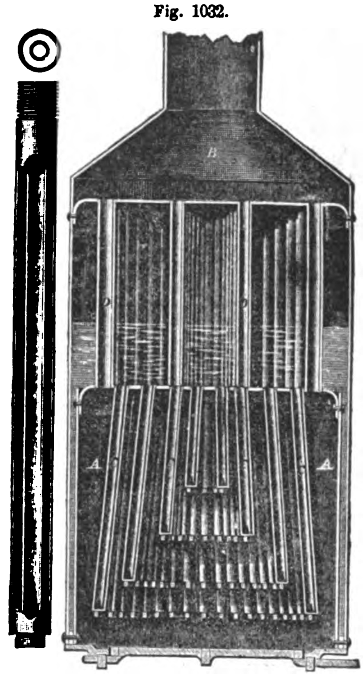
Fig. 1031.



Silsby Fire Engine Pump.

The La France steam fire engine also has the rotary principle.

Fig. 1032.



Vertical Fire Engine Boiler.

See the following references: —

Amoskeag Co. . . . . * "*Polytechnic Rec.*," Mar., 1876, p. 18.
Chemical, *Babcock* . . . . . * "*Amer. Man.*," Apr. 18, 1879, p. 6.
Chemical, *Clapp* . . . . . . * "*Sc. Amer.*," xxxvii. 111.
Floating, *Edwards & Symes*, Br. * "*Engineering*," xxiii. 125, 127.
English . . . . "*Sc. Amer.*," xxxv. 255.
Engine pump, Br. . . . . . "*Sc. Amer. Sup.*," 1906.
Steam, Engl. . . . . . . * "*Sc. Amer.*," xxxix. 246.
London . . . . * "*Sc. Am. Sup.*," 1747.
Gould . . . . * "*Sc. Amer. Sup.*," 419.
* "*Polytechnic Rev.*," Mar., 1876, p. 19.
* "*Engineering*," xxi. 432.
Injector hydrant, *Greathead*, Br. * "*Engineering*," xxviii. 80.
Hand, *Hull* . . . . * "*Sc. Amer.*," xxxv. 127.
Steam, *Moorlen* . . . . . . * "*Sc. Amer.*," xxxix. 319.
Steam, *Rumble*, Engl. . . . . * "*Sc. Amer. Sup.*," 2447.
Steam, *Shand & Mason*, Br. . . * "*Engineer*," xliv. 423; xlvi. 165.
Fire-engine, rotary, *Silsby* . . * "*Sc. Amer.*," xxxv. 115.
Silsby . . . . * "*Thurston's Vienna Report*," ii. 104.

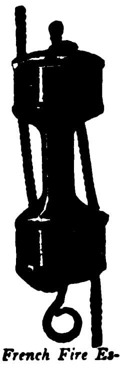
Reports of trials, "*Centennial Exhibition Reports*," vol. vi., Group XX., includes the following: —

Gould . . . . * p. 283.
Clapp & Jones . . . . * p. 285.
Silsby . . . . * p. 289.
Amoskeag . . . . * p. 292.

Fire Es-cape′. Figs. 1033, 1034, show respectively French and American forms of clutches to run on ropes when a person, suspended to either of them, is descending from the window of a burning house.

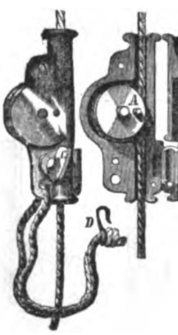
In Fig. 1033, the rope being firmly attached in the room, the person is suspended from the hook below, and the rope

Fig. 1033.



French Fire Escape.

Fig. 1034.



Rope Clutch.

being roven through the grooves, the friction opposes its rapid motion; the friction is increased by grasping the rope while descending.

In Fig. 1034, the rope runs through a fair leader groove in a hinged box; the two parts of which compress the rope in any required degree, so as to prevent too rapid descent of the person suspended therefrom by the hook *D*; *A* is the pulley-wheel, and *C* the pinch screw.

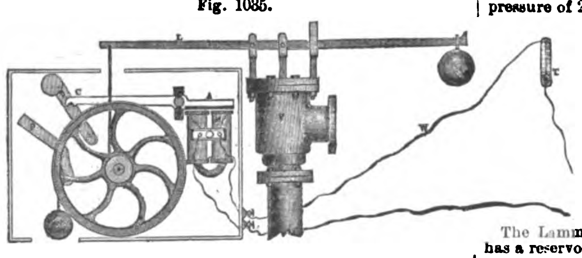
See the following:

Allen	* "*Sc. Amer.*," xxxvii. 163.
Clutch	* "*Sc. Amer.*," xxxvi. 335.
Portable, mounted, *Davis* . .	* "*Iron Age*," xxii., Dec. 12, p 7.
Portable ladders, *Falk*	* "*Manufact. & Builder*," ix. 150.
Portable, *Falk*	* "*Iron Age*," xx., Aug. 2, p. 9.
Portable, Hydraulic, *Gerard* . .	* "*Iron Age*," xxii., Oct. 31, p. 7.
Hydraulic, *Gerard & Turnbull* .	* "*Eng. & Min. J.*," xxvii. 150.
Houghton	* "*Sc. Amer.*," xxxvi. 294.
Automatic, *Leavitt*	* "*Sc. Amer.*," xxxvii. 255
Lescale	* "*Sc. Amer.*," xxxix. 169.
Net on poles	* "*Sc. Amer.*," xxxix. 19.
Shishmanian	* "*Sc. Amer.*," xxxviii. 147.
Ladder, *Winter*	* "*Sc. Amer.*," xli. 230.

Fire Ex-tin'guish-er. The subject of the portable or fixed apparatus, for projecting carbonic acid gas and water upon a fire, is considered on pp. 866, 867, "*Mech. Dict.*," including a reference to Sir William Congreve.

The larger apparatus, mounted as fire engines, are now in use in our cities, known as the Babcock Fire Engine.

Fig. 1035.



Fire Extinguisher for Mills.

The Anderson & Proctor apparatus, shown in Fig. 1035, is especially intended for mills, and is automatically operated through the medium of electricity, as described in § c, Fire Alarm, p. 849, "*Mech. Dict.*" Thermometers are placed freely at different parts of the establishment, and the raising of the mercury in either to a certain height completes a galvanic circuit, and opens a valve connecting by pipes with the special department from which the alarm proceeded and flooding it with steam.

See also the following: —

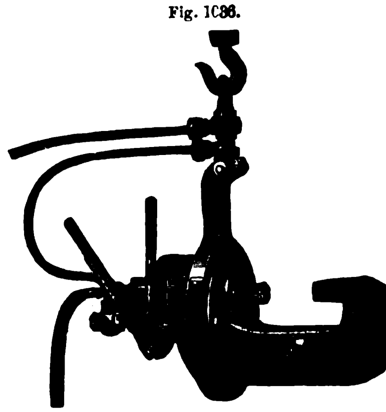
Apparatus, *Atlantic Fire Annihilator Co.* . . .	* "*Man. & Builder*," viii 145.
Compound, *Reec*	"*Sc. Amer.*," xxxvi. 228.
Portable, *Douglass* . . .	* "*Iron Age*," xxiii., June 26, p. 5.
On shipboard, *Granger* .	* "*Eng. & Min. J.*," xxiii. 454.
	* "*S. Amer.*," xxxvi. 383.
Shipboard, *Thompson* . .	* "*Man. & Builder*," viii. 16.
	"*Sc. Amer.*," xxxviii. 101.
Automatic, *Tenner* . . .	* "*Sc. Amer.*," xxxvii. 246.
Apparatus, "Tribune," .	"*Sc. Amer.*," xxxiv. 146.

Fire'-hole-ring Riv'et-er. The portable hydraulic riveter, for fire-hole-rings, originally designed by Tweddell for the special purpose of riveting up locomotive fire-hole door rings at Crewe.

The gap is 3.5″ when intended for locomotive work, and 5″ to 6″ when used for riveting on marine boiler front and back end plates.

This riveter is centered in a toothed wheel, which is put in

Fig. 1036.



Fire-hole-ring Riveter.

motion by a pinion, and the machine thus revolves in a vertical plane on its own center and in a very small space. A swivel joint between the outer rock and the suspending chain allows the riveter also to revolve freely in a horizontal plane.

The machine exerts a force of 33,000 foot pounds at each stroke, weighs 400 pounds, and can make 20 to 30 strokes per minute.

Fire'less Lo-co-mo'tive. A locomotive for street railways. That shown was designed for the Crescent City Railroad Company, of New Orleans, by Scheffler. Plate XV.

It has a cylindrical tank 31″ in diameter and 9′ long, with a capacity for holding 300 gallons of water, which is charged into it from a stationary boiler at a temperature due to a pressure of 220 pounds per square inch = 390° Fah. With this charge it runs about 6 miles, the pressure being down to about 40 pounds at the end of the run.

The driving wheels are 30″ in diameter, and the leading wheels 20″, with a wheel base of 5′ 7″. The cylinders are $4\frac{1}{2} \times 10''$. The valve gear consists of a main valve, which works full stroke at all times, and controls the exhaust, with a steam valve on top worked by a link, which governs the admission. Both valves are, however, worked by the same link. The weight of the engine, with the tank full of water, is 8,700 lbs.

The Lamm & Francq motor, used on the Paris Railways, has a reservoir containing 1,800 liters of water at 400° Fah.

Francq, Fr.	"*Manufacturer & Builder*," xi. 9.
Lamm & Francq, Fr.	* "*Engineering*," xxviii. 306, 375.
	* "*Scientific American Sup.*," 1760, 2125, 2521, * 2766.
	* *Anderson's* Report, "*Paris Exposition Reports*," iv. 465.
Mekarski, Paris . .	* *Ibid.*, iv. 462.
	"*Iron Age*," xxiv., Nov. 27, p. 7.
Scheffler, N. O. . .	* "*Railroad Gazette*," xxi. 383.
	* "*Scientific American*," xxxvii. 289.
	* "*Engineer*," xliv. 220.

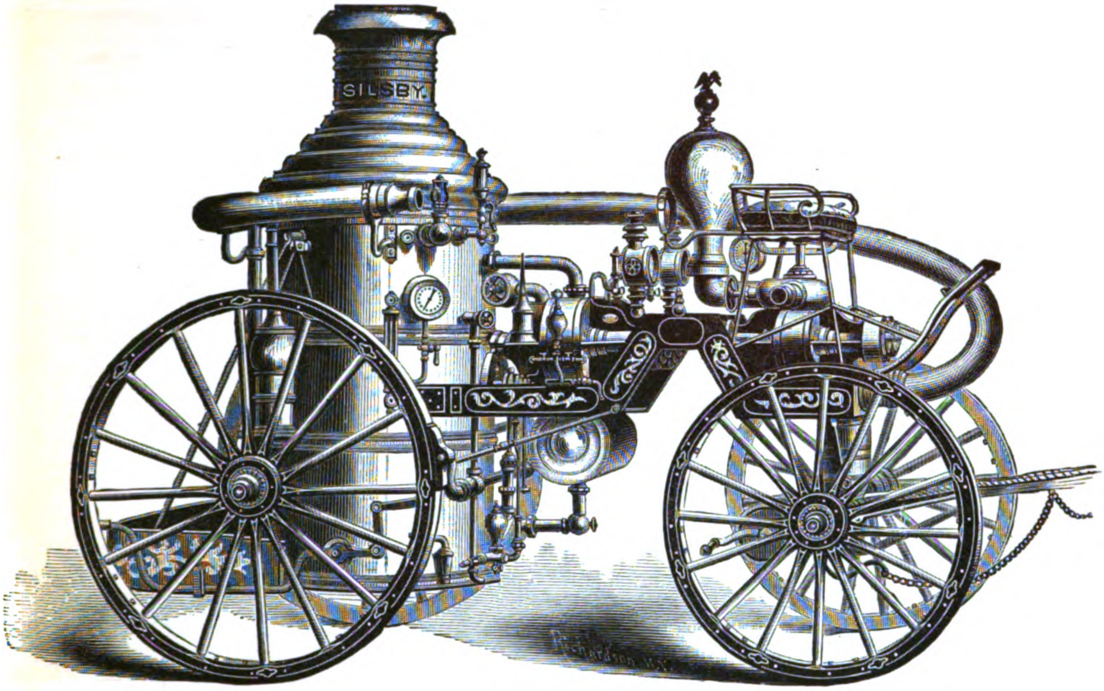
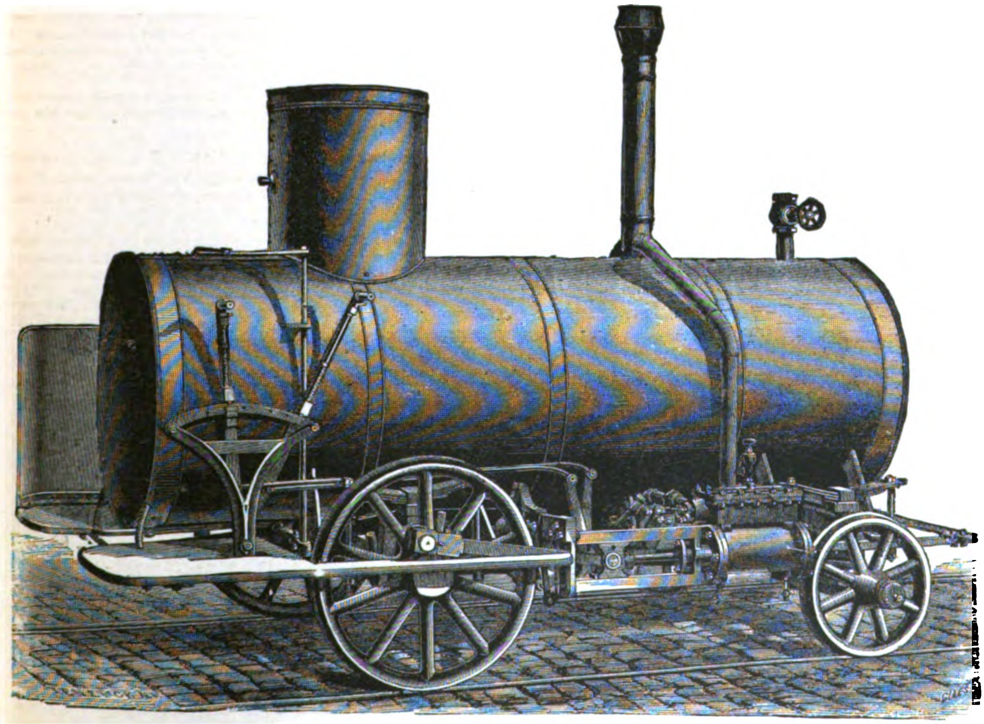


Figure 1081. **SILSBY FIRE-ENGINE.** *See page* 887.



SCHEFFLER FIRELESS LOCOMOTIVE.

(*Crescent City Railroad Co., New Orleans.*) *See page* 888.

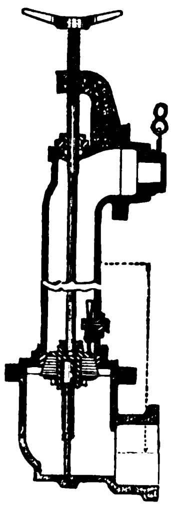
Fire'man's Axe. A chopping axe with a talon on the poll.

Fire'place Stove. A description of heater in which a close stove occupies the position of a parlor grate, has a protruding front and doors with mica panels. Also known as a *latrobe*. See Fig. 1998, p. 869, "*Mech. Dict.*" Fig. 2843, p. 1205; Fig. 5909, p. 2410, *Ibid.*

"Alhambra" . .	* "*Scientific American*," xxxix. 261.
Ventilating . . .	* "*Scientific American Sup.*," 1747.

Fire Plug. A device for connecting street mains with suction pipe of fire engine, or with hose for street watering or fire purposes. Used also in factories and large establishments of various kinds. See also FIRE COCK.

Fig. 1037.



Fire Plug (section).

Fire Pot. A solderer's furnace.

Fire-proof'ing. See following recipes and references: —

Wood: Follachi's plan. Place the wood on gratings and separated in a close vessel. Pump in following solution and boil.

Sulphate of zinc, 55 lbs.; potash, 22 lbs.; alum, 44 lbs; oxide of manganese, 22 lbs.; sulphuric acid of 60°, 22 lbs.; water, 55 lbs.; all of the solids are to be poured into an iron boiler containing the water at a temperatnre of 45° C., or 113° Fah. As soon as the substances are dissolved the sulphuric acid to be poured in little by little, until all the substances are completely saturated.

Theatrical scenery: boracic acid, 5; sal ammon., 15; potassic feldspar, 5; gelatine, 1.05; size, 50; water, 100.

Fabrics: In 14 parts of water, heated to 180° Fah., dissolve 10½ lbs. gelatine and 21 lbs. castor-oil soap. Then add 10½ lbs. gum lac, shaking the liquid until the last is completely dissolved. Remove from the fire, and add in small quantities 21 lbs. powdered alum until the alum dissolves. This forms an insoluble alumina soap, closely incorporated with the gelatine and the gum lac. Apply with a brush.

Cloth: Apply tungstate of soda.

Or: a solution of 4 parts borax and 3 of sulphate of magnesia, which precipitates an incombustible and insoluble compound, the borate of magnesia, in the fibers.

Or: phosphate of ammonia, 5 per cent solution.

Or: solution of acetate of lime and chloride of calcium.

Or: sulph. amm. and sulph. calcium.

Or: 5 per cent. phosphate of amm. and 5 per cent. alum. Requires reimpregnation after washing.

Or: for cloth, 8 parts, by weight, of sulph. amm.: 2.5 parts carb. ammon.; 3 parts boracic acid; 1.7 borax; 2 parts starch in 100 water.

Canvas or cordage, wood or straw: 6 parts boracic acid; 15 parts sal amm.; 3 parts borax in 100 parts water.

Paper: 8 parts sulph. amm.; 3 parts boracic acid; 1.7 parts borax. Applied at 122° Fah.

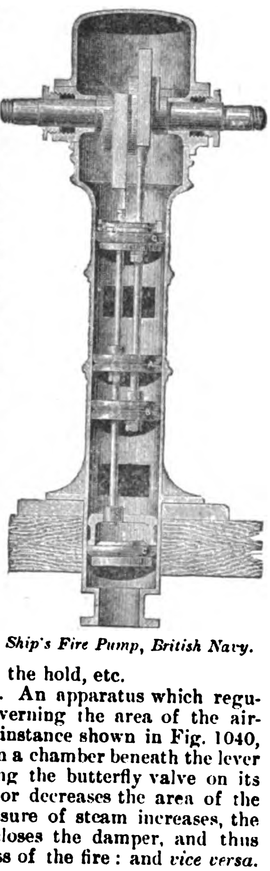
Paper: made from a pulp of	vegetable fiber .	1.00
	asbestos . . .	2.00
	borax	0.01
	alum	0.02
The ink is made of	graphite . . .	85.00
	copal varnish . .	0.08
	copperas . . .	7.50
	tinct. nutgalls .	30.00
	indigo carm. . .	q. s.

Buildings, "*Engineer*" .	"*Van Nostrand's Mag.*," xvii. 439.
Cloth	"*Man. & Builder*," ix. 1.
	"*Eng. & Min. J.*," xxvi. 333.
	"*Sc. American*," xli. 218.
	"*Sc. Am.*," xxxiv. 103, 405.
Concrete, "*Architect*" . .	"*Van Nostr. Mag.*," xvi. 237.
Construction, *Bayless* . .	"*Iron Age*," xix., Apr. 26, p. 22.
	* "*Iron Age*," xxv., Jan. 15, p. 3.
	"*Sc. American*," xxxvi. 104.
	"*Sc. American*," xxxviii. 43.
	* "*Sc. American Sup.*," 1363.
Hutton	"*Sc. American Sup.*," 158.
Northcroft, Engl.	"*Sc. American Sup.*," 973.
Paper by *Schumann* . . .	* "*Sc. Am. Sup.*," 2174, 2209.
	* "*Polytechnic Review*," Dec. 23, 1876.
Curtain	"*Sc. American*," xxxvi. 277.
	"*Iron Age*," xix., April 5, p. 7.
	"*Iron Age*," xxii., Aug. 1, p. 18.
Dress	"*Sc. Amer.*," xxxv. 127, 159.
Flooring, *Evans & Swain* .	* "*Sc. American Sup.*," 1110.
Floors, roof, *Northcroft* . .	"*Van Nostrand's Mag.*," xvii. 475.
Paper	"*Sc. American*," xli. 86.
Shutter, *Pollock*	* "*Sc. American*," xxxix. 290.
Theatrical scenery . . .	"*Sc. American*," xli. 218.
Tower	"*Sc. American Sup.*," 557.
Walls	"*Sc. American*," xxxvi. 307.
Wooden buildings . .	"*Iron Age*," xix., May 10, p. 24.
Wood, "*Building News*" .	"*Van Nostrand's Mag.*," xxi. 477.
Folacci	"*Sc. American*," xli. 103.
	"*Sc. American Sup.*," 702.

Fire Pump. A pump designed to be used for extinguishing fires.

The Stone pump, shown by two sectional views taken in planes at right angles to each other (Figs. 1038, 1039), is the favorite pump in several European navies. The pump has three pistons, operating one above another in a single cylinder placed on the deck of a vessel and worked by hand cranks. The operation of the pistons is by a two-throw crank, and the suction pipes connect with either of six different parts of the vessel. The same pump may be used to draw water from the ship's reservoir; from a barge alongside to replenish reservoir; from the sea to wash decks or extinguish fire; bilge water from the hold, etc.

Fig. 1038.



Ship's Fire Pump, British Navy.

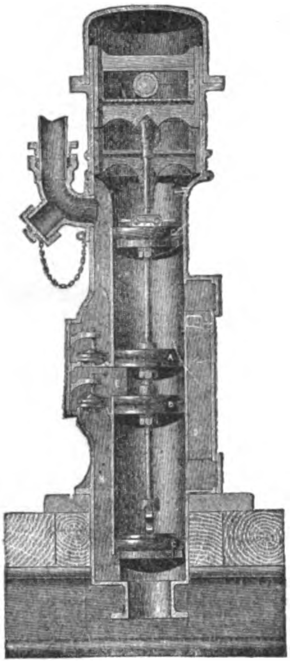
Fire Reg'u-la'tor. An apparatus which regulates the draft by governing the area of the air-duct or flues. In the instance shown in Fig. 1040, the pressure of steam in a chamber beneath the lever has the effect of turning the butterfly valve on its axis, and so increases or decreases the area of the duct. When the pressure of steam increases, the lever rises, partially closes the damper, and thus moderates the briskness of the fire: and *vice versa*. — *Le Van.*

Fish Cul'ture. A number of the devices used in modern fish culture may be reached by means of the following list of United States patents: —

No.	Inventor. Invention.
68,871	*Green*, A wire bottom box anchored. Inclined, to keep water flowing in at bottom.
72,177	*Drexler*, A pen to inclose crabs, turtles, etc.
78,952	*Furman*, Spawn chamber and receiver for young fish.
80,775	*Smidth*. Air pumped through the sea water in chamber.
105,176	*Collins*, A collecting screen beneath the spawning box.
116,112	*Stone*, Box carbonized on inside.
116,995	*Sabin*, Fish nursery. Spawning boxes.

No.	Inventor.	Invention.
136,834	*Holton*,	Spawn trays with upward current.
148,035	*Clark*,	Hatching trays with artificial current.
149,198	*Clark*,	Eggs preserved in layers of moss in refrigerator.

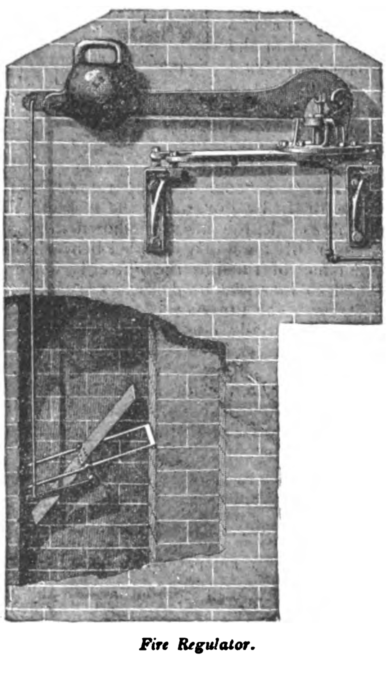
Fig. 1039.



Ship's Fire Pump.

151,080	*Bryan*,	Floating anchored hatching box.
160,002	*Bond*,	Spawning trays and egg collectors.
166,413	*Roth*,	Egg basket and containing box in current.

Fig. 1040.



Fire Regulator.

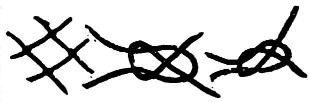
178,262	*Brackett*,	Hatching box with wire-netting bottom.
180,085	*Wilmot*,	Ova suspended in receptacle by upward flow.
199,527	*Ferguson*,	Ova in vessels mechanically agitated.
207,333	*Wright*,	Hatching box floats and its agitation lifts valves in the bottom and causes upward flow of water.

See also reports United States Fish Commission, and

Plaster casts of fish	"*Sc. Amer. Sup.*" 2003
Breeding apparatus	* "*Sc. Amer. Sup.*," 177.
Culture, *Pennell*	* "*Sc. Amer. Sup.*," 177.
Fish skin, numerous uses of .	"*Sc. American*," xlii. 88.
Fish hatching (Havre de Grace)	"*Sc. Amer.*," xxxviii. 159.
Transporting carriage, Austrian	* "*Sc. Amer. Sup.*," 367.

Fish'er-man's Knot. The knot made in netting. Fig. 1041. It is the same as used in the neolithic age of Europe, as is proved by the fragments of nets found in the lake villages of the Swiss region.

Fig. 1041.



Fisherman's Knot.

Fish Flour. Fish flesh dessicated and ground into a flour of varying fineness, according to taste. Largely used in Norway.

Fish Hatch'ing Ap'pa-ra'tus. The most practical and instructive collection of this description of apparatus is in the Museum of the United States Fish Commission, Washington, D. C. It contains —

Models of hatching houses at Bucksport, Me., and Grand Lake Stream, Me.

Hatching apparatus of

Green.	*Stillwell & Atkins.*
Brackett.	*Holton.*
Williamson.	*Bannister.*
Furman.	*Roth.*
Clark.	*Bryant.*
House.	*Coste.*
Ferguson.	*Mather.*

Spawning screens of

Ainsworth.	*Bond.*
Collins.	

Transporting tanks and cans of

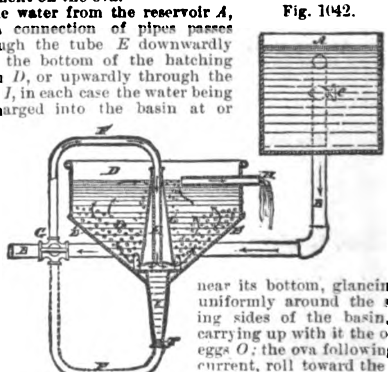
Mather.	*Stone.*
Stone & Hooper.	*Clark.*
Rogers.	*Wilmot.*
Atkins.	*Green.*

Slack. And numerous accessories.

See list under FISH CULTURE.

Wilmot's apparatus, Fig. 1042, dispenses with a screen to prevent the loss of eggs with the overflow water and substitutes a regulation of the force of the water-flow so as to float off worthless matter, imperfect eggs, and prevent deposit of sediment on the ova.

Fig. 1042.



The water from the reservoir *A*, by a connection of pipes passes through the tube *E* downwardly into the bottom of the hatching basin *D*, or upwardly through the tube *I*, in each case the water being discharged into the basin at or near its bottom, glancing off uniformly around the slanting sides of the basin, and carrying up with it the ova or eggs *O*; the ova following the current, roll toward the tube *E*; the heavy or sound eggs fall to the bottom of the basin at the sides of the jacket or tube, to be again moved by the circulation of water, while the light or imperfect eggs, together with sedimentary substances in the water, pass up the outside of the jacket by the upward flow, and are carried off with the waste water through the spout *H*.

"*Scientific American Supplement*" . . . . * 629.

Fish Hook. The general run of the line of invention in this class may be gathered from the following list of United States patents: —

No.	Inventor.	Subject of invention.
6,207	*Johnson*,	Spring-hook: 21 kinds of hook and modes of attachment.
7,709	*Warner et al.*	Spring-hook.
8,853	*Buels*,	Trolling-hook.
10,771	*Buels*,	Spring-hook.
10,761	*Siglers*,	Combination spring-hook.
13,081	*Cook*,	Spring-hook.
13,?68	*De Saxe*,	Trolling-hook. A spring shield covers the point of the hook when fishing among weeds.
13,649	*Johnson*,	Spring-hook.
14,706	*Buels*,	Fly or trolling-hook.
17,803	*McLean*,	Self-setting trap-hook.
25,507	*Haskels*,	Trolling-hook.
31,396	*Morris*,	A spring draws the bearded points together into the fish.
43,694	*Leinhart*,	A trigger raises hooks which transfix the fish.
44,368	*Gardner*,	Spring-hook.
50,799	*Crandell*,	Combination double-lever hook.
51,651	*Davis et al.*,	Spring-hook.
59,814	*King*,	Spring-hook.
59,893	*Crosby*,	Fish-hook (flattened in bend).
51,951	*Livermore*,	Wire loop to prevent fish from stealing the bait.
54,251	*Johnson et al.*,	Spring or spear-hook.
54,684	*Chapman*,	Trolling-hook, with spring and fly.
58,404	*Goodwin*,	Spiral spring around the hook to press the bait down to point.
60,786	*Rhodes*,	Spring-hook, spinner.
62,042	*Lee*,	The shank made in form of spiral spring.
68,027	*Angilard*,	Lever-hook, and striking-hook to fasten the fish.
70,868	*Leinhart*,	Spring-hook.
70,913	*Sterling*,	One hook on swivel to hold bait, the other to grapple the fish while pulling from the water.
69,221	*Kidders*,	Spring-hook. Two hooks, separate when the fish bites.
77,365	*Fish*,	Hook.
79,446	*Christian*,	Trolling-hook, with artificial bait.
80,151	*Dennett*,	Spring-hook.
86,154	*Heltz*,	Hook, with an eye to attach hook.
94,393	*Kemlo*,	Lock-hook.
94,894	*Kemlo*,	Lock-hook.
94,895	*Kemlo*,	Grapple-hook, with guard to prevent fish from getting loose from barb.
95,755	*Angers*,	Three hooks. When the middle hook is pulled, it loosens the outer hooks, which expand in the mouth of the fish.
104,930	*Chapman*,	Propeller or trolling-hook.
111,898	*Arnold*,	Mode of attaching hook to line.
115,434	*Chapman*,	Propeller or trolling-hook.
117,719	*Arnold*,	Mode of attaching hooks to lines.
121,132	*Mann*,	Trolling spoon-hook.
123,844	*Sinclair*,	Trolling-hook.
129,058	*Pitcher*,	Hook, with double spear, to thrust into fish.
139,180	*Mullaly*,	Artificial fly, hook concealed by the wings.
141,910	*Allen*,	Hook has quadruple bends.
143,146	*Harper et al.*,	Trolling-hook with oppositely revolving spoons.
146,443	*Fitzgerald*,	A squid jigger, with a ring of prongs.
146,764	*James*,	A spinning-squid, with fins which revolve it.
148,926	*Cahoon*,	A mackerel jig, the hook secured in a socket.
149,123	*Hazzard*,	A trolling-spoon fish shaped.
151,394	*Huard et al.*	A spring fish-hook is inclosed in the artificial fish.
153,854	*Skinner*,	The spoon is corrugated to make it more attractive.
157,480	*Perry*,	Hooks spring outward when bait is touched.
163,930	*Dunlap*,	Secondary spring-hook strikes the fish.
167,784	*Pierce*,	Two spoons, position controlled by springs.
171,697	*Place*,	Squid jigger, with a circle of prongs.
171,768	*Buel*,	Duplicate spoon fishing-tackle.
171,769	*Buel*,	Spinning-tackle; adjustable spring-hook on sliding ferrule.
177,639	*Hill*,	Spoon can move along the wire.
181,308	*Brush*,	Float attached to the shank of the troller.
184,627	*Jones*,	Swivel attachment for lines.
185,914	*Gregg*,	Artificial worm of rubber.
186,134	*Jahne et al.*,	A leader swiveled to the line and having two snoods.
189,805	*Smith*,	A circular system of pivoted hooks sprung inward.
190,222	*King*,	A pair of spring-hook claws.
191,165	*Miller*,	A supplementary pivoted spring-hook.
196,648	*Edgar*,	A tongue or mousing extending to the barb.
199,926	*Mitchell*,	Plunger driven into the mouth of the fish.
208,581	*Falvey*,	Rubber crawfish bait on an adjustable hook.
211,996	*Hill*,	Arrangement of movable spoon guide and rod.
218,345	*Wakaman*,	Artificial revolving minnow, with hooks.
223,194	*Vaché*,	Trigger and spring to jerk the hook.

Fish'ing and Whal'ing. The following list embraces the heads under this class: —

Accumulator.
Anchored net.
Aquarium.
Axe.
Babiche.
Bag.
Bag-net.
Bait, artificial.
Bait box.
Bait cutter.
Baiting needle.
Bait knife.
Bait mill.
Bait-mill knife.
Bait net.
Baleen.
Baleen knife.
Banner netting.
Bar net.
Bar weir.
Becket hitch.
Blubber fork.
Blubber hook.
Blubber knife.
Blubber mincing machine.
Boarding knife.
Boat hatchet.
Boat knife.
Boat spade.
Bob.
Bomb harpoon.
Bomb lance.
Bottom-set line.
Bowl.
Bull net.
Casting net.
Cast net.
Check stop.
Check knife.
Chopping knife.
Clam hook.
Clam knife.
Clamms.
Clap net.
Clearing ring.
Collecting seine.
Cork line.
Crab net.
Crib.
Cutting spade.
Dip net.
Dipping wheel.
Disgorger.
Drailing tackle.
Drails.
Dredge.
Dredging tube.
Drift net.
Drop net.
Eel bob.
Eel pot.
Eel spear.
Fatting knife.
Finning knife.
Fish-breeding apparatus.
Fertilizer.
Fish apparatus and processes for oil and manure.
Fish cutter.
Fisherman's knot.
Fish grapple.
Fish-hatching apparatus.
Fish hook.
Fishing line.
Fishing line reel.
Fishing net.
Fishing rod.
Fishing torch.
Fish knife.
Fish nursery.
Fish preparing and preserving.
Fish slide.
Fish spear.
Fish transporting carriage.
Fish trap.
Fish-way.
Flitching knife.
Float.
Fly-hook.
Folding net.
Fyke net.
Gaff.
Gear.
Gill-net.
Grains.
Grapple hook.
Grappling gear.
Grappling tongs.
Gun harpoon.
Gunwale winch.
Half-round spade.
Hammock net.
Handle net.
Hand line.
Harpoon.
Harpoon gun.
Hatching box.
Haul seine.
Head axe.
Heading knife.
Head knife.
Head spade.
Heart.
Heart net.
Heart seine.
Hook.
Hook net.
Horse net.
Ice chisel.
Ice chopper.
Ichthyocolla.
Isinglass.
Jack-lamp.
Jerk net.
Junk hook.
Lance.
Lance hook.
Landing gaff.
Landing net.
Land line.
Leader.
Latch.
Lever hook.
Lily iron.
Line (varieties, see list).
Line-hook.
Lint.
Lip hook.
Lock hook.
Mackerel latch.
Mackerel plow.
Mesh.
Meshing net.
Meter.
Mincing knife.
Mincing machine.
Mincing spade.
Minnow propeller.
Net (varieties, see list).
Net machine.
Net-maker's knife.
Oyster culture.
Oyster dredge.
Oyster knife.
Oyster rake.
Oyster tongs.
Pew gaff.
Pisciculture.
Pocket net.

Pot.
Pound.
Pound net.
Probing awl.
Projectiles.
Propeller.
Purse net.
Purse seine.
Reel.
Ripping knife.
Rocket harpoon.
Scaling knife.
Scoop net.
Seaming.
Seine.
Seine windlass.
Set line.
Sheath knife.
Sheave block.
Sinker.
Skim net.
Slivering knife.
Snood.
Spade.
Spawning screen
Spear.
Spilliard.
Spinner.
Splitting knife.
Spoon.
Spoon bait.
Spring hook.
Spring net.
Squid jig.
Squid line.
Stake net.
Swivel.
Tackle.
Throating knife.
Throat spade.
Throwing line.
Tilting net.
Toggle line.
Tongs.
Torpedo.
Towing net.
Trailing net.
Trammel net.
Trap.
Trap net.
Trawl.
Trawl-boy swivel.
Trawling hook.
Trawl line.
Trawl line roller.
Trawl net.
Trolling bait.
Trolling spoon.
Trot line.
Tunnel.
Vat net.
Weir.
Whalebone.
Whaling apparatus
Whaling gun.
Whaling rocket.
Whaleman's knife.
Whaleman's tools.
Whiffling tackle.
Wide spade.
Wing.
Wing net.
Worm.

Fish'ing Line. See LINE.

Fish'ing Line Reel. The following condensed description of United States Patents will give an idea of the general tendency of invention in this line: —

No.	Inventor.	Invention.
854	*Tiffany*,	Rollers for seine line on rail of vessel.
15,466	*Bailey*,	Crank wheel thrown in or out of gear with reel.
16,626	*Deacon*,	Crank wheel thrown in or out of gear with reel.
24,987	*Billinghurst*,	Line winds on a skeleton ring.
27,305	*Palmer*,	Reciprocating line guide, to wind evenly.
41,494	*Dougherty*,	Friction brake to control unwinding.
43,460	*Van Gieson*,	Frictional instead of positive connection between crank and reel.
43,485	*Ellis*,	Crank wheel can be disconnected from reel.
43,546	*Cummings*,	A spring catch and hook to connect reel and rod.
49,663	*Stuart*,	Reel in the handle; line passes through rod; arrangement for winding snug; disconnecting crank and reel.
55,653	*Hatch*,	Skeleton spool for line.
56,987	*Hartill*,	Mode of hanging spool and "drag" on paying out of line.
71,344	*Vom Hofe*,	Arrangement for reel gearing.
78,546	*Stacy*,	An elastic gum nipper for hand lines.
82,377	*Bradley*,	Reel with two concaved disks.
83,740	*Stetson*,	A screw clamp holds the line sheave on the boat's gunwale.
87,188	*Mounier*,	A pivoted clamp holds the reel for the set line. A bell alarms when bait is taken.
88,026	*Foster*,	A mackerel latch; a button and line channel.
95,839	*Ross*,	A skeleton reel.
96,652	*Altmaeir*,	Reel set between two sections of the rod.
103,668	*Sheldons*,	Reel like a kite-string holder.
112,326	*Decker*,	Mackerel latch; a pinch grip beneath a cleat.
121,020	*Terry*,	Frictional device for angler's reel.
128,137	*Fowler*,	Annular reel of hard rubber.
134,917	*Mooney*,	Mode of attaching to rod and operating reel.
135,283	*Noe*,	Fan regulator connected to reel gear.
147,414	*MacCord*,	One reel may be quickly substituted for another.
150,883	*Orvis*,	Perforated disks to allow line to dry.
161,314	*Winans et al.*,	A friction brake to prevent overrunning.
162,845	*McDonald*,	A roller with several grooves on the gunwale.
166,241	*Winslow*,	Reel in the handle of the rod with an outer movable cylinder.
175,227	*Winans et al.*,	Reel cover and spring brake.
177,544	*Noe*,	Brake to prevent overrunning of the line.
191,813	*Philbrook*,	Reel with thin metal sides, and click mechanism.
195,578	*Copeland*,	Reel in the handle, with bevel gears and exterior crank.
214,495	*Dickson*,	Multiplying gearing in the cap.
216,248	*Voss*,	A crank and shaft in the dory to wind trawl lines.
219,328	*Vom Hofe*,	Construction of reel and control of motion.
220,776	*Wardwell*,	Crank can be disconnected from reel; a reciprocating guide for winding line.

Fish'ing Nets. The following condensed description embraces the principal features of the subject: —

647	*Evarts*,	Floating seine extended from boats.
763	*Hale*,	A square net alongside drawn into bag form, to inclose school of fish.
932	*Tracy*,	Seine with bottom and semi-circular sides.
3,004	*Cook*,	Gill-net, submerged Small floats on seine line, and larger on surface of the water.
3,056	*Downs*,	Form for making nets for taking eels.
3,741	*Carr, Shannon & Co.*,	Fyke for eels.
10,794	*De Saxe*,	Landing-net with expansible frame.
20,125	*Hall*,	Seine with bag attached.
20,725	*Merritt*,	Net rigged overboard by booms.
34,887	*Goodwin*,	Leading nets and funnel entrances to slat trap.
39,676	*Randolph*,	Guide nets leading to pounds or shoal water.
55,635	*Field*,	A bag net.
56,917	*Ferl & Larkin*,	A drop net, Fig 3317, "*Mech Dict.*"
59,429	*Maxwell*,	Net, double, with rigid mouth, the inner being a funnel entrance.
62,481	*Crossman*,	Net, attached to side of boat, so as to be lowered or raised. Fig. 3318, "*Mech. Dict.*"
66,669	*Arnold*,	Net fabric
72,177	*Drexel*,	Securing and feeding crabs.
76,284	*Will*,	Gill-net, with rings for sinkers.
76,387	*Bell*,	Net-attachment for boats, with guys to mast, to hoist or lower.
78,716	*Arnold*,	Mode of making nets
80,274	*Collines*,	Perpendicular wooden braces extend below the sinker line.
82,490	*Cartwright*,	Set-net, to be anchored; the boat is attached about midway of the net, and a line is attached to small end of bag, and can be raised and emptied.
82,913	*Allen*,	Eel-pot.
83,493	*Harper*,	Bottom of seine longer than top, large sinkers.
83,429*	*Wilcox*,	Pound net or trap
87,740	*Wardmiller*,	Dip-net
99,713	*Sabins*,	Purse-net, with bait-box, the net stretched on wires similar to umbrella.
113,292	*Hammond*,	Fish-trap net with two hinged flaps.
113,572	*Rider*,	Net-supporter, to swing with the tide
113,817	*Tierman*,	Pound-net.
117,957	*Alexander*,	Bottom seine, with pursing lines.
120,974	*Jeffrey*,	Seine, with pursing lines.
124,635	*Smith*,	Purse seine, with a portion of its circumference depressed below the surface.
132,476	*Lirandais*,	Umbrella-shaped purse-net.
137,930	*Ketcham*,	A leader and heart conducting to a pound.
144,888	*Campbell*,	Stake for seines.
155,140	*Brewster*,	A leader heart and pound towed abaft a vessel.
167,189	*Nason*,	A landing-net.
194,434	*Howes*,	A bottom-net or pocket.
197,313	*Bates*,	A dip-net set on bottom.
215,031	*Webb*,	Pound net. See NET.

Fish'ing Rod. See the following list of United States Patents: —

10,795	*De Saxe*,	Hollow rod contains all the tackle; float has a trigger to jerk the hook.
20,309	*Underwood et al.*,	Tip has a sheave at the end.
25,693	*Pritchard*,	Line leaders on adjustable ferrules on rod.
35,339	*Vom Hofe*,	Sheave on the end of the rod.
58,833	*Isaacs*,	Enamel surfaces to line guides.
72,667	*Montrose*,	Rod has hinged sections and slipping ferrules.
100,895	*Hubbard*,	Parts of the socket are attached to each section, and screw together.
119,251	*Tout*,	Rod of laminæ of wood and whalebone.
137,015	*McHarg*,	Mode of securing the reel plate.
140,655	*Smith*,	Mode of locking the foot of one section in the socket of the other.
142,126	*Senieur*,	A post and socket to hold the foot of the rod.
154,141	*Hill*,	A mode of jointing the sections; a trigger and spring to jerk fish.

164,828 *Graves*, Line passes through center of rod.
169,181 *Leonard*, Mode of constructing the socket ferrules.
170,183 *Perry*, Fishing rod case of light wood, canvassed.
173,534 *Endicott*, Expansible guide and reel bands.
198,879 *Fisher*, Tip formed of a wire helix coiled into tubular shape.
206,264 *Robertson*, The butt is in two parts, one in the other.
207,665 *Leonard*, Split stay strips, to re'nforce rod.
208,500 *Van Altena*, Reel contained in slot of rod. Line check.
222,681 *Earle*, The entering action has a cap which incloses the socket over which it slips.

Fish'ing Torch. Hamline; a ball of cotton is fed by a spout from a reservoir behind the reflector.

Wilson & Keagle; a wire gauze tube filled with asbestos, which forms the wick.

Fish Knife. A great variety of knives is found in use among fishermen, cleaners, curers, and packers of fish; for ripping, heading, crimping, and trimming of fish. Among them are the following: some of them are synonyms: —

Bait knife. For cutting up flesh for bait.
Bait-mill knife. Used on the rollers of bait-mincing machines.
Cheek knife. For trimming cod-fish.
Chopping knife. For mincing bait.
Clam knife. For opening clams.
Fatting knife. Used in creasing the sides of inferior mackerel, to make them resemble No 1 mackerel.
Finning knife. For removing the fins of large fish.
Flitching knife. For slicing halibut, etc., into steaks or flitches, in preparation for salting and smoking.
Heading knife. For cutting off the heads of halibut, or other large fish.
Mackerel Plow. Also known as a *fatting* knife, for creasing the sides of lean mackerel to improve their appearance.
Net-maker's knife. A blade (2″) without a handle, and the heel of the blade curved so as to fit the finger like a ring.
Oyster knife. A stout knife for opening oysters.
Ripping knives. For splitting the fish to remove the viscera.
Scaling knife. For removing scales. Sometimes has a saw edge.
Sheath knife. The fisherman's knife, worn at the belt.
Slivering knife. For slicing the flesh from the sides of fish to be used as bait.
Splitting knife. For ripping, and for halving the fish before salting.
Throating knives. For opening behind the gills, and then ripping the fish. Frequently double-edged.

Fish Nurs'er-y. A place where spawn is gathered and the young fish protected from the ravages of their natural enemies. See FISH CULTURE.

Fish Slide. (*Fishing.*) An inclined box set in a stream at a small fall or ripple to catch fish descending the current.

The open end of the box is presented up stream and the bottom being slippery the fish are dashed to the upper end of the box and scooped with a landing net.

Used in the southern rivers of the United States to supply local demand for fish.

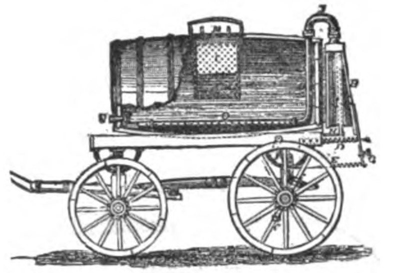
Fish Spear. A lance for bleeding captured whales, etc., or, on a small scale, a *leister* or *gig* for spearing fish from canoes or in holes of streams. See also GRAINS.

Fish Trans-port'ing Car'riage. The transportation of fish and of fish ova is an important consideration in fish culture, and many devices for packing ova and removal of fish from place to place have been devised.

Fig 1043 shows a fish transporting carriage by Haynmerle, of Austria. It consists of a large tank mounted, and with devices by which the running gear is caused to work the bellows and drive a continuous stream of air through the tank to aërate the water. The lever *F*, rod *E*, and spiral spring *D* operate the bellows *B*, forcing air through pipe *T* and distributor *O* into the tank. *M* is an ice tray and *P* a filter. *N*, draw-off cock. *G*, handle for working the bellows when the wagon is at rest. — "*La Nature.*"

See collection in United States Fish Commission Museum, Washington, D. C. Cans, barrels, tanks, force pumps, siphons, aërators, aquaria, bellows, dippers, etc.

Fig. 1043.



Fish Transporting Carriage.

Fish Trap. A device set to catch fish. Snares, pounds, grapples, etc., come under this class. See also NET.

See also, DIPPING WHEEL, *supra.*

List of United States Patents.

3,056 *Downs*, Forming blocks for making eel baskets.
7,709 *Warner et al.*, Spring grapple.
16,014 *Horton*, Spring grab hooks.
16,217 *Van Hosen*, Spring jaws and bait trigger.
20,343 *Garl*, Baited detent and spring nippers.
22,644 *Gray*, Slat cage, with expansible opening slats.
23,154 *Bowman*, Dark chute entrance to trap.
75,075 *Talbot*, Angler's tackle to signal when the fish takes the bait.
76,489 *McCaughan*, Set line with trigger and weight to strike and hook the fish.
77,893 *Koehler*, Set line with trigger and spring.
82,913 *Allen*, Eel pot with funnel of perforated sheet rubber.
85,199 *Beach*, Baited trigger and falling cage.
113,292 *Hammond*, Folding net of basket sections sprung by a line.
123,164 *Fuller*, Float with spring lever to strike when the baited hook is pulled.
131,439 *Harcourt et al.*, Self-closing trap door to cage.
132,476 *Lavaudais*, An umbrella-shaped net closed by trigger and springs.
137,980 *Ketcham*, Pound of net has a funnel entrance and a door to close the entrance.
141,588 *Pavonarius et al.*, Cylinder with semi-circular door sprung by trigger.
156,648 *Peck*, Spring arm to throw baited lines.
178,375 *McRoberts*, Gravitating door lifted by entering fish.
188,503 *Davis*, For fishing in ice-holes; hooked fish makes signal.
198,894 *McBryde*, Swinging gates and mirror for decoy.
201,504 *Davis*, Fish approaching bait press on spring fingers and enter cage.
202,818 *Hesse*, A spring lever to strike fish at the bait.
202,962 *Robertson*, A spring lever to strike fish at the bait, with reel to wind in line.
204,538 *Clark et al.*, Sunken cage with baited trigger and falling door.
215,031 *Webb*, Anchored seine with flaps and pockets.
218,737 *Henderson*, A glass vessel in a trap to hold live bait.

Fishing Electric light under water. Fr. "*Teleg. J.*," iv. 32.
Fishing boats, Berlin Exposition * "*Sc. Am. Sup.*," 3835

Fish'way. The museum of the Fish Commission, at Washington, D. C., affords the best opportunity for study of this subject; and the catalogue of the collection contains detailed information. The devices are capable of classification, as

Gap	Tunnel.
Groove.	Compartmental.
Step	Spiral.
Box or pool.	Moving.
Inclined plane	Partitional.

55,929 *Steck*, A series of inclined planes in vertical series.
57,159 *Livermore*, Inclined series of chambers with tubular connections. Fig. 2003, "*Mech. Dict.*"
126,257 *Brewer*, Zigzag way in bottom of chute.
132,349 *Brackett*, Zigzag chute.
154,216 *Brewer*, Offset boards on bottom of chute.
208,408 *McDonald*, Force of water directed up the chute.
218,299 *McDonald*, Chambers and inclines in chute.

McDonald . . . * "*Scientific American*," xli. 275.
Rogers . . . . * "*Scientific American*," xliii. 22.

Fis'sure Knife. (*Surgical.*) A bistoury used in operations for anal fissure.

Figs. 586, 587, p. 124, Part III., *Tiemann's "Armamentarium Chirurgicum."*

Fis'sure Vein. (*Mining.*) A fissure or crack in the earth's crust filled with mineral matter.

Fis'tu-la Knife. A probe-pointed knife for fistula in ano. *Dr. Kelsey.*

Fig. 1044.

Fistula Knife.

Delicate knives are also made for *fistula lachrymalis*: bistouries also: CANALICULAR INSTRUMENTS are mentioned under that caption on page 157, *supra*.

Fit. In car-axles, that part upon which the wheel is forced.

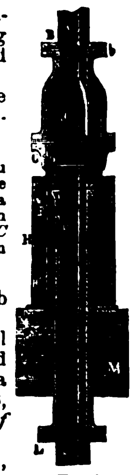
Five Cant File. One for filing M-toothed saws. It has one angle of 108° and two of 36° each.

Fix'a-tion In'stru-ment. (*Surgical.*) A hook or forceps with delicate sharp claws to hold the eyeball steady during an operation.

Figs. 78-80 *d*, Part II., *Tiemann's "Armamentarium Chirurgicum."*

Fixed In'ter-val Reg'u-la-tor. (*Electricity*) A form of polyphote regulator for voltaic arc lamps in which the regulation of the carbons is effected automatically at definitely recurring intervals of time. *Rapieff's* and *Brokies'* lamps are of this order.

Fig. 1045.



Fixed Piston Pump.

Fixed Pis'ton Pump. One in which the cylinder moves, the piston being relatively fixed.

Fig 1045 represents the pump Donnadieu in which the valved piston *D e* is on the summit of the induction pipe *E L K*, on a base *M*. *H* is an outer cylinder in which the skirt *P* attached to the chamber *A B C G*, moves up and down *d* is the eduction valve.

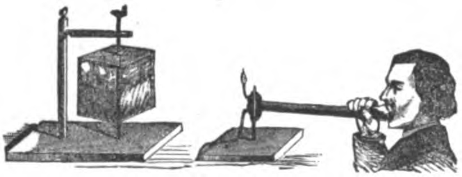
Flake Stand. The cooling tub or vessel of a still-worm.

Flak'ing Ham'mer. A steel hammer, bluntly pointed at each end and used in striking flakes from a flint nucleus. See Fig. 2, p. 18, *Evans' "Ancient Stone Implements of Great Britain."*

Flam'beau-let. A small torch, an allumette.

Flame'less Lamp. A lamp with incandescent spongy platinum. An *aphlogistic lamp*.

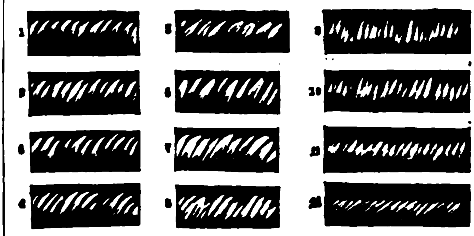
Fig. 1046.



Koenig's Flame Manometer.

Flame Ma-nom'e-ter. An instrument to obtain graphic representation of the condition of the human vocal organ. The invention of Koenig.

Fig. 1047.



Flame Pictures of Healthy and Diseased Voices.

It is composed of a large cube whose four vertical sides are covered with mirrors, and which is revolvable about a vertical axis; of a gas jet, burning with a small flame; and of a mouth-piece which terminates in a lenticular box or capsule. A very thin, tense, and impermeable rubber membrane divides this capsule into two compartments, in one of which the sounding tube terminates, while the other serves as a passage-way for the gas from the conducting tube to the jet at which it is burned.

On singing or speaking into the mouth-piece, sound waves are produced by the alternate condensation and rarefaction of the air within the tube; the rubber membrane acquires a corresponding rate of vibration, and so modifies continuously the rapidity of the delivery of the gas to the burner, causing the gas flame to leap up and down in unison with the sounds transmitted. On rotating the prismatic mirror this but slightly perceptible motion is rendered distinctly obvious, persistence of vision spreading out the image of the flame into a broad serrated band of light.

These serrations vary with the character of the tones produced, as well as the degree of the diseased condition of the vocal chords. In the latter case especially the difference in appearance of the image becomes so striking that a skilled observer can very readily form a correct idea as to the actual state of the vocal organs. The flame pictures shown in Fig. 1047 give some idea of the results: —

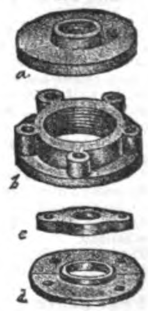
Series 1-4 are healthy notes in different pitches; highest above and the others successively lower.

Series 5-8 are the same in pitch, but with a voice slightly hoarse.

Series 9, 10 are the result of severe hoarseness.

Series 11, 12 are the result of disease, the voice being almost inaudible, glottis open, and the chords scarcely vibrating.

Fig. 1048.



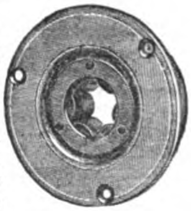
Flanges.

a. Flange.
b. Bossed flange.
c. Oval flange.
d. Collar.

Flange. A plate for covering, or partly closing, the end of a pipe or cylinder.

Flange Bush'ing. A flange carrying a shell which acts as a bushing to a hole. In the example the bushing is for a block sheave and has anti friction rollers.

Fig. 1049.



Flange Bushing.

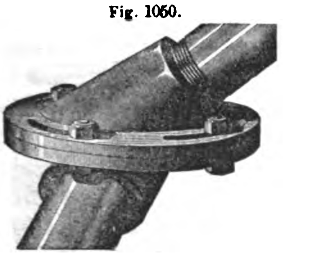
Flange Coup'ling. A device for connecting pipes at any angle from 0° to 90°. It has two circular plates, each flat upon one side and having on the other a short internally-threaded tubular projection, inclined at an angle of 45° to the plane of the plates. The plates are slotted to receive the coupling bolts. Fig. 1050.

Flange Pipe. One having at the end (or ends) an annular projection with holes for bolts, by which it is fastened to a similarly-provided pipe or other object. See Fig. 2007, p. 876, *"Mech. Dict."*

Flange Pul'ley. One with rims to keep the belt from running off. Fig. 1051.

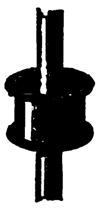
Flan'ging Ham'mer. A machine for turning flanges on sheet-metal for boilers, tanks, furnace-

Fig. 1050.



Flange Coupling.

Fig. 1061

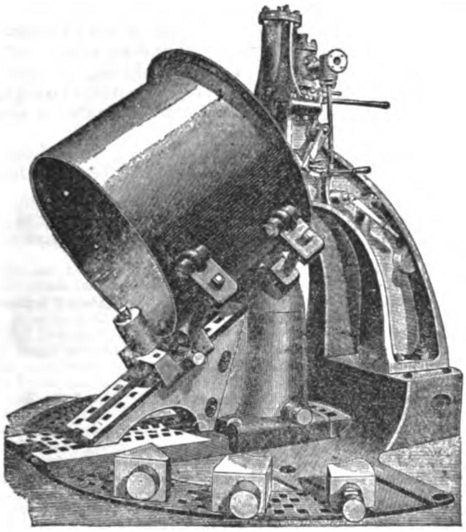


Flange Pulley.

fronts, girders, parts of steam vessels, etc. The machines differ much in size and form, according to the requirements of special work and the size of the object under treatment.

In the machine of Campbell & Hunter, Leeds, England, the flanging block with separate anvil is mounted upon a

Fig. 1052.



Flanging Hammer.

swiveling slide, upon which it can be moved as required. The block has a projecting angular face in front, upon which is carried an adjustable roller or rollers for taking the end thrust of the flues, plates, etc. On each side of the roller carriage are two wrought-iron arms, and two others on each side of the anvil block, each arm having a small runner at the outside end; these arms keep the flue square, and the runners assist it when being turned round. For turning the flue round when flanging, two chain barrels with ratchet motion and sufficient chain are provided; these barrels are fixed in frames upon the foundation plate, one on either side of the flue: the chain is given a lap around the flue and is wound on to the empty barrel as it unwinds from the full one, or the flue can be revolved by hand. Flues up to 4′ in diameter can be done at one heat.

The anvil block is arranged to admit a variety of anvils for flanging end plates up to 15′ in diameter, tube plates, dished crown plates, etc., and for setting back the bottoms of vertical fire-boxes, and the guide block will admit heads to suit.

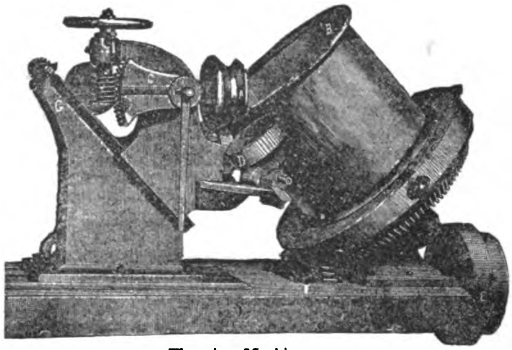
Campbell & Hunter . * "*Engineer*," l 229
* "*Scientific American*," xliii. 854.

Flan′ging Ma-chine′. (*Sheet-metal Working.*) One for making round and oval sunk-head cans, such as are used for packing butter, lard, etc., the heads of such cans being joined to the bodies by a double seam, without solder.

The flanging machine throws out the edge of the body, and the double-seamer closes the top (or bottom) in four movements; but at a single setting of the can, while it is either empty or full.

In Hanson's flanging machine (Br.), the steel roller, *A*, revolves on the end of a segmental rack, its angle of relation to the bending flange of the cylinder *B* being adjusted by

Fig. 1053.



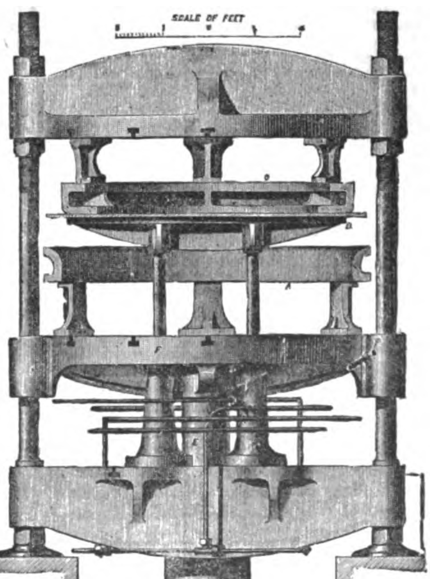
Flanging Machine.

worm wheel. Wheel *A* rotates by friction, and the cylinder by miter gearing from pulley *E*. The distance between the roller *A* and flange *B* is adjusted to suit various thicknesses of plate by means of the slide on the standard *G*, and the miter wheels on its summit. The roller *D* serves to guide and steady the cylinder.

Flan′ging Press. Fig. 1054 represents Piedbœuf's hydraulic press, for flanging, stamping, or straightening boiler plates. As illustrated, the press is arranged for flanging plates.

The plate to be flanged, having been heated, is placed on a ring, *A*, the interior of which is of a form corresponding to

Fig. 1054.



Flanging Press.

that to be given to the plate. This ring *A* is carried on columns which rest on the movable table *F*, this table being raised by the ram *E*, working in the hydraulic cylinder *D*.

The cylinder D is attached to a strong cast-iron frame, which is connected by the four columns to the fixed upper table.

In addition to connecting the upper and lower tables, the columns serve as guides for the moving table E, the latter being furnished with four bushes, which embrace the columns as shown. Four rams in the auxiliary cylinders are run up first, and by means of a table, B, hold the plate about to be flanged against the block C and prevent buckling, and as the table F is raised by the ram of the press, the plate to be flanged is pressed to the shape of block C by the passing over it of the ring A.

Brown, Br. . . . . * "*Engineer*," xlix. 173.

Flan'nel. 1. The first stage in the manufacture of plain cloth.

2. A class of woolen goods of various qualities and finish.

Domett flannels have a cotton warp and wool filling.

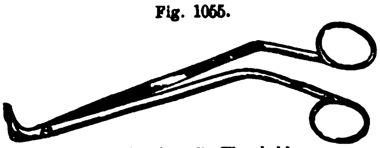
American blue flannel, for coating, is sheared and finished like cloth, but retains the lightness and pliability of the flannel texture.

French plaid is a fancy flannel: it consists of plaids, or broken plaids and checks, dyed in the wool.

See Hayes' "*Centennial Report*," v. 49–52.

Flap Hold'er. (*Surgical.*) A delicate pre-

Fig. 1055.



Dr. Turnipseed's Flap-holder.

hensile instrument for holding flaps of sutures in confined situations; in operations for vesico-vaginal fistula, etc.

Flashed Glass. (*Glass.*) Also known as *doubled glass*. A glass made of several colors superposed; it is worked in a different manner from plain glass.

Colored glass is drawn into sticks of a certain length and annealed. A piece of this glass is heated, attached to the end of a blow-pipe, blown into a hollow ball. The ball is opened, and formed into a cup. A ball of white glass is blown by another workman and introduced into the cup. The two are blown and rubbed together while hot, to make them adhere.

The two are then treated as a single piece, and finished in any ordinary way by molds or tools.

Flash'ing. (*Hydraulic Engineering.*) Artificial assistance to navigation by ponding a river, and suddenly removing the barrier, to carry barges and rafts over shallow places in the stream.

"*Mech. Dict.*," p. 876. See also "*Barrage*."
System on the Yonne, etc., Fr. "*Vienna Exposition Reports*," Watson's Report, iii p. 27.

Flash Light Ap'pa-ra'tus. A device for automatically giving sudden flashes of light at specific intervals as a signal. Flash lights are used in lighthouses as a means of varying the character of the lighting. See LIGHTHOUSE, "*Mech. Dict.*"

The means adopted are large and small governors; the small one giving gas enough to keep the light going, and the larger one acted upon by a time-piece through the medium of electric arrangements. "*Journal of Gas Lighting.*"

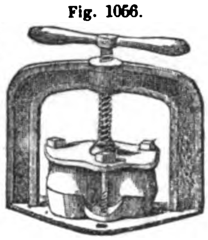
Pebbles . . . . * "*Scientific American Sup.*," 1287.
Flash light on car "*Scientific American Sup.*," 979.
"*Mechanical Dictionary*," p. 877.

Flask Clamp. A dentist's clamp, for holding the flask in which the denture is exposed to heat in the muffle. Fig. 1056.

Flat Bar Spi'ral Spring. One made by bending a flat bar so that its wide face is radial to the axis of the core or mandrel on which it is wound. *s, t, v*, Fig. 1143, p. 483, "*Mech. Dict.*"

Flat Cha'sing. (*Fine Art Metal-working.*) A mode of ornamenting silver ware, producing figures by dots and lines made with a punching tool.

Fig. 1056.



Flask Clamp.

Flat Coil. A heater coil, in steam or hot-water arrangements, the pipes of which are coiled so as to lie in a plane. Such are used against walls, for heating buildings, and on the bottom of evaporating pans.

Flat'-foot Ap'pa-ra'tus. (*Surgical.*) A curved steel sole worn inside the shoe to correct the abnormal flatness of the sole.

Flat Mir'ror. (*Optics.*) One for reflecting parallel rays; as distinguished from a *condensing* mirror, etc.

Flat Rib Knit'ting Ma-chine'. A machine for making shirt cuffs, bottoms for drawers, etc. Campbell & Clute.

Flat'ten-er. (*Blacksmithing.*) See FLATTER.

Flat'ten-ing. (*Leather.*) The same as shaving, except in some cases the skin after skiving is shaved across (*i. e.*, nearly at right angles to the skiving), and then flattened by being shaved again in the same direction as the skiving.

Flat'ten-ing Ov'en. (*Glass.*) A heated chamber in which split-glass cylinders are flattened for window glass. See Fig. 2014, "*Mech. Dict.*"

The usual style of oven has flattening, cooling, and piling-up sections. The flattening stone, supported on a small truck, runs on rails into the oven.

Segard, of Anzin, France, has two stoves carried on carriages, running on rails at different elevations, so that one can be returned while the other is going, one passing under the other. Work performed: 600 cylinders in 24 hours.

In another form of oven the cylinders are introduced into a compartment when they are heated, then flattened upon a stone carriage; the carriage is pushed into a compartment at the head of the *leer* (oven) and from the carriage the sheet is pushed upon iron bars which run longitudinally of the leer, and lie in channels sunk in the stone floor. The bars run upon rollers, and are lifted by a system of levers so as to raise the glass from the floor to move it along in the *leer* when another sheet is to be laid down. The sheets thus advance, step by step, till they reach the cool end of the oven, the bars after each forward motion being lowered and returned to their original position. The oven contains 9 sheets, which make the course in from 20 to 30 minutes.

Another form of *leer* has a rotating stone and compartments.

A form of flattening oven much used in France for baking colors on enameled glass consists of a leer, with compartments attached, for heating and flattening the glass. The flattening compartments contain the usual flattening stone mounted upon a carriage traveling back and forth upon rails from the heating to the flattening chamber. The *leer* contains a number of rollers mounted on cross shafts, and near enough to one another to give a sufficient resting support for the sheets of glass. These rollers receive a slow rotary motion. The cylinder being heated, flattened on the stone, run into the chamber opposite the mouth of the leer, the sheet transferred to the rollers which take it gradually and continuously to the discharge end of the *leer*. Both sides have a chance to cool.

See *Colne's* Report, "*Paris Exposition Reports*," 1878, vol. iii., p. 239.

Flat'ten-ing Stone. (*Glass.*) A flat stone carried by a small truck running on rails, and carrying the cut-glass cylinder; the stone is run into the flattening oven to allow the glass to flatten out. See FLATTENING OVEN.

Flattening table, *Laboulaye's* "*Dictionary*," article "*Verre*," iii., Fig. 2544, ed. 1877.

Flat'ter. (*Blacksmithing.*) A swaging tool or fuller. *a*. Fig. 2124, p. 922, "*Mech. Dict.*"

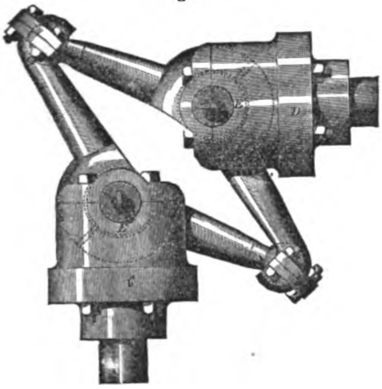
Flesh'er. (*Leather.*) Or *Fleshing knife*. A long, two-handled and somewhat blunt-edged knife, curved to fit the sloping rest of the beam. Its cross-section is concave downward. It is used to scrape off the hair, scarf-skin, loose flesh, and cellular tissue.

Flesh'ing Knife. (*Leather.*) A currier's knife used in removing cellular tissue, etc., from the hide. See FLESHER.

Flesh Side. (*Leather.*) The side of a skin or hide next to the flesh. As opposed to *grain* side.

Flex'i-ble Coup'ling. An angle joint for transmitting motion. A substitute for the gimbal.

Fig. 1067.

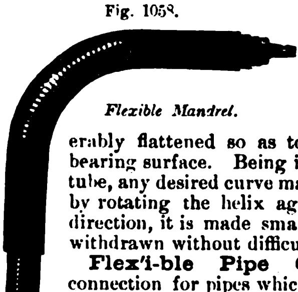


Clemens' Mechanical Movement.

The coupler arms are carried in pairs in their jaws by their hinge-jointed hubs on the pivot-pins *E*. The outer ends of the arms are coupled together by ball-and-socket joints. The weight preserves the balance. * "*Scientific American*," xxxv. 230.

Flex'i-ble Man'drel. A device for bending metallic tubes regularly and quickly, without flattening. It is a stout spiral of closely laid steel wire, preferably flattened so as to give extended bearing surface. Being introduced into a tube, any desired curve may be made; and by rotating the helix against its leading direction, it is made smaller, and may be withdrawn without difficulty.

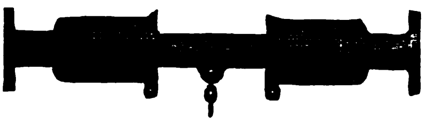
Fig. 1058.



Flexible Mandrel.

Flex'i-ble Pipe Coup'ling. A connection for pipes which allows them to be laid out of line without leaking, and to expand longitudinally without impairing the joint. A tubular section with flanged ends fits in the bells of the respective pipes.

Fig. 1059

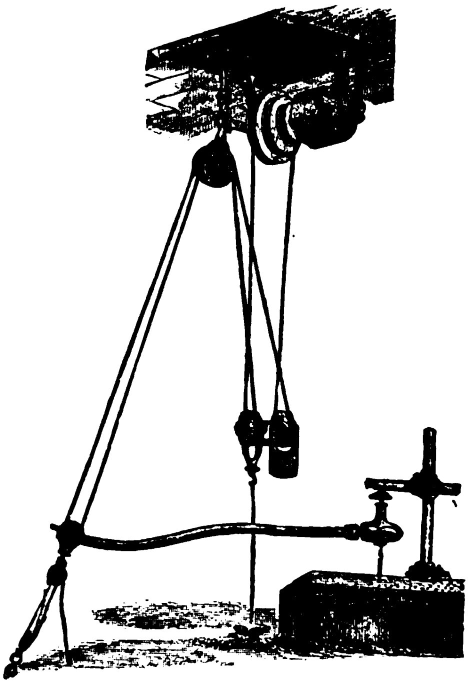


Flexible Pipe Coupling.

Flex'i-ble Shaft. A pliable power transmitter. A coil of steel wire is overwound with another spiral in a reverse direction, this by a third, and so on. The ends of the wires are brazed, and the whole covered with a hose. Its uses are numerous.

Thirion's flexible coupling was shown in Paris in 1867.

Fig. 1060.



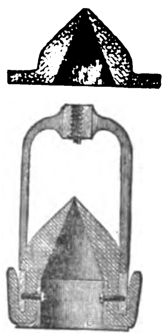
Stowe Flexible Shaft.

* "*Engineering*" . . . . xxii. 40.
* "*Engineering and Mining Journal*" xxii. 75.
* "*Mining and Scientific Press*" . . xxxiv. 81.
* "*Iron Age*" . . . . xxi., April 25, p. 1.
* "*Scientific American Supplement*" . 816.

Flex'i-ble Sole Plane. See CIRCULAR PLANE.

Flex'i-ble Valve. Perreaux's valve (French) of india-rubber opens as it descends, by the pressure of the water beneath, but closes against any pressure from above. It is used for lift pumps, especially in cases where it is required to pump liquids which corrode metals. They shut quickly, are durable and retentive.

Fig. 1061.



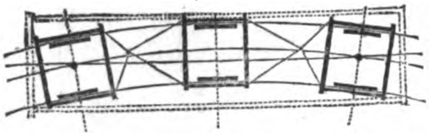
Perreaux's Flexible Valve.

The upper figure shows the form of valve, the lower one its application. It is so designed that, in addition to being a bucket valve, it forms a cup to keep the bucket tight in the barrel.

Similar valves have been made in the United States for deep oil-well pumps.

Flex'i-ble Wheel Base. (*Railway.*) A system of arranging car trucks, which consists in mounting the axles with their axle-boxes, guards and springs in frames separate from the main under-frame of the carriage. The end frames have central pivots, around which they swivel freely, while the middle frame is so arranged that it can slide transversely. The three frames are connected together by articulated radiating gear, so that they act sympathetically, and each axle assumes a position coincident with the radial lines of the curve, instead of remaining parallel to each other, as in

Fig. 1062.



Flexible Wheel Base.

the ordinary construction, in which the wheels grind their way along the sides of the rails. The wear and tear of ties and rails is thus greatly reduced, because the flanges of the tires are always parallel with the rails.

Flint Brick. A fire-brick made of powdered silex, with a sufficient flux to assist it to agglutinate at practicable temperatures.

Flint Glass. (*Glass.*) The use of calcined flints, to furnish silica for the glass, is the origin of the name.

In England, a glass containing lead. Called by French and Belgians *crystal.* Germans call all white glass *crystal*, whether or not lead enters into it; the Bohemian, for example, which has a potash and lime base; and ground quartz furnishes the silex.

The equivalent of what is called in England *white glass* is here known as *lime glass*, and is not equal in brilliancy to *flint* glass, which is an English invention, and that country produces the best specimens.

It is said to have originated in this way: When wood began to be scarce, and coal was substituted as a fuel, it was necessary to cover the glass pots to keep out impurities which colored the glass. As this diminished the heating power, it was difficult to melt the frit, and red lead was added as a flux.

Materials usually employed: —

Carbonate of potash	1
Red lead	2
Sand	3

Oxide of manganese in small quantities acts as a corrective of color.

Boracic acid has been used, and permits of the substitution of oxide of zinc for red lead, and of lime, soda, or baryta for potash. The result is a beautiful glass suitable for table-ware or optical purposes, remarkable for limpidity, whiteness, and brilliancy.

Flitch Beam. A beam made in layers of material pinned together. The invention of *De Lorme.* "*Nouvelles Inventions pour bien Bastir,*" 1561.

The beam, specifically known as the *flitched beam*, is shown in Fig. 313, p. 139, "*Mech. Dict.*," and differs from the *laminated*, which is of thin and bent material, as in Figs. 312, 316, pp. 138, 139, *Ibid.*
See also "*Scientific American Supplement,*" * 2035.

Flitch'ing Knife. (*Fishing.*) For slicing halibut, etc., into steaks or flitches, in preparation for salting and smoking.

Float. (*Fishing.*) 1. *Angling* line floats are of cork, quill, or light wood.

Net floats are of cork, cedar, glass globes, rubber tubing, etc.

Harpoon-line floats are empty kegs, bladders, inflated seal-skins, etc.

The floats of the gill-nets of Lake Michigan are splinters of cedar, 30″ × ½″ × ⅜″.

Glass floats are very common in Europe, having been used in Norway, Sweden, and elsewhere. Were shown in quantity at the Centennial in the Scandinavian department.

See the following patents: —

No.	Inventor.	Subject.
86,609	*Terrell*,	Made of hollow glass.
99,572	*Ingram*,	A wire loop above and pin below, lock the line.
127,218	*Brown et al.*,	Vulcanized rubber with projecting ears.
128,885	*Jewell*,	The float body has a longitudinal wire prolonged into a spiral at each extremity.
165,867	*Quinn*,	Board float loaded at one edge: for trawl lines.
179,490	*Sander*,	Net float with attaching slot.
186,232	*Davis*,	Glass floats for gill-net.
188,755	*Redfield*,	A spiral coil of wire at each end.

2. For raising sunken vessels. A camel or caisson. See those heads: also Fig. 4148, p. 1874, "*Mech. Dict.*" Fig. 1617, p. 688, and list under Hydraulic Engineering, *Ibid.*, *et infra.*

Clark & Standfield * "*Scientific American Sup.*," 2071.

3. A ball on a lever, floating in a cistern to operate a faucet.

Benton . . . . * "*Scientific American*," xxxiv. 310.

4. A wooden trowel, to smooth a mortar surface.

5. (*Mining.*) Loose rocks, or such detached from the original formation.

Float'ing Board. A cast-iron plate, ribbed beneath and planed true on top, for "floating up" tin cans; *i. e.*, soldering the ends inside, the can standing upon the heated plate till the solder runs.

Float'ing Bridge. The landing platform of a ferry-boat; so called by Fulton in his description of the Hudson River ferry, started August, 1812. See Ferry-boat.

Hoogly, Calcutta . "*Van Nostrand's Magazine*," xviii. 475.
"*Scientific American Sup.*," 1897.

Float'ing Brush Dike. (*Hydraulic Engineering.*) A device to check the current of a stream and form a deposit.

It is made by taking saplings from 20′ to 30′ long and from 4″ to 8″ diameter, and nailing or wiring to them scraggy brush of any kind. This forms what is known as the *weed.* Instead of the saplings rope may be used to which to fasten the brush. One end of the weed is anchored and the other supported by a buoy. The weeds are placed in the river 10′ to 20′ apart, and check the current gradually without giving rise to the scouring action produced by a solid dike. A *willow curtain* acts in a similar manner.

See "*Report U. S. Engineers*," 1880, * ii. 1452. *Ibid.*, 1878, * ii 655, sketches Nos. 1, 2.

Float'ing Dam. An anchored dam.

Floating dam in the Dorran Canal, Vienna, * "*Engineer*," xli. 190.

Float'ing Dock. One which is floated beneath a vessel to raise it. See "Bermuda," Plate XIX., opp. p. 884, "*Mech. Dict.*" See also Depositing Dock, *supra*, and the following references: —

Float, *Clark & Standfield*	* "*Sc. Amer. Sup.*," 352, 2070.
	"*Marine Engineering News*," 1878.
	* "*Engineering*," xxvi. 119.
Paper on, *Clark*	* "*Engineering*," xxvii. 382.
Ponton, *Lauria*, Italy	* "*Engineer*," xliv. 188.
	"*Scientific Am. Sup.*," 1507.
Depositing, *Nicolaieff*, Rus.	* "*Engineer*," xli. 293, 294.
	* "*Engineering*," xxi. 311.
	* "*Engineering*," xxvii. 28.
	* "*Scientific American*," xl. 147.
	* "*Scientific Amer. Sup.*," 392.
Victoria Docks, Br.	* "*Engineer*," xlv. 272, 279.
Wheeden	* "*Scientific Amer.*," xxxiv. 182.

Float'ing Lev'er. (*Railway.*) A name applied to the horizontal brake-levers beneath the car-body.

Float'ing Wire Dike. (*Hydraulic Engineering.*) An open wire screen anchored at its lower edge and sustained by buoys along its upper. Its object is to arrest matters floating in the stream and by causing an obstruction obtain a deposit of sediment.

"*Report of U. S. Engineers*," 1880 . . . . p. 1452.

Flocked E-nam'el. (*Glass.*) Enamel ornamentation on glass whose surface has been previously dulled by grinding or acid.

Flog'ger. A bung-starter. An instrument for beating the bung stave of a cask to start the bung.

Floor Arch. An arch with a flat extrados.

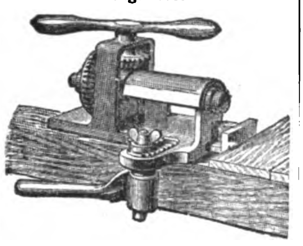
Floor-bor'ing Ma-chine'. One with a large and heavy bed-plate to which the work may be dogged while the drill press is moved to position to work upon it.

Floor Ce-ment'. A concrete for cellar floors and walks.

Broken stone or gravel and sand	4
Lime	1
Hydraulic cement	1

Mix the ingredients dry excepting the lime. Slack the lime separately and add it to the remainder. Work thoroughly and as dry as possible. Apply a thickness of 6''. When set add a coating of cement 1, sand 2.

Fig. 1063.



Floor Cramp.

Floor Cramp. A device for closing up the joints of flooring boards previous to nailing. Fig. 1063.

"Crown," "*Engineer*," xlv. 417.

Fig. 1064.

Floor Hanger.

Floor Fend'er. A knob fastened to a floor, to receive the impact of an opening door and thus protect the wall of the room.

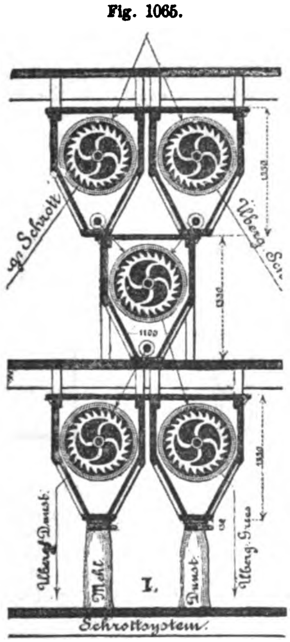
Floor Hang'er. A shaft bearing fastened to the floor. Used for running countershafts and lines when it is not convenient to suspend them from the ceiling joists.

Floor'ing Tile. Ceramic ware for paving. See TILE.

Floor Light. A frame with glass panes in a floor.

Flour Bolt. Fig. 1065 shows an Austrian arrangement for bolting meal. Each of the various cylinders makes a simple division of its contents and the ultimate division of the numerous grades is made by successive actions: Each cylinder rotates in a tight chamber, and has beaters inside to expedite the passage through the cloth of the finer particles. It is particularly intended for roller mills in which the work of grinding is by numerous successive actions, each detaching portions of flour from the material under treatment. See CYLINDER MILL, p. 243, *supea*, and HIGH MILLING, *infra*.

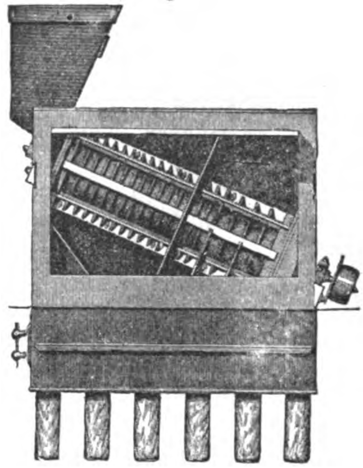
Fig. 1065.



Hoerde's Bolting Chests. (*Vienna.*)

Fig. 1066 represents a form of flour-bolting chest made by Ruston, Proctor, & Co. (Br.) The cylinder is of hard wood, covered with wire gauze of varying fineness. The shaft has horse-hair brushes; the feed is automatic, and the issues for the various grades of fineness discharge into separate sacks.

Fig. 1066.



English Flour Bolt.

The numerous successive boltings in the high-milling new process methods, and in the roller and cylinder mill processes have much increased the uses of the bolt.

See the following: —

Alger	* "*Scientific Amer.*," xxxv. 306.
Rathbun	* "*American Miller*," v 124.
Shuttleworth & Morse	* "*American Miller*," viii. 39.
Chest, *Smith*	* "*Scientific Amer.*," xxxiv. 166.
"Troy," *Campbell & Suisher*	* "*American Miller*," iv. 62.
Dresser, "Victor"	* "*Scientific Amer. Sup.*," 2754.
Martin, Austria	* "*Engineer*," xlvi. 105.
"Victor"	* "*Engineer*," xlvi. 434.
Sifter, *Thomas*	* "*Scientific Amer.*," xlii. 50.

Flour Core. A dry-sand core in which flour has been used for the purpose of increasing the adhesiveness and strength of the sand when dried.

Flour Mill. See the following references: —

Detwiler	* "*American Miller*," vi. 101.
Oliver Evans	* "*American Miller*," vii. 1.
	* "*American Miller*," viii. 114.
Haxall, Richmond, Va.	* "*Scientific Am. Sup.*," 1731.
Large, Minneapolis	* "*Scientific Amer.*," xli. 291.
"Washburn, A."	* "*Scientific Am. Sup.*," 3913
Portable, *Munson*	* "*American Miller*," vi 209.
Mills in U. S.	* "*Scientific Amer. Sup.*," 589.
Roller mill	* "*Scientific Amer. Sup.*," 617.

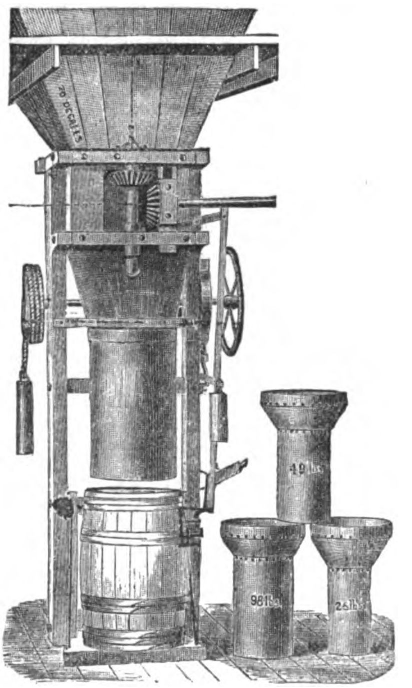
See also GRINDING MILL, ROLLER MILL, CYLINDER MILL, and list under MILL.

Flour Pack'er. A machine for barreling flour. A flour-chest and spout are made in accordance with the size of barrel to be packed by the machine. The horizontal shaft communicates motion by miter-wheels to the vertical shaft and auger which presses the flour into the barrel, the tube receding as the barrel fills. The machine is started by a simple movement of a lever, and stops automatically when the barrel is filled. By change of auger and spout it is adapted for any of the usual sizes of packages. A cut-off valve holds the flour in the bin when changing sizes. See Fig. 1067.

Flow'ing Bat'te-ry. (*Electricity.*) Or *perfluent* battery. One in which the battery is kept constant by the flowing of the exciting liquid through the cell or cells. See PERFLUENT BATTERY.

Flue. A duct for heated products of combus-

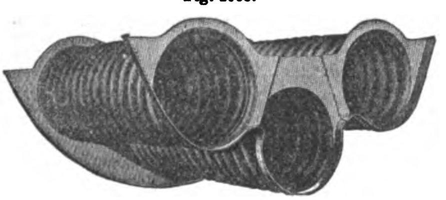
Fig. 1067.



Flour Packer.

tion; a chimney. Fig. 1068 shows Fox's flue (Br.), in which the metal receives greater strength by corrugations.

Fig. 1068.



Corrugated Boiler Flue.

Flume. A long artificial channel or chute for conveying logs or lumber from an elevated situation to distant mill or works.

A chute for conveying water for use in hydraulic or placer mining.

"Cherokee" gravel mines	* "*Min. & Sc. Press*," xxxv. 313.
Lumber	* "*Min. & Sc. Press*," xxxiv. 161.
California	* "*Sc. Am. Sup.*," 1840, * 1509.
Smartsville Cal.	* "*Mech. Dictionary*," p. 891.

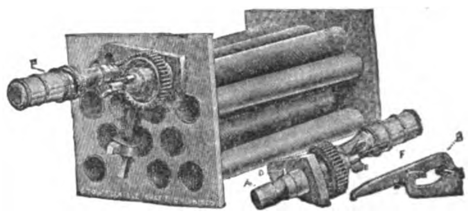
Flume Car. A car to travel in a flume; wheels rest on the sides of the flume, and the water runs a paddle wheel.

"*Engineering and Mining Journal*" . . . . xxi. 223.

Flue Cut'ter. A tool for cutting out a faulty flue or tube, to be replaced by a perfect one.

Fig. 1069 shows a section of boiler with flue cutter in position for use, and the same in detail. The mandrel and tool carrier *A* is inserted in the flue to be cut off, and held in position by the clamps *B B*. The shaft is attached by means of the hand-piece *F*, which is also the means of starting and stopping the cutter when in use. The cutters *D* are forced out against and through the flue as it is cut, by means of the feed-screw *E*.

Fig. 1069.



Flue Cutter.

Flush Box. A cistern for especial use in dwellings where the supply of water is intermittent. The action of Morris's waste preventive flush box is follows: —

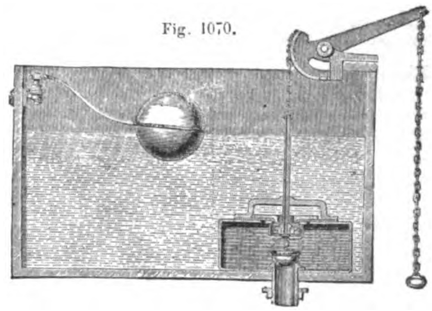


Fig. 1070.

Waste Preventive Flush Box.

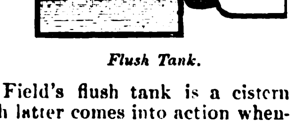
When the lever is pulled, it first closes the communication between the large cistern and the flush box, and then opens the outlet or discharge-valve, and is so arranged that in no case can the valve communicating with the large cistern and the discharge-valve be open or partially open at one and the same time; so that no more than the contents of the flushing-box (about 2 gallons) can by any possibility be used at one operation.

Flush Deck Pump. One the upper surface of which is even with the deck, the chamber depending beneath. It has a hinged cover and the plunger is removable.

Fig. 1071.

Flush Deck Pump.

Fig. 1072.



Flush Tank.

Flush Tank. Field's flush tank is a cistern with a siphon which latter comes into action whenever the liquid attains a certain height in the cistern. It is adapted for the automatic periodical emptying of the cistern. May be useful apparatus in the periodical flushing of drains.

"*Manufacturer and Builder*" . . . * x. 280; * xi. 187.

Flu'ted Glass. (*Glass.*) A mode of treating glass to render it a perfect transmitter of light but prevent observation through it. Used in partitions, doors, and windows. It is much used in Europe, and has semi-circular flutings pressed into it.

It is made by blowing a pear-shaped piece which is then introduced into a brass mold having a number of deeply channeled flutings inside. The glass is now blown, as usual in cylinder blowing, and retains the imprints of the flutings. It is finished in the usual manner, care being taken not to rotate the ponty, as that would distort the flutings. The cylinder in expanding and lengthening reduces the depths of the flutes, but the flutings in the mold are sufficiently exaggerated to meet the flattening of the subsequent operation.

Flu'ted Tap. A tap for making screw holes. Longitudinal grooves in the sides, constitute the thread — cutting edges. See Fig. 6211, p. 2495, "*Mech. Dict.*"

Fig. 1073.

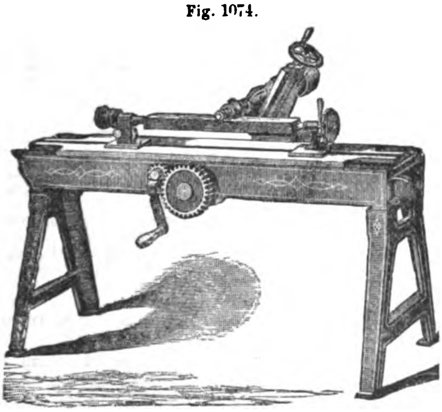
Fluting Iron.

Flu'ting Iron. A laundry iron for fluting clothes. There are many forms. See Figs. 2044, 2046, pp. 893, 894, "*Mech. Dict.*" The damp cloth is pressed between the two surfaces of the heated iron. Flutes may be nickel-plated.

Fluter, *Knox* . . . * "*Iron Age*," xviii., Sept. 21, p. 19.

Flu'ting Ma-chine'. One for grooving balusters, table-legs, etc. The stick is placed on centers

Fig. 1074.

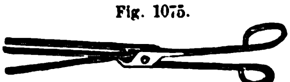


Fluting Machine.

as in a lathe and passed beneath the circular cutter which is mounted on a mandrel and rotated by band-pulley. See also FLUTING LATHE, Fig. 2045, p. 894, "*Mech. Dict.*"

Flu'ting Scis'sors. An instrument for fluting linen, etc. One member is hollow to hold a heated iron rod.

Fig. 1075.



Fluting Scissors.

Fly. (*Add.*) 13. The fore flap of a bootee. A strip of leather which overwraps the front vamp and receives the strings or other fastening.

Fly Hook. (*Fishing.*) One arranged with an artificial fly.

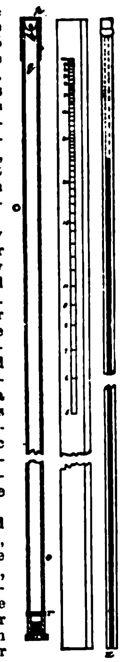
Fly'ing Ma-chine'. See references: —

Machine		"*Scientific American Sup.*," 1838.
Man, *Ignazio*, Italy	*	"*Scientific Amer.*," xxxvii. 232.
Machine, *Ritchell* .		"*Scientific Amer.*," xxxviii. 405.
	*	"*Manufacturer & Builder*," x. 166.
Simonds		"*Scientific American Sup.*," 96.

Fly'ing Sound'er. A name applied to Sir William Thomson's deep-sea sounding apparatus. It consists of a glass tube lashed to a length of line above the sinker and connected to a line of piano-forte wire wound upon a reel from which it is payed out when sounding. By worm on the reel shaft, actuating gearing on a counter, the length of line payed out is shown, but the principal determination of depth is, after the tube has been hauled on board again, by means of the observed condensation of air in the tube when compared with a scale graduated to fathoms according to the known law of compression of air at given depths. The interior of the glass tube is lined with a preparation upon which the entering sea-water — or a liquid contained in the enveloping metallic tube acted upon by the sea-water — shall mark the distance that liquid has been forced into the glass tube, which may be said to constitute a pressure-gage.

The intention is to measure the depth of water below the ship at any time without reducing her speed, but it is equally well adapted for taking soundings when lying to. As a matter of observation, in sounding from a steamer running at 14 knots in water of 70 fathoms depth, the sinker has been found to draw about 195 fathoms of wire off the reel and to take about 40 seconds of time to reach bottom. The counter driven by the wheel indicates the length of line payed out when bottom is reached and the depth may be instantly declared, if there has been sufficient experience in similar circumstances of apparatus, speed of ship, currents and weather, but the observation of the gage tube when brought on board again after sounding affords the more definite determination.

Fig. 1076.



Thomson's Deep Sea Sounding Tube.

The glass tube, Fig. 1076, is of sufficiently small bore to obviate the splashing of water within it during sounding. It is guarded by an outer metallic tube, *o*, which is attached by a length of hempen line to the wire. The lining of the tube is chromate of silver mixed with gum to enable it to adhere to the tube, and the mark is made by the chemical action of the sea-water which is forced out of the sheath into the tube as the apparatus descends. The action is to induce a double decomposition. The chlorine leaves the sodium of the common salt and combines with the silver, while the chromic acid and oxygen leave the silver and combine with the sodium. The chloride of silver, white and insoluble, remains on the glass in place of the yellow chromate.

The tube *o*, shown with its case *o*, and the graduated comparing stick in Fig. 1076, is closed at the upper end and open at the other (*x*), and slips within a metallic case *o*, the lower end resting upon a piece of vulcanite, *r*, to prevent shocks on reaching the bottom. The upper end *p* is removed for the introduction of the tube and then closed, the openings *q* allowing sea-water to enter as the apparatus descends. The lower end of the case *o* has a screw plug removable for purpose of cleaning.

Figs. 1077, 1078 show the apparatus in side and end elevations.

On the bed *A* are the standards *C L* which hold the reel *B* and the brake-drum *K* respectively. The reel is rotated by handles *D*, and on its axis is a worm, *F*, which actuates gearing *a b h i*, to revolve index fingers *f f* on the dials *l l* to indicate amount of wire payed off.

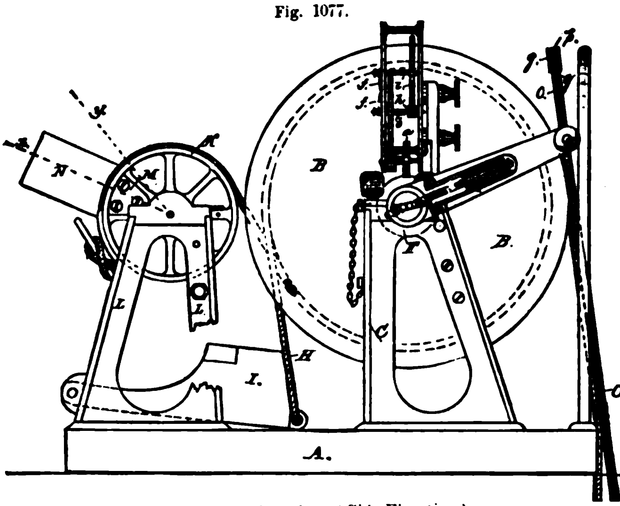
H is a brake rope which takes a turn round the drum *G* and is fastened at its respective ends to the brake-weeel *K*, and the pivoted weight *I*. *N* is a weight which exercises, in the position shown at *x*, a retarding force of 6 or 8 pounds on the drum, but which, when elevated, allows the brake rope to slacken so that the wire can be readily wound back on the reel after a sounding is had.

n n show the position of the sounding lead and *n'* its arming.

When it is desired to obviate the necessity of previous chemical or other preparation of the tube, a pressure-tube is used, open at each end and provided with valves, one at the lower end, to let sea-water enter when the sinker is going down, the other at the upper end to let air escape when it is drawn up, each of these valves remaining closed except when urged in its opening direction by a small definite amount of force.

Using this apparatus, the White Star steamer "Britannic" now takes soundings regularly, running at 16 knots over the Banks of Newfoundland and in the English and Irish Channels, in depths sometimes as much as 180 fathoms.

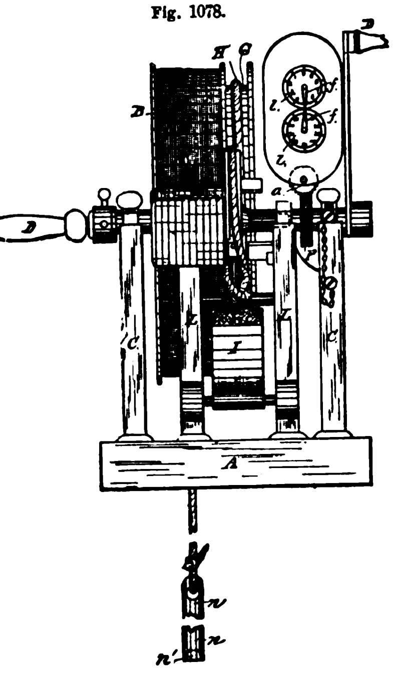
Fig. 1077.



Sir William Thomson's Flying Sounder. (*Side Elevation.*)

The steel wire weighs about 1¼ pounds per 100 fathoms and bears when new from 230 to 240 pounds without breaking. Its circumference is 0.03 inch.
See address of Sir William Thomson, Royal Society, February 4, 1878.
See also SOUNDING APPARATUS.

Fig. 1078.



Sir William Thomson's Flying Sounder. (*End Elevation.*)

Fod'der Cut'ter. A machine for cutting corn stalks for feed.

See ENSILAGE CUTTER; CHAFF CUTTER; STRAW CUTTER.

Fod'der Mill. 1. A mill for coarse grinding of grain for feeding stock.

2. A mill for grinding corn fodder, to render it more easy to feed in mangers, and more readily mixed with bran, or other enriching matter. A substitute for a fodder cutter.

"*Manufacturer and Builder,*" * xi. 70.

Fog Bell. The fog bell of Zaffarini, of Ferrara, Italy, is rung by a rocking air-tight float, which carries a pair of erect hammers with pliable stems. See illustrations, p. 898, "*Mech. Dict.*"

Fog Gun. A signal gun, fired as a warning to mariners during foggy weather.

Explosive gas is sometimes used. See GAS GUN.

Fig. 1079.

Fog Signal.

Major Elliott's account of the fog signal experiments at Dover, England, is found in his Report U. S. Engineers, "*European Light-house Systems.*" Referred to in "*Van Nostrand's Magazine,*" xiv., pp. 109-111.
Wigham . . . . . . "*Technologiste,*" xxxix 339.

Fog Sig'nal. Nearly allied to the gun is the fog signal, made by the discharge of a ball of compressed gun cotton in the focus of a parabolic reflector.

See FOG BELL; FOG GUN; FOG TRUMPET, etc, "*Mech. Dict.,*" *et infra*, and the following references:

Acoustic signals	* "*Engineer,*" xli. 87, 46.
	* "*Sc. Am. Sup.,*" 183, 184.
Automatic, floating	* "*Sc. Amer.,*" xxxvii. 118.
Horn, *Barker*	* "*Engineer,*" xlix. 411.
Horns, guns, whistles, etc. .	* "*Engineer,*" xli. 46.
Compressed air, *Sautter, Lemonnier & Co.*, Fr.	
	* "*Engineering.*" xxx. 366.
Fog signals, paper by *Wigham*	* "*Sc. Am. Sup.,*" 2398.
Whistle, *Leighton*	* "*Sc. Amer.,*" xlii. 1.

Fog Trum'pet. The siren is a steam trumpet. See Fig. 5114, p. 2191, "*Mech. Dict.*"

The sound is caused by the passage of steam at 70 lb. to the square inch through the openings made by the revolution of one disk with radial slits cut in it in front of a similar disk fixed in the trumpet. The most effective rate of rotation is from 2400 to 2800 revolutions per minute. The trumpet is of cast-iron.

Fig. 1080 shows Brown's siren fog signal, the trumpet, valve, and rotating mechanism being mounted on a semi-portable steam boiler.

Steam is generated in *A* and passes to the valve *B*, which is a perforated disk mounted on an axis and rapidly rotated by a belt from the engine-wheel *D*, in apposition to a stationary disk similarly perforated, so that the steam passes when the holes come in correspondence, and thus causes a series of puffs. The *degree* depends on the pressure, the *pitch* on the rapidity of the succession of the puffs, the *duration* upon the time the throttle is left open, the *quality* upon questions relating to the material of the trumpet, shape of opening, etc.

The fog trumpet of Amadi, of Trieste, was exhibited at Vienna in 1873.

It consists of a trumpet, formerly operated by compressed air, but now directly by steam; is provided with an automatic distributing steam-valve, and with a special valve, with finger-board, to produce sounds of varying pitch.

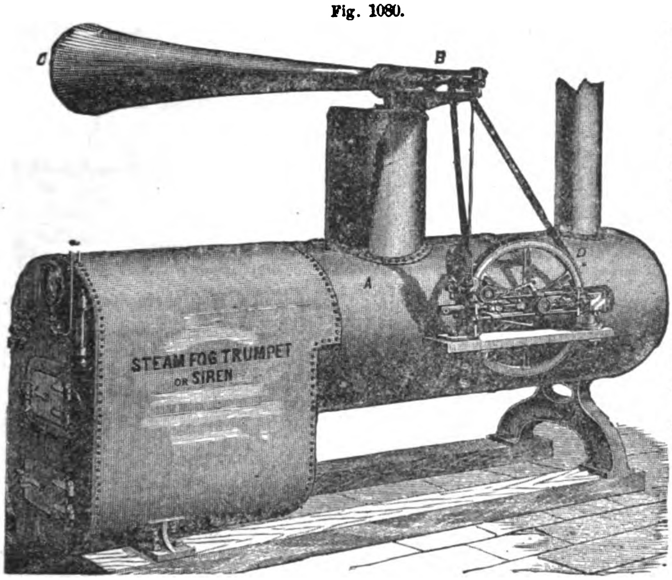
This trumpet, set up on Point Salvore, Istria, is operated by an 8-horse power steam boiler, at 25 lbs. pressure; can produce 30 blasts in 30 seconds, and is audible at 15 nautical miles distance in clear weather.

Report of Major George H. Elliott, Corps of Engineers, U. S. Army. Van Nostrand.

See also "*Van Nostrand's Magazine,*" xiv. 106.

The ordinary fog-horn is a brass trumpet 8′ 6″ long, 3″ diameter at the mouthpiece, and about 23″ at the mouth. It

Fig. 1080.



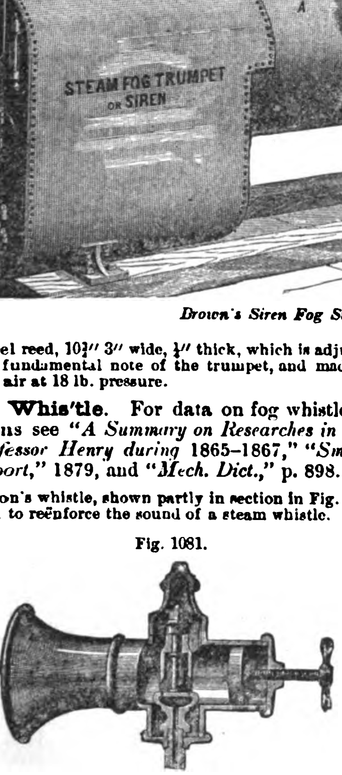
Brown's Siren Fog Signal.

has a steel reed, 10¾″ 3″ wide, ½″ thick, which is adjusted to suit the fundamental note of the trumpet, and made to vibrate by air at 18 lb. pressure.

Fog Whis'tle. For data on fog whistles and fog horns see "*A Summary on Researches in Sound by Professor Henry during* 1865–1867," "*Smithsonian Report*," 1879, and "*Mech. Dict.*," p. 898.

Leighton's whistle, shown partly in section in Fig. 1081, is intended to reënforce the sound of a steam whistle. It con-

Fig. 1081.



Fog Whistle.

sists of a fog-horn containing a steam whistle, behind which there is an adjustable resonance chamber. The whistle has straight parallel sides and straight orifices.

Foil Car'ri-er and Plug'ger. A species of pliers for grasping foil or other filling and with curved ends which, when brought into apposition, form a plugging tool.

Foil, Va'ri-e-ga'ted.

Japanese: Thirty or forty thin plates of gold, silver, copper. and various alloys, are laid one over the other in a given order, and soldered together at the edges, so that the whole forms a stout plate of metal. Punches of various shapes, conical, pyramidal, with triangular, square, or pentagonal sides, are now used to make a pattern of perforated figures, which exhibit on their inner sides concentric circles, triangles, and other forms, corresponding to the punches used. The plate so prepared is hammered and rolled until it has become quite thin, the holes disappear, and the figures have spread out, preserving, however, their parallelism. A number of broken, straight, and curved lines are thus produced, which, as in a Damascus blade, are free of each other, though consistent in themselves in the same metal, their effect being further enriched by the use of acids to modify the colors. It will easily be understood that thin plates prepared in this way, having an extremely flexible nature, admitting relief, with stamped or engraved designs, and capable of receiving the most various colors and forms, will have many uses in decorative art. — *Prof. Lielegg.*

See DAMASKING METALS, p. 245, *supra*.

Fold'er. (*Sheet Metal Working.*) A machine for turning locks or tapping edges of cans. Being adjustable, it will turn narrow or wide locks, or round edges for wiring.

Fold'ing Boat. See list under *Boat*, p. 114, *supra*, and Fig. 2057, p. 899, "*Mech. Dict.*"

Fold'ing Ma-chine'. (*Sheet Metal Working.*) A machine for folding the edges of blanks preparatory to seaming. Generally called a *double-edging machine*.

(*Printing.*) A folder attached to a perfecting printing machine.

(*Bookbinding.*) A machine for folding sheets, signatures, or quires.

Quire, *Richmond*, Br.
* "*Engineer*," l. 314.
Folding and perforating, *Lawrence*, Br. * "*Sc. Am. Sup.*," 2096.
* "*Iron*," 1878.

Fold'ing Net. (*Fishing*) One made to shut together to inclose the prey. A *purse* net is a variety.

Food Car. One used in a hospital or asylum to convey rations or food to the wards.

Foot Ap'pa-ra'tus. (*Surgical.*) Includes:

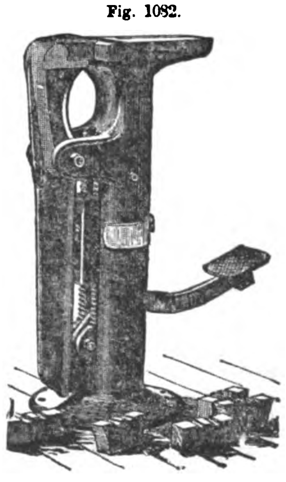
Apparatus for eversion.	Artificial feet.
For club-foot (talipes).	Support for weak ankles.
Apparatus for flat feet.	For short leg.
Splints, bandages, and slings, for fractured or luxated parts.	Contracted tendo achillis.
	For over-riding toes.
	For bunions, etc.

Foot Pow'er. The baromotor of Gaston Bozérain, of Paris, is a combined treadle and hand-lever motor. Shown at the Paris Exposition, 1878.

* "*Man. & Builder*," ix. 280.
* "*Sc. Am.*," xxxvii. 242.
Foot power, *Lane* . . . . * "*Sc. Am.*," xxxix 294, 870.
Foot drill, *Pratt & Whitney* . * "*Iron Age*," xviii., July 6, 1.
Foot lathe, *Cornell Univ.* . * "*Engineering*," xxv. 240
Shepherd . . . . . . * "*Iron Age*," xx., Aug. 2, 28.

Foot Vise. A device used in the smaller operations of blacksmithing; making calks on horseshoes, heading bolts, etc.

Fig. 1082.



Foot Vise.

Foot Wall. (*Mining.*) The layer of rock immediately under the vein.

Foot Warm'er Heat'er. Apparatus for warming the contents of the foot-pans which are used in the railway cars of Continental Europe to warm the feet of the passengers. In the apparatus on the Paris, Lyons, and Mediterranean Railway the injection of steam has substituted the emptying and refilling with hot water.

The apparatus at a station will heat 240 foot-warmers per hour to a temperature of 185° Fah.

Paris, Lyons, & Med. Ry.	* "*Engineering*," xxvii. 111.
	* "*Scientific Amer. Sup.*," 2794.
Verloop, Ger.	* "*Engineering*," xxx. 208.
W. Ry. of France	* "*Engineering*," xxviii. 225.

For'age Cut'ter. A chaff cutter. See Ensilage Cutter; Straw Cutter, "*Mech. Dict.*"

Russian military ration of forge: —
Biscuits of oatmeal, pea flour, rye meal, ground linseed; 28 small biscuits a ration. The nutriment equal to 12 lbs. oats, at one-fifth the bulk.

For'age Press. See Baling Press, Fig. 184, p. 69, *supra*.

Force. The upper die in a stamping machine. In zinc stamping the workman has various irregular shapes to manage. See description in "*Iron Age*," xxiii., March 6, p. 27.

For'ceps. (*Surgical.*) A grasping tool, having two parts hinged scissors-fashion. The names are generally descriptive of the purpose, or of the part to which they appertain. The list following is derived from "*Tiemann's Armam Chirurgicum.*" See also list on p. 903, "*Mech. Dict.*" The larger number of the instruments here cited are to be found under their alphabetical captions in this volume or in the "*Mechanical Dictionary*."

List of surgical forceps: —

Alligator.
Arrow extracting.
Artery.
Bone-cutting.
Bone-holding.
Bull-dog.
Bullet.
Canulated.
Caustic.
Cilia.
Clamp.
Conjunctiva.
Craniotomy.
Curvilinear.
Dental.
Depilating.
Dilating.
Dissecting.
Dressing.
Ear.
Embryotomy.
Entropium.
Epiglottis.
Epilating.
Extirpation.
Eye.
Eyelet.
Fenestrated.
Fixation.
Gouge.
Gullet.
Hare lip.
Hemorrhoidal.
Iris.
Laryngeal.
Lens.
Ligating.
Lithotomy.
Luxation.
Microscopic.
Midwifery.
Nail extracting.
Nasal.
Necrosis.
Needle holding.
Obstetrical.
Phymosis.
Pile.
Placenta.
Polypus.
Punching.
Rongeur.
Root.
Sac.
Saw.
Seizing.
Self-holding.
Sequestrum.
Slide catch.
Spring catch.
Spicula.
Splitting.
Sponge.
Strabismus.
Tenaculum.
Throat.
Tissue.
Tongue.
Tooth.
Torsion.
Tracheal.
Trepanning.
Trichiasis.
Twisting.
Urethral.
Uterine.
Vulsellum.
Wire cutting.
Wire twisting.
Wisdom tooth.

Fore Car'riage. The frame and pair of wheels on which the front end of the beam rests in many forms of European plows.

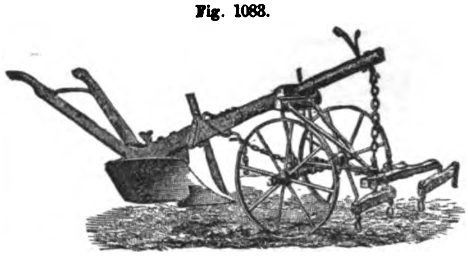
Fore'-end. (*Fire arm.*) The wooden piece under the barrel forward of the guard.

Fore'-hearth. (*Metallurgy.*) The forward extension of the hearth of the blast-furnace; it is closed by the *dam*. Fig. 704, p. 293, "*Mech. Dict.*"

Fore'lock. (*Nautical.*) The wedge passing through a mortise in the shackle of an anchor.

Forge. (*Metallurgy.*) *a.* A form of furnace

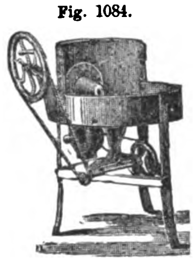
Fig. 1083.



Fore Carriage.

for obtaining iron by direct process from the ore. See Blomary; Direct Iron Process; Iron Process; Hearth, etc.

Fig. 1084.



Portable Forge.

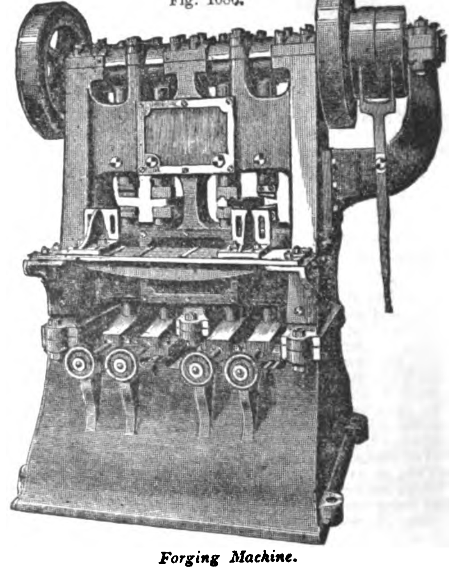
Fig. 1085.

Portable Forge.

b. A blacksmith's fire-place. Figs. 1084, 1085 show English forms of portable forges. Many other forms are noticed under Blower; Jewelers' Forge; Laboratory Forge, etc.

Buffalo Forge	* "*Iron Age*," xxii., Dec. 5, p. 19.
	* "*Scientific Amer.*" xxxviii. 3.4.
Patterson	* "*Man. & Builder*," x. 57.
Thwaites & Carbutt, Br.	* "*Engineering*," xxvi. 35.
Hammer. *Longworth*, Br.	* "*Engineer*," xliv. 4.
Rawlings	* "*Scientific Amer. Sup.*," 1868.
Tangye, Br.	* "*Engineer*," xlii. 378.
Alker	* "*Scientific American*," xl. 166.

Fig. 1086.



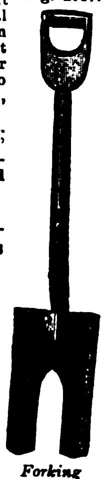
Forging Machine.

For'ging Ma-chine'. Massey's forging machine (Br.) is intended for a class of forgings, such as spindles, bolts, studs, rollers, pins, files, and a great variety of other articles in common use.

It has four pairs of blocks or hammers, $8\frac{1}{2}''$ diameter. The lower blocks can be set up or down while the machine is running. The eccentric shaft is steel, running in very large white-metal bearings. The machine can be worked from both sides, so that two or more men can use it at the same time. Speed, 750 revolutions per minute. Weight 7,000 lbs. Power required to drive, about one horse. Floor space required, 4' 3'' by 3' 9''. Height over all, 6' 6''.

See STEEL PRESS, Fig. 5747, p. 2369, "*Mech. Dict.*" Also, paper on the "*Système Haswell*," at Vienna, by Butler, of Leeds, England. Debate by Paget, Sir Joseph Whitworth, and others. "*Scientific American Sup.*," 712.

Fig. 1087.

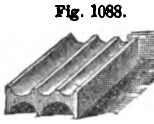


Forking Spade.

Fork'ing Spade. A bifurcated digging tool. The tool with several tines is a *digging fork*.

Form'ing Iron. (*Forging.*) A species of swage block, used by the blacksmith in rounding rods. The grooves of various radii to suit different requirements.

Fig. 1088.



Forming Iron.

Form'ing Ma-chine'. 1. (*Sheet Metal Working.*) A machine for bending tin plate to circular form. The diameter of the circularly bent plate depends upon the relative proximity of the three rollers between which the plate passes.

See also STAMPING PRESS, Figs. 5543–5545, pp. 2304, 2305, "*Mech. Dict.*"

2. The forming machine, Fig. 1089, is adapted for felt, buckram, straw, tin, and what not.

Fig. 1089.

Forming Machine.

See also HAT-FORMING MACHINE.

3. A machine for laying up strands into rope, Fig. 1090. It is on the same principle as Fig. 4442, p. 1981, "*Mech. Dict.*"

For'no-con-ver'tis-seur. A French name, familiar to English speaking metallurgists as the title of the Ponsard furnace for the manufacture of steel.

See article by J. Sylvain Périssé, member of the national jury in Paris, 1878, published in the "*Journal of the British Iron and Steel Institute*," and reproduced in "*Van Nostrand's Engineering Magazine*," xxi. 252.

See also PONSARD FURNACE.

The *Ponsard* furnace, like the *Siemens-Martin* and others, whether applied to metallurgic or other purposes, is a gas generating furnace and has a peculiar regenerator. See GAS GENERATING FURNACE; *Siemens'*, Figs. 1159, 1160, and *Ponsard's*, Figs. 1161, 1162, pp. 886, 887, *infra*, both of them as applied to gas works.

Forty'five De'gree El'bow. A pipe coupling equal to $\frac{1}{8}$ bend. See BEND.

Foun'dry Fur'nace. System of *Piat*, Paris: Reverberating and blast furnaces. The furnace of sheet-iron containing the crucible is on trunnions, or can be unshipped and moved by crane or by hand to the flask. See CRUCIBLE FURNACE.

* "*Scientific American Supplement*" . . . . . 2857.

Foun'dry La'dle. One for carrying molten metal from the cupola to the flasks.

See LADLE; SHANKS, "*Mech. Dict.*" *et infra.*

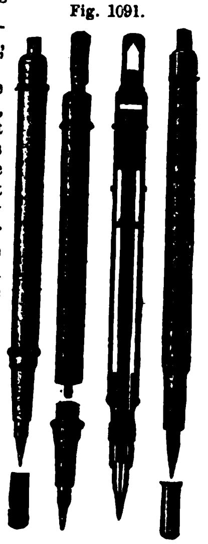
Aikin & Drummond's mounted ladle is supported on two wheels at a point on the shank, which enables a stout boy to counterpoise and push it, holding by the crotches.

Pintsch's ladle, Fuerstenwalde, Prussia, is of wrought iron, and the iron flows from a partitioned channel riveted along the side of the kettle. and opening into the same near the bottom. This excludes floating dross.

French foundry ladle, *Laboulaye's* "*Dictionnaire*," ii., Figs. 930, 931, 947, article "Fonderie de fer."

Foun'tain Pen. One carrying a supply of ink, fed gradually to the point of the instrument. The pens shown in Fig. 1091 have abandoned any attempt at graceful writing, being merely hollow handles with tubular points. A fine needle inside governs the flow of the ink in the Stylographic pen, — the two figures on the right. In the McKinnon pen, the tubular point is fine, and yields ink when pressure is applied.

Fig. 1091.



Fountain Pens.

Foun'tain Pump. A garden or syringing pump, for watering flowers, or applying wet poisons to the cotton worm, etc.

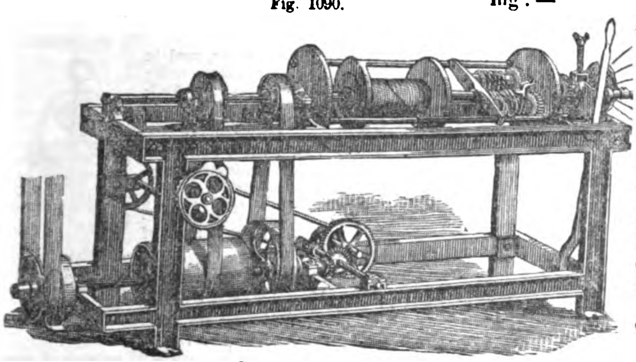
Comstock's "*Report upon Cotton Insects*," 1879,* p. 239, and Fig. 51.

See also SPRAYING MACHINE; SPRINKLER; INSECT DESTROYER, *infra*.

Four-cyl'in-der En'gine. See the following: —

Brown, Winterthur . . * "*Engineering*," xxi. 126, 177.
Vosper, Br. . . . . * "*Engineering*," xxvii. 5?9.
Compound, *Watts*, *Br.* * "*Engineering*," xxvi. 118.

Fig. 1090.



Rope-forming Machine.

Four-high Mill. A rolling mill with four rollers in tier. "*Iron Age*," xxii., Dec. 5, p. 3.

Four Screw Chuck. A lathe chuck in which the object is centered by the use of four screws quadrantically disposed. See DRILL CHUCK, p. 276, *supra*.

Four Spindle Drill. A gang drill with four spindles.

Pratt & Whitney, * "*Thurston's Vienna Report*," ii. 224.

Four-strand'ed Splice. (*Nautical.*) A splice made in a four-stranded rope, or *four cant* rope.

Four Valve Spec'u-lum. A urethral, or other, speculum which has four expanding fingers as in several of the instances, Fig. 5360, p. 2260, "*Mech. Dict.*" Certain speculi are always referred to under their specific names, as *otoscope*, *rhinoscope*, etc. See list under SURGICAL INSTRUMENTS and SCOPE, p. 2056, "*Mech. Dict.*"

Four'-way Cock. 1. (*Railway.*) A faucet in the air-brake arrangement with two passages in it, and used for opening and closing communication between the brake cylinder reservoir, brake pipe, and triple-valve. See TRIPLE-VALVE.

2. A bath tub cock with index, "Hot," "Cold," "Waste," "Shut."

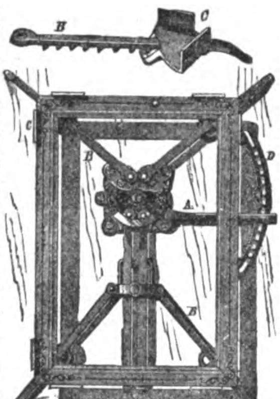
Frac'ture Ap'pa-ra'tus. (*Surgical.*) The list includes splints, bandages, swings, extension apparatus, bedsteads, etc. The distinctions are also drawn from the part affected. See SPLINT, EXTENSION APPARATUS, COUNTER EXTENSION APPARATUS, etc., in "*Mech. Dict.*"

See list under SURGICAL INSTRUMENTS AND APPARATUS, pp. 2459-2461, "*Mech. Dict.*" The following references are to *Tiemann's* "*Armamentarium Chirurgicum*," Part IV.

Femur	Figs. 102, 103, 105-111.
Fracture bed . . .	Figs. 104, 158, 159, 168, 169
Patella	Figs. 112-118.
Lower leg	Figs. 119-121.
Lower maxillary . .	Fig. 122.
Clavicle	Figs. 123-127.
Lower arm.	Fig. 128.
Suspending apparatus	Figs. 102, 103, 120, 130, 140, 154, 156, 157, 174.

Frame Clamp. A device for putting picture and looking-glass frames together. To a single lever *A* moving over a rack *D*, four stretchers are connected each to one of the corner clamps *C* so as to draw them equally. The clamps *C* are adjustable on the stretchers, as seen in the detached view, according to the size of the frame.

Fig. 1092.



Frame Clamp.

Frame Drill'ing Ma-chine'. A machine, Fig. 1093, with several self-acting drilling head stocks for operating on different parts of a locomotive frame at the same time. — *Whitworth.*

Frame'less Spec'ta-cles. Those in which the nose-piece and temples are attached directly to the lenses; bows being dispensed with.

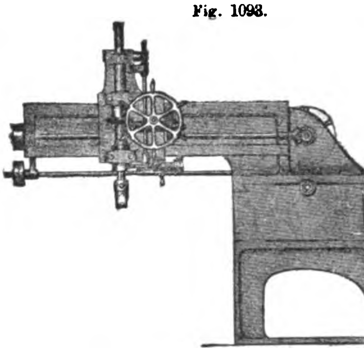
Frame Pla'ning Ma-chine'. A machine with independent self-acting cross slides and tools, for planing different parts of a locomotive frame at the same time.

Frame Slot'ting Ma-chine'. A machine for working on locomotive frames, having several self-acting head-stocks capable of being independently operated.

Frank'lin Spec'ta-cles. The lens in each bow is divided on its major axis; the upper section for *far*, and the lower for *near* observation; for distance and for reading.

Freez'ing Ap'pa-ra'tus. (*Surgical.*) See ATOMIZER; SPRAY APPARATUS, etc., Fig. 181, p.

Fig. 1093.



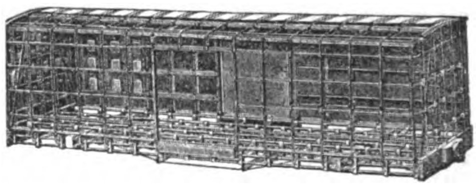
Frame Drilling Machine.

93, "*Mech. Dict.*," and Fig. 128, p. 55, *supra*. See also ICE.

Freezing mixtures, "*Mechanical Dictionary*," p. 1167.
"*Scientific American Supplement*," 142).

Freight Car. One for carrying freight, as distinct from passenger, express, mail, etc., cars, on the one hand, and gravel, coal, and construction cars on the other. Fig. 1094 shows a box freight car with frame made of tubular iron.

Fig. 1094.



Box Freight Car.

See the following references: —

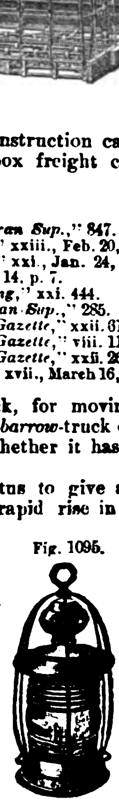
Light	"*Sc. American Sup.*," 847.
Iron	"*Iron Age*," xxiii., Feb. 20, 7.
Metallic	"*Iron Age*," xxi., Jan. 24, p. 7; May 14, p. 7.
N. Y. Central	* "*Engineering*," xxi. 444.
	"*Sc. American Sup.*," 285.
Lake Shore and Mich. S.	* "*Railroad Gazette*," xxii. 610.
Standard box, N. Y. C. . .	* "*Railroad Gazette*," viii. 119.
Freight stock car, *Chalender*	* "*Railroad Gazette*," xxii. 261.
Hoist and conveyor . . .	* "*Iron Age*," xvii., March 16, 1.

Freight Truck. A hand-truck, for moving heavy packages, known as a freight *barrow*-truck or freight *wagon*-truck according to whether it has 2 or 4 wheels respectively.

Fresh'et Sig'nal. An apparatus to give an alarm upon the occurrence of a rapid rise in a stream.

Gros's freshet signal apparatus, used in the Lot, Aveyron, France, indicates automatically, by electrical means, any variations in level from a higher to a lower point. A float at the higher point communicates its upward and downward movement, by means of a battery and wire, to a needle pointing on a graduated scale. When the rise is such that there is danger, a bell is sounded which sets in action a number of bells in the houses of inhabitants along the banks and warns them of the coming flood.

Fig. 1095.



Fresnel Lamp.

Fres-nel' Lamp. One with a cylindrical lens formed of prismatic zones above the equatorial region.

Fres-nel' Lens. (*Optics.*) A lens consisting of a central portion of spherical section and surrounding rings, so adapted as to direct the rays practically parallel, and prevent their loss by radiation in useless directions.

The *Fresnel* is the third in the series of the great improvements which are now universally adopted in light-houses, using the dioptric system. These three inventions are French, and are the *Argand* burner (1774), the mechanical lamp (*Carcel*), and the *Fresnel* lens (1810). The light is in the focal center of a series of lenses, which assume what may be roughly called a barrel-shape, around the burner. The equatorial portion of the series is a sort of cylindrical hoop, the vertical section of the band of glass showing such lines that the rays passing through it are diverted to a horizontal plane; the rays striking above or below the central zone are intercepted by rings of prismatic section, and are so refracted as to assume a direction parallel to those proceeding from the equatorial region of the glass envelope surrounding the burner. See DIOPTRIC LIGHT, Fig. 1657, p. 704, "*Mech. Dict.*"

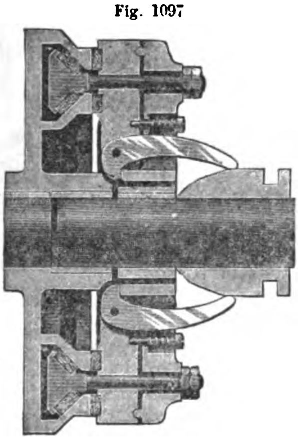
Fig. 1096.

Fresnel Lens.

Fret Saw. A jig or band saw, for bargeboard, bracket, and Sorrento work.

McChesney, Br. * "*Engineer*," xliii. 65.
* "*Manufacturer & Builder*," xi. 220.
Rogers. * "*Engineer*," xlvi. 124

Fig. 1097



Friction Clutch.

Fric'tion Brake. 1. *Prony's* brake. A form of *dynamometer*. Fig. 2102, p. 915, "*Mech. Dict.*"

Richards . . . . . "*Iron Age*," xx., Aug. 30, p. 11.

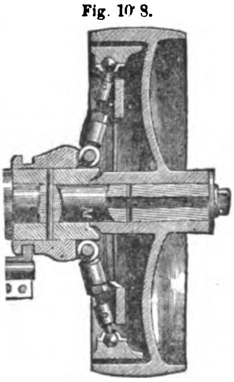
2. A measurer of the lubricity of oils. See FRICTION METER, OIL TESTER.

Fric'tion Clutch. A device by which a pulley is made fast to a shaft so as to partake of the motion of the latter; or one shaft made to partake of the motion of another

Fig. 1097 shows Frisbie's clutch, which fastens by the hub. The cone is moved by the shipper expanding the levers and so locking the parts together that the frictional adherence is equal to the duty of transmitting the motion of one part to the other.

Mason's clutch, Fig 1098, operates by expanding the friction segments against the inner rim of the wheel: a longitudinal sliding movement of the sleeve towards the pulley effects this; and *vice versa*.

Fig. 1098.



Friction Clutch.

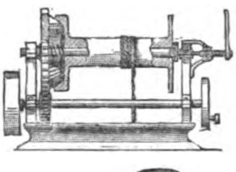
A Belgian friction clutch operates by contact of two disks with interlocking face grooves.

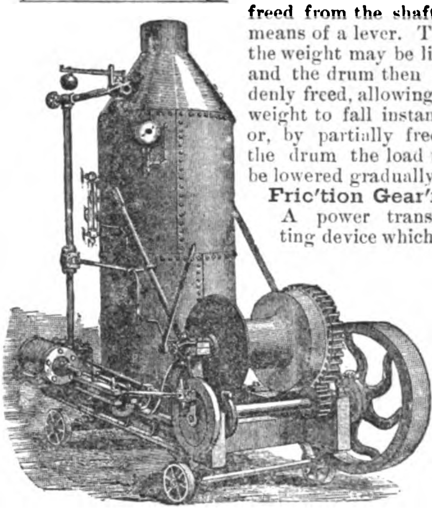
See the following:—

Addyman . . . . . * "*Engineer*," xlix. 268.
Am. Clutch Co. . . . . * "*Iron Age*," xvii., June 8, p. 5.
Coupling, *Bagshaw*, Br. . * "*Engineering*," xxx. 100.
Belgian . . . . . * "*Sc. American*," xxxvi. 147.
Pfleiderer, Br. . . . . * "*Engineering*," xxvii. 243.
Drum, *Mundy* . . . . * "*Scientific Amer.*," xxxvi. 338.
Pulley, *Bean* . . . . * "*Eng. & Min. Jour.*," xxi. 250.
Brown . . . . . * "*Mech. Dict.*," Fig 2103, p. 916; Fig. 1351, p. 578.
"Giant" . . . . . * "*American Miller*," viii. 225.

Fric'tion Drum Hoist. A hoisting engine operated by friction from a constantly moving shaft. Fig. 1099 shows Mundy's friction drum hoisting machine, used for pile drivers and derricks. It is a portable engine and hoist, but the drum can be locked to or freed from the shaft by means of a lever. Thus, the weight may be lifted and the drum then suddenly freed, allowing the weight to fall instantly; or, by partially freeing the drum the load may be lowered gradually.

Fig. 1099.





Friction Drum Hoist.

Fric'tion Gear'ing. A power transmitting device which depends upon the frictional adherence of the allied parts.

In Van Haagen's, the wheels have square grooves in their peripheries which interlock so as to form intimate bearing surfaces.

See also Fig. 1601, p. 680, "*Mech. Dict.*," where friction gear is shown as working the feed of a sawmill.

Fig. 1100.

Friction Gearing.

French * Art. "*Engrenage*," *Laboulaye's* "*Dict.*," iv., Figs. 3526, 3527.
Round belt in multi-grooved pulleys * "*Newton's Journal*," 157, N. S., vi. 163.
Paper by Wicklin. * *Cooper's* "*Belting*," 288.
Pump driver, *Hind*, Br . . . . * "*Engineering*," xxii 118.
Gear . . . . * "*Engineering*," xxiii. 147.

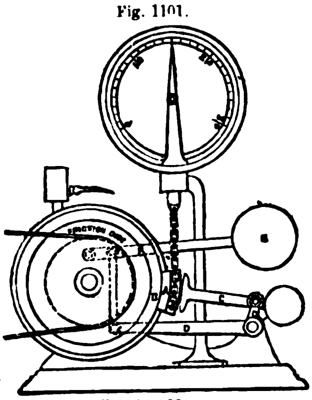
Fric'tion Heat'er. A device for obtaining heat from friction. A cylinder of water has an iron end plate, against which revolves a disk, and the friction of the two generates heat, which is communicated to the water. The latter is conducted in any usual way to different parts of the house. — *Prof. Wills.*

Fric'tion Ma-chine'. An electric machine, generating electricity by contact with amalgamated silk.

Fric'tion Me'ter. A test for lubricators.

The block *A* is pressed against the periphery of the wheel by an arm *C*, which is a segment of a roller, balanced and pivoted on the short arm of the bell crank *D D*, the long end of which is connected by a link to the lever *F*, which has a weight, *E*, on the outer end of it; and a chain connects the friction block *A* to a spring balance. The wheel is to be made to turn to the right at any desired velocity of circumference, by means of a band from a lathe, or otherwise, when the friction of the wheel on the friction block will tend to carry the latter along with the former; but it is prevented from doing so by the chain to the spring balance, which indicates the amount of the tendency of the block to move along the wheel, or, in other words, the total amount of friction on the rubbing surface. — *Napier.*

Fig. 1101.



Friction Meter.

See also OIL TESTER; LUBRICANT TESTER.

Fric'tion Rol'ler Drop. An arrangement for working a drop hammer. Hotchkiss & Stiles. See Fig. 2104, FRICTION HAMMER, p. 916, "*Mech. Dict.*"

Fric'tion Wheel. One operating by the friction of its surface; as in some cases a large buff-covered wheel driving a number of spindles by frictional contact.

See some notices in Cooper's "*Belting*," 206.
See also FRICTION GEAR; FRICTION CLUTCH, *supra;* and FRICTION WHEEL; FRICTION HAMMER, "*Mech. Dict.*"

Friez'ing Cut'ter. A rotative bit for making friezes, moldings, etc.

Friez'ing Ma-chine'. An edge-molding machine. The vertical cutter projects up through the table of the machine and works molding on the stuff fed up to it. It is called a friezing machine, as it is adapted to making frieze moldings for ceilings. See Fig. 3200, p. 1468, "*Mech. Dict.*"

Frit. (*Ceramics.*) The material for glaze of pottery.

A frit for stoneware glaze: —

Ground feldspar	25
Ground quartz or flint	25
Sal soda	25
Clay	15
Boracic acid	10
	100

After being fused in a *frit furnace*, it is run into a stone vat, cooled, broken into fragments, and ground into a fine paste with water in a *frit mill.* The result is a fine slip to which white lead as a fuse and cobalt as corrective of yellow are added.
The porous biscuit is dipped in this slip.

Frit Fur'nace. (*Ceramics.*) A reverberating furnace in which frit for glaze is fused.

Frit Mill. (*Ceramics.*) A tub mill, with buhr-stones in which the material for glaze (see FRIT) is ground into an impalpable slip.

Fromm'hold Cell. A single liquid battery having a platinized leaden plate clamped between two zinc plates with intermediate insulation. Immersed in dilute sulphuric acid.

See Slater & Watson's English Patent, 1852.

Front Cyl'in-der Head. That head which is opposite to the piston. The *back end* has the stuffing box for the piston-rod.

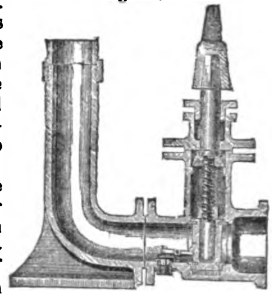
Front Sight. As distinguished from rear or hind-sight. The sight on a gun near the muzzle. It may be *globe, aperture, open,* or *pin.* See SIGHT.

Frost Cog. A toe or projection on a horse shoe to keep the animal from slipping on ice or frozen ground.

Frost'ing. (*Fine Art Metal-working.*) Making a dead surface on the metal so as to give a sombre tint; or it may be done over a part of the surface so as to throw the bright portions into greater prominence and so obtain variety.

Frost Valve. A valve which opens to allow water to escape from the portion of the pipe or pump where it is liable to be frozen. Stone's frost valve is so arranged that the act of screwing down the hydrant to close it opens the small frost valve and allows the hydrant to free itself of water.

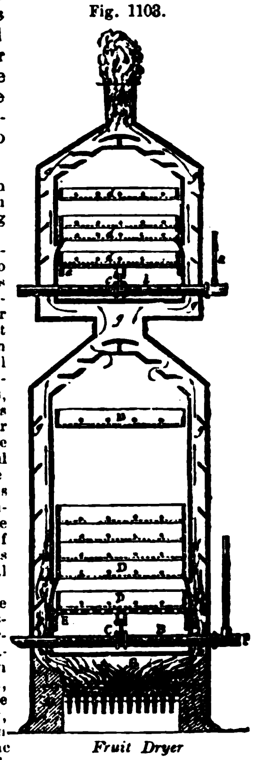
Fig. 1102.



Frost Valve.

Fruit Dry'er. The Reynolds fruit dryer is a shaft in which the shelves are horizontal. The trays of fresh fruit are put in at the bottom, the pile of trays being lifted temporarily for that purpose by means of the lifting bottom *D*, crank shaft *C B*, and handle *A*. From 12 to 20 trays are used; the heat is about 200° Fah., and the fruit in the upper trays is bathed in the steam and aroma of the fresher fruit more immediately exposed to the fire.

Fig. 1103.



Fruit Dryer

The point of delicacy in management consists in prompt drying after cutting to avoid discoloration.

It is a good plan to subject the freshly cut fruit to the fumes of sulphurous acid gas, obtained by burning sulphur in a chamber or cask in which the cut fruit is exposed. This is a plan used from time immemorial to prevent acetic fermentation in wine and cider casks, and also to delay the vinous fermentation with wine or cider. The trays with the finished article are removed from the top one at a time In Fig. 1103 the apparatus has a supplementary chamber above for finishing the operation when a tray of doubtful completion has been removed. Gold medal at Paris, 1878.

In a California machine the trays are similarly disposed but hung on a carrier-chain. The *Williams* machine has a high tower with a furnace at the bottom, and endless chains with wire trays which revolve slowly, causing the fruit last put in to pass first through the hottest part. Bleaching with sulphur is used. The *Alden* process is somewhat similar.

The *Jones* dryer (Farquhar, York, Pa.) is made in three forms, *horizontal, portable, double-flue upright.*

In the *horizontal* fruit dryer a current of heated air is drawn through the two horizontal fruit chambers by an exhaust fan. The chambers are one above the other with side doors for the introduction and removal of fruit trays.

In the *portable* the trays are in vertical columns in a sheet iron box at bottom of which is a furnace. The trays are put in at bottom, the pile being raised for that purpose, and the trays with finished fruit removed from the top. The trays are covered with netting.

The *double-flue* is larger, parts are duplicated, and it occupies the height of two stories, or a cellar and one story

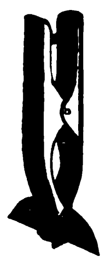
Dietz California fruit dryer has a number of sloping chambers one above another The fruit in wire trays is put in at front and pushed back from time to time as new trays are ready, and the dried fruit removed at the back. The fire-heat circulates in all the chambers, the fresh fruit being exposed to the hottest part.

Alden . . . . . * "*Mining and Sc. Press,*" xxxviii. 267.
Boswell . . . . . * "*Mining and Sc. Press,*" xxxvii. 281; xxxviii. 268.
Blower . . . . . * "*Mining and Sc. Press,*" xxxvi. 249.
Harris . . . . . * "*Mining and Sc. Press,*" xxxvi. 289.
Mumbrue . . . . * "*Scientific American,*" xlii. 162.
On drying fruit . . * "*Scientific American,*" xl. 146.
* "*Scientific American Sup.,*" 2103.
"*Scribner's Magazine,*" June, 1878.

Fruit Pit'ter. A device to remove the stones of fruit, such as peaches and plums.

Hatch's pitter splits the fruit and removes the pit. Each half of the tubular opening carries its own section of the knife, and the two are hinged together so as to expand to any necessary size.

Fig. 1104.



Fruit Pitter.

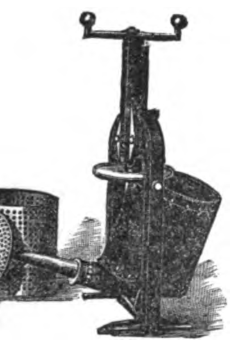
See also CHERRY, PEACH, etc. "*Mech. Dict.*"

Fruit pitter, *Lillie* * "*Min. & Sc. Press,*" xxxiv. 289.

Fruit Press. Cider, wine, and oil presses are considered under their own captions. Figs. 1105, 1106 show domestic presses for small fruit, and useful also for stuffing sausages. See also DRAW-UP PRESS, Fig. 872, p. 274, *supra*, and list under PRESSES, *infra*.

Fruit (or Seed) Sep'a-ra'tor. A machine which separates and grades cranberries, beans, and seed.

Fig. 1105.



Fruit Press (Open).

Fig. 1106.

Fruit Press (Closed).

The detachable feeder runs on top, and has a trembling motion, combined (optionally) with lateral motion. The sieves are lettered for kinds of grains and seeds, and numbered for places where used. — *Brown.*

Fruit Sli'cer. An open-bottomed box with a follower, to contain fruit, and slipped back and forth in grooves over a knife fixed like that of a slaw-cutter beneath. — *Wharry.*

Fu'el. The table gives the comparative evaporative value of fuels.

The feed water being 212° Fah. when it enters the boiler, the following results were obtained from the consumption of 1 pound of the undermentioned fuels. The first eight give the average of many samples tested by Messrs. Delabecho and Playfair: —

	Specific Gravity.	Pounds of Water Evaporated.		Compar. Values.
Welsh coal	1.315	9.05	By trial	1.000
Newcastle coal	1.256	8.01		0.885
Derby and York coal	1.292	7.58		0.837
Lancashire coal	1.273	7.94		0.877
Scotch coal	1.260	7.70		0.851
British average	1.290	8.13		0.898
Irish anthracite	1.590	9.85		1.088
Patent fuels	1.167	9.20		1.016
French coal (average)	1.310	8.00	Approx.	0.884
Lignites (average)	1.198	6.66		0.736
Dried peat	1.300	4.52		0.500
Coke (average)	0.750	9.00		0.995
Oak	0.930	4.52		0.500
Pine	0.660	2.50		0.276

Wood for Fuel as compared with Coal. — It is safe to assume that $2\frac{1}{4}$ lbs. of dry wood is equal to 1 lb., average quality, of soft coal, and that the fuel value of the same *weight* of different woods is very nearly the same, — that is, a pound of hickory is worth no more for fuel than a pound of pine, assuming both to be dry. If the value be measured by the *weight*, it is important that the wood be dry, as each 10 per cent. of water or moisture in the wood will detract about 12 per cent. from its value as a fuel.

The weight of one cord of different woods (air dried) will be found to be about as follows, for an honest cord of split wood: —

Hickory, or hard maple	4,500 lbs.
White oak	3,850 lbs.
Beech, red oak, and black oak	3,250 lbs.
Poplar (white-wood), chestnut, and elm	2,350 lbs.
The average of pine	2,000 lbs.

The fuel value as compared with coal is about as follows: —

1 cord air-dried hickory or hard maple equal to	2,000 lbs. coal.
1 cord air-dried white oak equal to	1,725 lbs. coal.
1 cord air-dried beech, red oak, or black oak equal to	1,450 lbs. coal.
1 cord air-dried poplar, chestnut, or elm equal to	1,050 lbs. coal.
1 cord air-dried average of pine wood equal to	925 lbs. coal.

Buckeye Engine Co.

Fu'el, Ar'ti-fi'cial.

The artificial fuel of Loiseau is made under Patents 78,982, 104,471, 147,663–147,666, 167,913, 167,914.

1868 Patent: coal dust, clay, saleratus, and shellac made into a paste, formed in molds and dried.

1870 Patent: a protecting covering.

1874 Patents: 1. a mixing apparatus.

2. Clay is dried, reduced to powder, mixed with the coal dust, moistened with milk of lime, kneaded, molded into lumps, the lumps waterproofed with a resinous material.

3. Mixing and molding apparatus. The coal dust with clay and lime-water is placed in a pug-mill, delivered to compressing rollers in a broad sheet, and the compressed lump falls upon a conveying apron.

4. A machine for coating the artificial fuel with a waterproofing composition. An apron dipping into a tank.

5. Molding. The balls are formed by two hemispheres, which are fastened together by bolts. Wire cloth aprons are confined between the hemispheres.

1875 Patents: 1. Mixing and molding. Stirrer blades on revolving shafts feed the composition to the molding cylinders.

2. Coal waste mixed with pulverized clay and diluted rye and lime paste.

See the following references: —

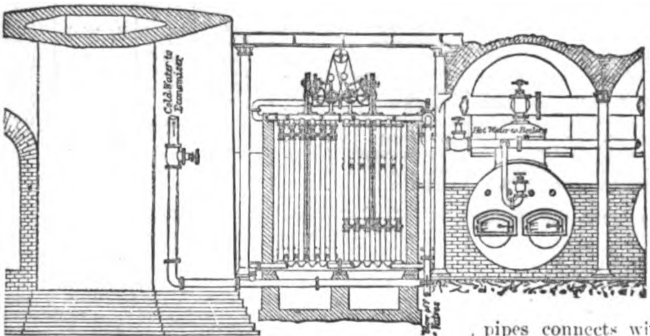
Dixon . . . . "*Scientific Amer. Sup.,*" 7.
In France, etc. . . . . "*Engineering,*" xxvi. 379.
Paper on, *Loiseau* . . . "*Man. & B.,*" x. 178, * 202.
Loiseau . . . . "*Iron Age,*" xvii., Ap. 20, p. 7.
Loiseau . . . . "*Report Juries of Group I., Paris Ex. Rep.,*" 1876, p. 55.
Loiseau . . . . "*Van Nost.'s Mag.,*" xix. 544.

Loiseau	"*Scientific Am.*," xxxviii. 369.
Compressed	"*Scientific Am. Sup.*," 2469.
"Amianthine coal."	
Rocker, Fr.	"*Scientific Am.*," xxxix. 149.
Fuel, gas, *Strong* . . .	"*Scientific Am.*," xxxix. 273.
Fuels, liquid.	
Paper by Aydon . . .	"*Scientific Am. Sup.*," 1890.
Tan-bark fuel, Fr. . .	* "*Scientific Am. Sup.*," 3895.
Press, *Grant*, Br. . .	"*Iron Age*," xxii., July 11, p. 20.

See also BRIQUETTE. See *Siemens'* "*Fuel.*"

Fu'el E-con'o-mi-zer. An invention of Twibill, of Manchester, England. A feed-water heater by the waste heat escaping at the chimney.

Fig. 1107.

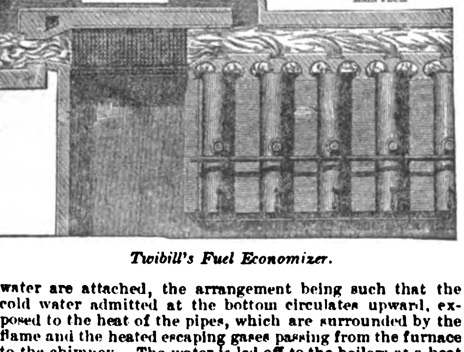


Fuel Economizer.

Statement: "There are two sources of waste in all steam boilers which may in a measure be made to neutralize each other. The gases going to the chimney carry off on an average, according to good authority, 31 per cent. of the fuel, and in the most economical boiler this cannot be reduced below 12 per cent. The feed-water, on the other hand, has to be heated from the normal temperature to that of the steam before evaporation can commence, and this generally at the expense of the fuel which should be utilized in making steam. This temperature at 75 lbs. pressure is 320°, and if we take 60° as the average temperature of feed, we have 260 units of heat per pound, which, as it takes 1151 units to evaporate a pound from 60°, represents a loss of 22.5 per cent. of fuel. All of this heat, therefore, which can be imparted to the feed-water from the waste heat in the escaping gases is just so much saved."

The *economizer* is placed parallel to the battery of boilers, between them and the chimney shaft. It consists of 36 transverse rows of vertical pipes, there being 12 pipes in each row, connected at top and bottom by transverse horizontal pipes. The pipes are of cast iron and cylindrical, the lower end turned slightly conical and pressed into a socket in the transverse pipe beneath, in which it is planted. The transverse pipes communicate at their ends with transverse longitudinal pipes, and to these the inlet and outlet for the feed-

Fig. 1108.



Twibill's Fuel Economizer.

water are attached, the arrangement being such that the cold water admitted at the bottom circulates upward, exposed to the heat of the pipes, which are surrounded by the flame and the heated escaping gases passing from the furnace to the chimney. The water is led off to the boilers at a heat of 280° Fah.

A scraper is provided for each pipe to remove soot from the exterior to keep the heat-conducting character of the iron intact. These are coupled in groups, and kept continually moving up and down by means of gearing, pulleys, and scraper chains.

The *Babcock & Wilcox* fuel economizer holds a similar place between the furnace and chimney. The tubes are connected at top and bottom with horizontal tubes, the lower row of which are connected to a mud-drum, and the upper row are connected together at the end diagonally opposite to the mud-drum. The feed-water enters at one end of the mud-drum and passes out at the opposite end of the upper connecting pipe. The hotter gases, filling the upper portion of the chamber, come in contact with the water at its highest temperature, so that it is possible to heat the latter very nearly to the temperature of the escaping gases before it flows to the boiler.

Ample provision is made for cleaning the interior of the vertical and horizontal tubes, and the mud-drums, by means of hand-holes with metallic joints opposite the ends of each tube. This is important, as in most hard waters sediment will form in the economizer more readily than in the boiler.

By means of a direct flue to chimney, the economizer may be cleaned without stopping the boilers.

Mechanical scrapers worked from above are provided for removing deposits of soot from the exterior of the tubes, the soot falling into a chamber below, from which it may be removed at convenience.

The Miller economizer consists of rows of tubes lining the sides of the fire chamber beneath, and partially alongside of the boiler. The system of pipes connects with the lower and upper portions of the boiler and causes a circulation, as well as adding a large amount of heating surface.

Mason & Alcock, Br.	* "*Engineering*," xxix. 261.
Warish, Br. . . .	* "*Engineer*," xlviii. 451.
Babcock & Wilcox .	* "*Eng. & Min. Journal*," xxviii. 109.
	* "*Manufacturer and Builder*," xi. 1.

See also list of references under FEED WATER HEATER, pp. 328-330, *supra*. See also HOT-BLAST APPARATUS, *infra*, for a device of somewhat similar construction but for the purpose of heating air for metallurgic furnaces. See also REGENERATOR and GAS-GENERATING FURNACE, for other methods of utilizing escaping furnace heat.

Fuel Feed'ing Ap'pa-ra'tus. In Jucke's device the fuel is placed on an endless chain carried by two rollers and driven by the engine. This endless chain forms the fire-bars, and moves so slowly that the fresh fuel placed upon it at the furnace mouth is gradually carried backward, consumed, and delivered at the rear in the form of ashes and clinkers. The rollers and chain are carried on a sort of trolly, so that the whole can be drawn out when necessary, and the rate of motion is made adjustable to regulate the supply of fuel.

See also STOKER, MECHANICAL.

Ful'gu-ra-ta. (*Electricity.*) A spectro-electric tube in which the decomposition of a liquid by the passage of an electric spark is observed.

In that of M. Duboscq, the vertical tube has a pair of platinum wires: the upper one extends nearly to the lower end, and the lower one is surrounded with a short conical glass tube, which by capillary attraction continually supplies the fluid under examination which covers the point of the lower electrode. "*Telegraphic Journal*," * iv. 285.

Full Cir'cle. A form of FIFTH WHEEL, *q. v.*

Ful'ler Bat'te-ry. (*Electricity.*) One having a zinc element, which is permanently amalgamated by placing its enlarged base in mercury in the porous cell, which is otherwise filled with water. The carbon plate is placed in the outer vessel in a solution of sulphuric acid and bichromate of potassium.

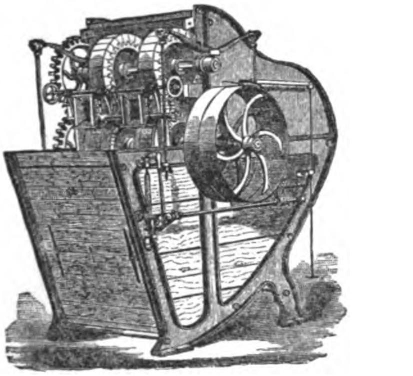
The thin portion of zinc is covered with wax, paraffine, caoutchouc, or the like.

"*Telegraphic Journal*"	* v. 9, * 53.
Niaudet, American translation	218.
"*English Mechanic*"	* xxiii. 321.
"*Scientific American Sup.*"	* 628, * 1127.

Ful'ling Mill. 1. The old fulling mills were generally of wood, and the necessity for weight gave rise to their being of enormous size. The beating mill, which the nearest resembles the ancient tramping, — practiced in Asia with camel's hair for thousands of years past, — is shown in Figs. 2125, 2126, p. 923, "*Mech. Dict.*" The roller mill, which is more compact, is shown in Figs. 2127, 2128, *Ibid.*; but a still more improved form is the Rodney Hunt, shown in Fig. 1109.

In this mill, the shape of the box answers to the requirements of the work, to avoid useless quantity of suds. The

Fig. 1109.



Rotary Fulling Mill. (*Top casing removed.*)

frame is of iron, and casing of hard pine. The main squeeze rolls have cast-iron shafts covered with wood, the fiber of the wood being presented endwise outward. The bottom rolls have brass flanges between which the top rolls run. The rolls are geared, and pressure is obtained by elliptic springs. All the inside working surfaces are of wood or brass, to avoid staining the goods. By certain attachments the fuller has control of the goods, felting and stretching lengthwise, or felting the width as he may desire. An automatic stop-motion stops the mill in case of the "knotting up" of the goods.

Baldwin . . . . * "*Scientific American*," xxxviii. 38.
Benoit, Fr. . . . * *Laboulaye's* "*Dictionnaire*," ii., article "*Laine*," Figs. 1328, *et seq.*, ed. 1877.

2. A machine in which wool hats are felted; an operation equivalent to the *sizing* formerly done at the battery.

The hat body having been *formed* by a fleece of wool from the carding machine wound upon the cone, and thence removed and given a certain amount of consistence known as *hardening* (see HAT-HARDENING MACHINE), is then to be felted or fulled to give it strength, an operation which compacts the fibers and makes the cone much smaller.

The principle of felting is probably sufficiently well understood, and need not be explained here. See pp. 833, 834, "*Mech. Dict.*"

The precursor of the fulling mill was a machine invented by James S. Taylor, of Danbury, Conn., and patented May 3, 1853, as a hat-shrinking machine.

It had four rollers set with their axes in relatively angular position, which caused a roll of hats placed between them to travel slowly along while turning around between the rollers. Two of the rollers had also a vibratory motion, and the effect was a rubbing pressure, and an advancing motion. An ingenious device, and useful in its day.

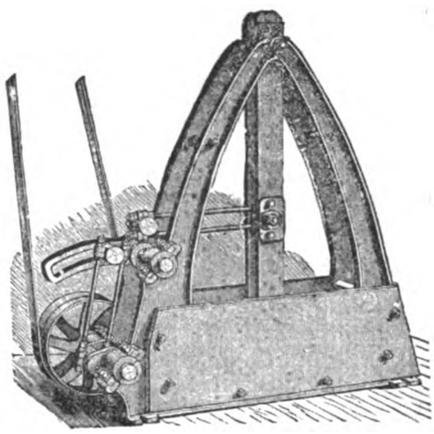
The first successful fulling mill was used in the factory of the "Seamless Clothing Manufacturing Company," of Matteawan, N. Y., about 1860, at which time the company commenced the manufacture of wool hats; and it may be remarked that the use of the fulling mill is yet principally confined to the wool hat factories, the sizing of fur hats being almost wholly done by hand on the battery.

Various styles of fulling mills are now used.

Fig. 1110 shows a mill called a *pusher*, which is used to start the hats — to follow the language of the factory — when they leave the hardening machine. The beater is driven by a bell crank, which receives motion from a crank shaft by means of a connecting rod, which is adjustable in a curved slot in the bell crank to vary the stroke of the beater.

Sometimes one beater is used, but generally two beaters acting in opposite directions, and placed side by side in the

Fig. 1110.



Crank Mill for Fulling Wool Hat Bodies.

same fulling bed, and consequently acting upon two batches of hats in the respective ends of the bed.

To finish the hat body another kind of fulling mill is used, having *fulling stocks*.

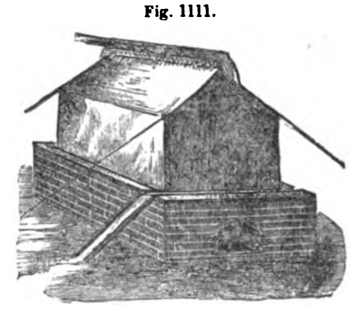
Four cast-iron frames are bolted to a solid foundation; these form the bearings for the beater shafts, and contain the fulling beds. A driving shaft operates two large gear-wheels, to which the lifting toes which actuate the beaters are attached. Two beaters operate in each bed, and the hat bodies placed in a body in each bed, slowly turning by the successive blows, are gradually fulled to a suitable size.

In some cases acidulated water is used to facilitate the fulling of the hat bodies, but in most cases fuller's soap is employed.

Full Way Valve. A pipe valve which lifts entirely out of the current. Also called a *clear-way* valve.

Fume Con-den'ser. An arrangement for condensing heated vapors and fumes, arsenic, zinc,

Fig. 1111.



Fume Condenser.

mercury, etc. See CONDENSER, "*Mech. Dict.*," *et supra.*

That shown in Fig. 1111 has canvas roof and sides flooded with water.

Fu'nis Clamp. (*Surgical.*) A clamp with two steel plates and catch for compressing the umbilical cord.

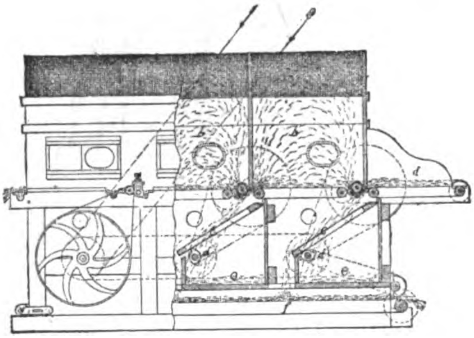
Fun'nel Box. (*Mining.*) An apparatus for collecting slimes from water. *Spitzkasten.* It is a row of square funnels increasing in size and depth, the slime-carrying water passing from one funnel box to another, the increasing capacity of each decreasing the rate of movement of the water, and thereby depositing in the successive boxes solid matter of increasing fineness.

"*Mining & Scientific Press*" . . . . . * xxxiv. 145.

Fur Blow'ing Ma-chine'. A machine to loosen out fur and remove hair and other impurities. The invention of William B. Rotch.

A number of pickers are made to operate upon the fur, which is fed into the machine by a feed upon *A*. The fur is presented to the rapidly revolving picker by two small feed

Fig. 1112.



Rotch's Fur Blowing Machine.

rollers which take the fur from the feed apron. The fur being held by the rollers is combed out, and the lighter portion is thrown by the picker into the upper chamber *B*, while the heavier part falls upon a screen *c*, which, being shaken by double cams on the shaft *d*, causes the hair and other small particles to collect in the box *e*, while the larger pieces fall upon an endless apron and are carried back to be operated upon a second or a third time until all the fur is removed.

The chamber *b* is covered with a wire cloth to allow the fine dust to escape with the current of air which is created by the rapid motion of the picker, and which carries the lighter portions of fur into the chamber, where it is deposited upon a second endless fur apron, passed by a second pair of feed rolls to the next picker, where the same operation is repeated, and so on, until, the fur having passed from 3 to 6 separate pickers, is delivered in an even *bat* ready to be used in the forming machine See HAT-FORMING MACHINE.

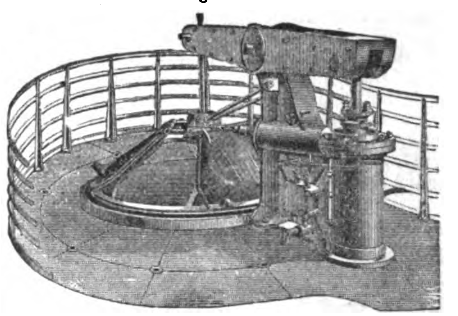
Fur'nace. See the following: —

Air furnace.	Mercury furnace.
Blast-furnace.	Open hearth furnace.
Blomary.	Ore furnace.
Blow-pipe furnace.	Osmium crucible.
Calcining furnace	Pattinson's pots.
Carbonizing furnace.	Petroleum furnace.
Catalan forge.	Ponsard furnace.
Cementation furnace.	Puddling furnace.
Coke furnace.	Reducing furnace.
Coke oven.	Refinery.
Copper furnace.	Regenerator furnace.
Corsican furnace.	Reverberatory.
Crucible.	Roasting furnace.
Crucible furnace	Roasting hearth.
Cupellation furnace.	Shaft furnace.
Decomposing furnace.	Siemens' furnace.
Forno-convertisseur.	Siemens-Martin furnace.
Foundry furnace.	Smelting furnace.
Gas furnace.	Steel furnace.
Gas-generating furnace.	Tempering furnace.
Hot blast oven	Terrace furnace.
Hot blast stove.	Turf furnace.
Ladle furnace.	Turning furnace.
Lead furnace.	Wind furnace.

Fur'nace Char'ger. The Weimer furnace-charger consists of an inverted cone placed over the hopper, and doors in the cone opening to admit the ore, flux, and fuel. These doors slide on hinges secured to a revolving ring on top of the cone. Near the tunnel head is a post on which a beam vibrates; the bell inside the tunnel-head is hung to one end, and a piston is suspended from the other and moves in the vertical cylinder. The horizontal cylinder moves the ring to which the sliding doors are hung.

Fur'nace Char'ging Bar'row. See CHARGING BARROW. Fig. 600, p. 191, *supra.*

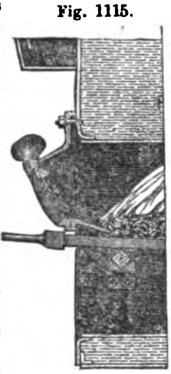
Fig. 1113.



Weimer's Furnace Charger.

Fur'nace-char'ging Scales. A scale with several beams and poises so as to fill into a barrow separate quantities by weight of the ore, fuel, and flux which go to make a charge. This allows the proportional quantities to be collected in the barrow instead of obliging them to be separately emptied into the furnace. The principle is the same as the CREAMERY SCALES, which see.

Fig. 1115.



Furnace Door. (*Section.*)

Fur'nace Door. The fuel opening in front of a furnace. Contrivances have been introduced for causing water to circulate through the hinges and doors to moderate the extreme heat of the engine room.

Ashcroft's balancing furnace doors are shown in Figs. 1114, 1115, in perspective and section.

Fur'nace Feed'er. Methods of feeding furnaces automatically, and also means for avoiding

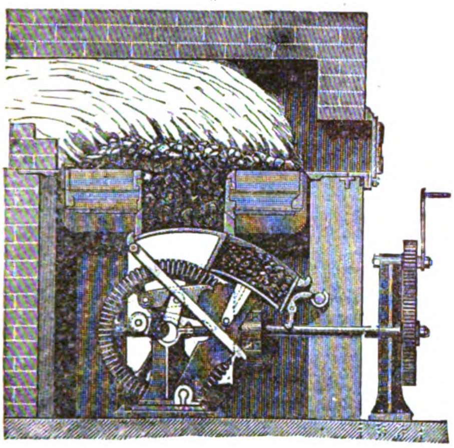
Fig. 1114.

Ashcroft's Balancing Furnace Door.

the wasteful production of smoke, are described on pp. 2224–2226, *"Mech. Dict."* Base burning, bottom feeding, secondary consumption, the dead-plate system, the revolving furnace, and steam injection, are there described. See also list of FURNACES, *"Mech. Dict.," et supra.*

Fig. 1116 shows Frisbie's bottom feeding furnace, in which the coal is fed from beneath; being filled into a box while in the position shown in the figure, the wheel is subsequently revolved, bringing the box into position immediately beneath the furnace when the piston in the bottom of the box is raised and the coal expelled, taking its place as the lower

Fig. 1116.

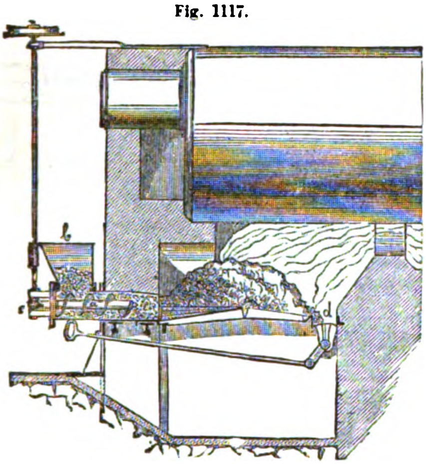


Bottom-feeding Furnace.

stratum of the fuel. A plate on the feed wheel holds up the coal when the box is again brought forward.

Fig. 1117 shows the Schultz furnace feeder. The coal is

Fig. 1117.



Dead-plate Automatic Feeder

placed in a hopper and fed by a continuously moving screw conveyor on to the dead plate in the furnace where it is first converted into coke, the gas escaping through the incandescent fuel.

See also GAS AND COKE FURNACE.

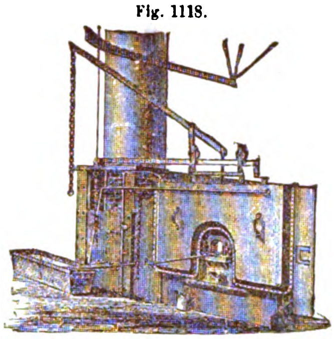
See: *Butcher* . . * "*Engineering*," xxv. 79, 118, 177, 213, 273.
Frisbie . . . . . * "*Engineering*," xxi. 244,
* "*Scientific American*," xxxv. 358.
McDougall, Br. . . * "*Engineer*," xliv. 262.
Schultz, Ger. . . * "*Scientific American Sup.*," 2523.
Helix, *Smith*, Br. . * "*Engineering*," xxv. 514.
* "*Scientific American Sup.*," 2193.
* "*Iron Age*," xxiii., April 17, p. 1.
Grate, *Hunter*, Br. . * "*Engineering*," xlvii. 408.
Hoist and drop, *Lonsdale*, Br.
* "*Engineering*," xxii. 497, 549.

The "helix" furnace of Smith (Br.) has a long screw conveyor which removes coal from a hopper and has subsidiary screws, one for each furnace, which continuously bring their portions of coal and deposit it in the lower stratum of fuel.

Fur'nace Scales. See FURNACE-CHARGING SCALE.

Fur'nace Shield. A heavy iron door lowered in front of a puddling furnace to shield the men from the intense radiated heat.

Fig. 1118.



McDonald's Furnace Shield.

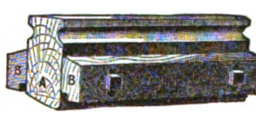
Fur'nace Slag Glass. (*Glass.*) See SLAG GLASS.

Fur'ni-ture Plush. (*Fabric.*) Also known as Utrecht velvet. A fabric with a mohair weft in the commoner qualities, but, in the best, of mohair entirely, the warps being cut in the same manner as the silk warps in velvet. See MOHAIR.

Fur'row Dres'sing Ma-chine'. A machine for cracking and dressing the furrows of millstones. See MILLSTONE DRESSING MACHINE.

Fur'row Gage'-staff. An instrument for gaging the furrows in millstones. The middle bar has a face the shape of the bottom of the furrow, and the side pieces *B B* are adjustable for the required depth of furrow and are set by bolts. In using, the face of the portion *A* is painted, so as to indicate when it touches any protruding point in the furrow. — *Taft.*

Fig. 1119.



Furrow Gage-staff.

Fig. 1120.

Furrow Rubber.

Fur'row Rub'ber. An emery tool for dressing out the furrows of millstones.

Fur'row-ing Ma-chine'. A machine for making or dressing the furrows of millstones. See MILLSTONE DRESSER.

Fu-run'cule Knife. (*Surgical.*) An instrument with a small triangular lateral blade on its end for lancing boils in the meatus auditorius.

Fuse. An exploder, time or percussion, applied to shells or other explosive charges. "*Mech. Dict.*," Fig. 2132, p. 928.

Official trials of fuses, "*Ordnance Report*," 1878, Appendix S, 2, p. 399, *et seq.*

Hotchkiss, percussion fuse . . .	Plate I., p. 399.
Schenckl, percussion fuse . . .	Plate II., p. 400.
Absterdam, percussion fuse . .	Plate III., p. 401.
Eggo, percussion fuse	Plate IV., p. 402.
German, percussion fuse . . .	Plate V., p. 403.
Pettman (British), percussion fuse	Plate VI., Fig. 1, p. 404.
Royal Laboratory (British), percussion fuse.	Plate VI., Fig. 2, p. 405.
Lissberger, percussion fuse . . .	Plate VII., Fig. 1, p. 406.
time percussion fuse . . .	Plate VII., Fig. 2, p. 407.
German, time percussion fuse . .	Plate VIII., p. 408.
M'Intyre, time percussion fuse .	Plate IX., p. 409.
Gill, combination fuse (No. 1) .	Plate X., p. 410.
Gill, combination fuse (No. 2) .	Plate XI., p. 411.
O'Reilly, combination fuse . .	Plate XII., p. 411
Thompson, combination fuse . .	Plate XIII., p. 412.
Ware, combination fuse (No. 1) .	Plate XIV., p. 413.
combination fuse (No. 2) . .	Plate XV., p. 414.
Treadwell, combination fuse . .	Plate XVI., p. 415.
Ruben & Fornerod, combination fuse	Plate XVII., XVIII., p. 416.

M'Intyre, combination fuse . . Plate XIX, p. 418.
Plumacher, percussion fuse . . Plate XXI., p. 420.
Stateham . . . . * "*Sc. Am. Sup.*," 2644
French, time . . . . *Laboulaye's* "*Dict.*," art. "*Artifices de guerre*," i., Fig. 171.
percussion . . . . *Ibid.*, i., Fig. 169.
Prussian, percussion . . . . . *Ibid.*, i, Fig. 170.

Fu'si-ble Met'al. An alloy with a determinate fusing point, and placed in a position to melt and allow escape of steam or to sound an alarm when the stated temperature is exceeded.

A number of tables of alloys with indicated melting points are given on p. 62, "*Mech. Dict.*" To these may be added, —

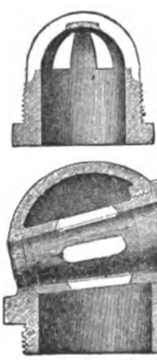
	Bismuth.	Lead.	Tin.	Antimony.	Melting Point, Degrees, Fah.
D'Arcet . .	8	5	3	-	Below 212
	2	5	3	-	Below 212
Walker . .	8	5	4	1	-
Onion . .	5	3	2	-	Below 197

By adding to the last given, mercury 1 part on taking the metal from the fire, an alloy will be obtained, which is liquid at 170° Fah. and only solid at 140°. Used for anatomical injections.

French cliché molds are made of the Walker alloy.

Electrotype molds of d'Arcet's and Walker's. Also for metallic pencils and laboratory baths.

Fig. 1121.



Fusible Plug.

Fu'si-ble Plug. One placed on a steam boiler or in an electric circuit (fire alarm), which melts when subjected to a heat exceeding the point for which the alloy is constituted. See FUSIBLE ALLOY.

The plug shown is covered with fusible metal and the spaces filled with the same. Water from the boiler circulates in the tube around the plug; the latter being screwed into place is readily removed, refilled, and replaced.

Fu'sing Disk. An invention of Jacob Reese, of Pittsburg, for cutting round steel bars.

It consists of a disk of soft steel 3-16″ thick and 42″ diameter, making 240 revolutions per minute, which gives a travel of about 2500′ to the edge of the saw. The round bar travels in the same direction 200 revolutions per minute, so that the edge of the disk and the surface of the bar move in opposite directions.

A round bar of steel 1¾″ in diameter is fused in two in 10 seconds without being at any time in contact, the kerf being 5-16″ wide. The disk remains cool; the bar is heated.

"*Engineer*" . . . . * i. 259.
"*Scientific American Supplement*" . . . 4138.

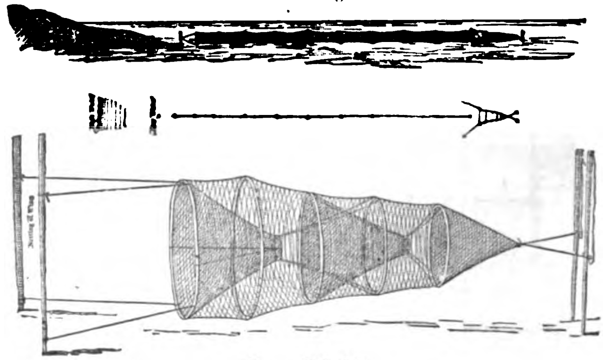
The circular saw for the removal of the fag ends of rails and bars while yet hot from the rolls is an apparatus used in many rolling mills. See HOT IRON SAW, *infra*.

Fyke Net. (*Fishing.*) A bag net with distended mouth and succession of funnel-shaped compartments.

In the upper part of the illustration a long *leader* is shown conducting the fish along shore into the fyke net. The netting of the wings is not shown, but extends from the stakes to the mouth of the *fyke*, and the end of the leader enters between the displayed wings, which are perhaps 5′ high and 20′ long. The leader, 100′ long, 5′ deep. The fyke has 5 hoops, 9′ to 15′ in circumference.

Under NET will be found a list of names of various pounds and traps, some of which embrace the same feature.

Fig. 1122.



Tyson Fyke Net

G.

Ga'bi-on. A basket, or frame of open work, used in hydraulic and harbor works to form a bar, dyke, or jetty. Cognate contrivances, as fascines, mats, etc. (which see), have a similar purpose; forming a nucleus for the holding of broken stone, gravel, or sand; or for the collection of sand or silt brought by the current, tides, or waves. See list under HYDRAULIC ENGINEERING.

The gabions of the Galveston jetty works are thus made: A bottom of 2″ planks is bored for the reception of upright pine poles, which have the bark left on them and these are held in position by a frame fastened to their tops. They are then wattled with the southern cane, which is so abundant. The gabions are stayed with cross braces internally, a ballast of concrete laid over the bottom and rammed, the top stayed by planks, the stakes nailed to the planking above and below, and the top and bottom planks tied together with ¾″ iron bolt rods. The gabion then receives two coats of cement and is allowed to dry for two weeks; such a gabion is 12′ × 6′ and 6′ high. The gabions are sunk upon a foundation mat of canes wattled on a frame of wood, and fascines of cane are thrust into the intervals between the standing gabions, which are planted by means of guide poles and are sunk by pumping them full of sand. Mats, fascines, and concrete blocks are arranged upon and around the group of gabions by divers.

See JETTY, *infra*, where the system adopted by the Dutch is represented. See also * "*Scientific American Sup.*," 245.

Ga'bi-on-ade'. A structure consisting of a number of gabions filled with sand or stone and sunk in lines upon fascines or hurdle mats, as a core for a sand shoal in harbor improvements. See "Works in Galveston Harbor."

"*Engineering*" . . . . * xxiv. 235.

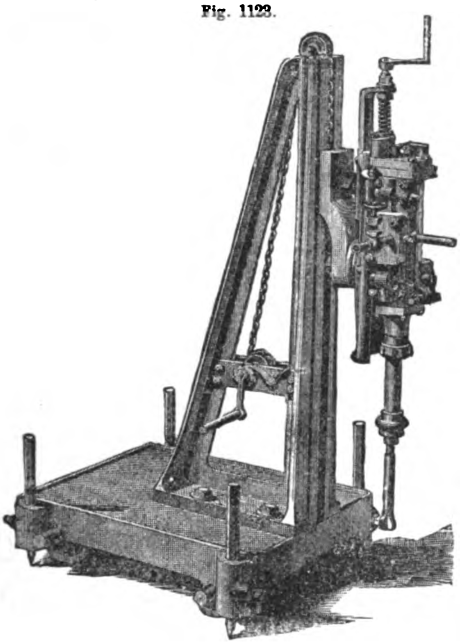
Gad'ding Car. (*Quarrying.*) One arranged to carry a drilling machine so as to present it to drill a series of holes in line. Used especially in getting out dimension stone.

See also CHANNELING MACHINE, Fig. 1246, p. 526, "*Mech. Dict.*;" the latter, however, works with chisels and makes a groove instead of a series of holes for as many *gads*, by driving which the stone is riven on the line of holes.

Fig. 1123 shows the drill mounted on car for gadding. It may be presented horizontally for heading, and lowered or raised on the column so as to make the horizontal holes at any altitude or at any angle.

The name is derived from the *gads*, or wedges which are used to rive the block after the row of holes has been drilled or jumped. The *gad* is shown in Fig. 2140, page 932, "*Mech. Dict.*" Another mode of splitting dimension stone upon the line of a row of holes is by means of the *plug-and-feather*, Fig. *a*, 3834, p. 1749, *Ibid.* In this case a wedge is driven between two oblique-faced plugs previously introduced into the hole. Each hole of a linear series being thus furnished, the wedges or gads are tapped in order down the line, again and again, until the stone parts on the line thus weakened and strained.

Fig. 1123.



Gadding Car and Drilling Machine.

Gaff. (*Fishing.*) A hook on a staff used in landing heavy fish; for salmon, halibut, cod, dory, etc.

The *pewgaff* is used in handling and pitching fish.

Gaff-top'sail Hook. (*Nautical.*) A mousing hook for a gaff topsail with rope sheet.

Fig. 1124.

Gaff-topsail Hook.

Gag. (*Surgical.*) An apparatus for distending the jaws during examination of or operation upon the mouth, fauces, etc., or in reducing lock-jaw. *Speculum oris.*

Figs. 259, 264, Part II., *Tiemann's "Armamentarium Chirurgicum."*

See also Fig. 3245, p. 1487, "*Mech Dict.*," and CHEEK RETRACTOR, Fig. 606, p. 192, *supra.*

Gage. A tool for measurement, inside or outside.

See CALIPER; CYLINDRICAL GAGE; MEASURING MACHINE; CORRECTIVE GAGE, etc., *supra*, *infra*, and in "*Mech. Dict.*;" also list under GAGE, p. 933, *Ibid.*

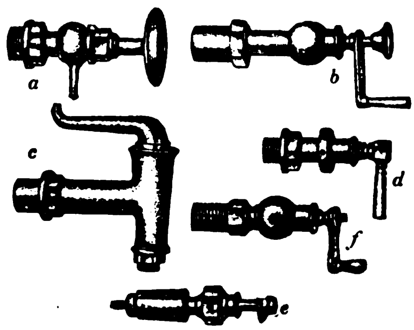
See also list under MEASURING AND CALCULATING INSTRUMENTS, *infra.*

Gaging and measuring implements. * "*Am Manufact.*," Mar. 28, 1879. p. 13.
Gages and Calipers, Standard * "*Journal Franklin Inst.*," March, 1879.
* "*Engineering*," xxvii. 407.
* "*Iron Age*," xxiii., Jan. 31, p. 63.
Gaging appa., Barrel, Aust. . * "*Engineer*," l. 404.
Gage, Carpenter's, etc., *Stoner* * "*Sc. Amer.*," xxxvi. 406.
Gages . . . . * "*Sc. Amer.*," xxxvi. 878.
Gaging casks, etc. . . . . *Keene's "Handbook of Practical Gauging."*

Gage Cock. A trycock to ascertain depth of water in a steam boiler.

Borden . . . . . . * "*Scientific American*," xxxvii. 294.
McCool & Elliott . . . * "*Iron Age*," xxi., April 18, p. 5.
Meyer . . . . . . * "*Iron Age*," xvii., March 30, p. 1.

Fig. 1125.



Gage Cocks.

a. Gage valve; wooden wheel.
b. Gage cock; lever handle.
c. Gage cock.
d. New York gage cock.
e. Mississippi gage cock.
f. Gage cock.

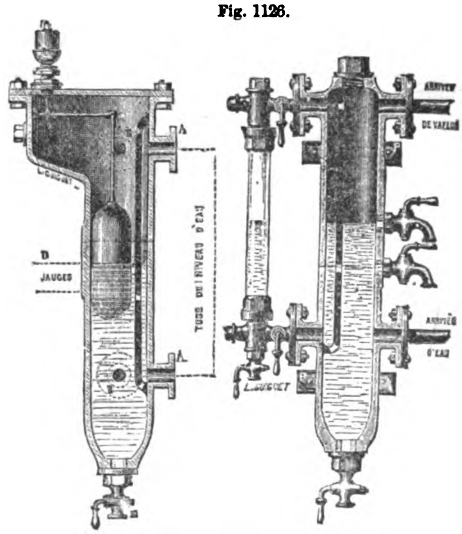
Gage Glass. A glass placed on a boiler to show the water level therein.

Fig. 1126 shows the gage glass of Damourette, Paris.

The instrument on the left is intended to be placed directly upon the boiler and has a float operating an alarm whistle when the water sinks below a given level. The dotted lines show the position of the glass tube.

The instrument on the right communicates with the boiler

Fig. 1126.



French Gage Glass.

by two pipes for water and steam, and has all the fittings, gage cocks, glass, tube cocks, sediment cock, etc.

The interposition of the chamber makes a slack-water between the boiler and gage glass which prevents the effect of ebullition manifesting itself in the latter, and the chamber also acts as a sediment catcher, keeping the glass clean.

Gage glass fittings, *Blake*, Br. . * "*Engineering*," xxix. 186.

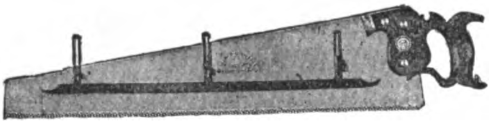
Gage Lathe. A lathe for turning work to size: handles of all kinds, chair legs, pillars and rounds, bedstead rails, beaded work and *nulled* spindles are turned to patterns also, but this speciality constitutes the machine tool a *nulling* lathe.

In the more perfect forms of gage lathes for turning exceptional shapes, three cutting-tools are used: one for turning the stick to a rough cylindrical form; a second to rough out the irregular outlines wanted; and a third to smooth-finish it. The second cutter is caused to approach or recede from the line of centers by a templet, against which the tool-holder rests and along which it slides. The roughing-tools are of the usual V-shape. The finishing-tool is a long blade, set at an angle with the center line of the lathe in order to take a smooth shaving. Its edge is given such a shape that it finishes the work accurately.

The piece to be turned is supported between centers by a ring, and the workman is thus enabled to turn a comparatively long and slender stick. The movement of the slide-rest which actuates the cutters is checked at the end of its throw by a self-acting stop.

Gage Saw. A hand saw with a gage bar adjustable to determine the depth of kerf.

Fig. 1127.



Gage Saw.

Gage Wheel. (*Agricultural.*) A wheel on the forward end of plow beam, to limit the depth of furrow. Fig. 850, p. 267, *supra*, shows a plow with a pair of gage wheels.

Gage Ta'ble-shears. A machine for cutting straw and mill boards to a regulated width, for book covers, box making, etc. See BOARD CUTTER, *supra*, and Fig. 739, p. 311, "*Mech. Dict.*"

Gag'ger. (*Molding.*) A piece of iron in a mold to hold a core in place. A *chaplet*.

Gaiffe Bat'te-ry. (*Electricity.*) There are several forms of batteries by this inventor.

a. Chloride of silver battery, "*Niaudet*," American translation, * 206; "*Telegraphic Journal*," * vi. 398.
b. Sulphate of mercury battery, "*Niaudet*," * 147. (Elsewhere credited to *Marie-Davy.*)
c. Improvement on *Leclanché*, "*Scientific American Sup.*," 3189; "*Telegraphic Journal*," vi. 185.
d. Chloride of zinc, "*Technologiste*," xli. 43.

A number of holes are drilled into a porous carbon cylinder, and filled with a coarse powder of manganese ore. The cylinder is connected with a rod of amalgamated zinc, and the whole plunged in a solution of 20 parts of chloride of zinc in 100 parts of water. — "*Comptes Rendus*."

See also * "*Scientific American Sup.*," 129.

Gain. A notch, as made in the side or edge of a piece of timber to receive another bar of the frame. See illustration in SCARF, Fig. 4660, p. 2051, "*Mech. Dict.*" See also GAINING MACHINE, Fig. 2044, p. 935, *Ibid.*

Gal'ley Knot. (*Nautical.*) A form of knot. See 10, Fig. 2777, p. 1246, "*Mech. Dict.*"

Gal-van'ic Bat'te-ry. See under the following heads: —

Aërated battery.
Agglomerated battery.
Alum Battery.
Aluminium battery.
Anderson battery.
Bagration battery.
Balloon battery.
Becquerel battery.
Bichromate battery.
Breath battery.
Bunsen battery.
Callan battery.
Callaud battery.
Camacho battery.
Carbon battery.
Carré battery.
Chloride of lime battery.
Chloride of silver battery.
Chloride of tin battery.
Chromic acid battery.
Clamond battery.
Coke consuming battery.
Column battery.
Compound plate battery.
Constant battery.
Couronne de tasses.
Cruikshank battery.
Daniell battery.
De la Rue battery.
Double fluid battery.
Dry pile.
Earth battery.
Electric battery.
Faure battery.
Flowing battery.
Frommhold cell.
Fuller battery.
Gaiffe battery.
Galvano-caustic battery.
Gas battery.
Graphite battery.
Gravity battery.
Grenet battery.
Grove battery.
Hill battery.
Inversion battery.
Latimer-Clark battery
Leclanché battery.
Leyden battery.
Magazine battery.
Magnetic battery.
Marie-Davy battery.
Marine battery.
Maynooth battery.
Mechanical battery.
Meidinger battery.
Menotto battery.
Mercury battery.
Micro-battery.
Moist battery.
Muirhead battery.
Muncke battery.
Niaudet battery.
Nickel battery.
Perchloride of iron battery.
Perfluent battery.
Peroxide of lead battery.
Peroxide of manganese battery.
Plunging battery.
Pneumatic battery.
Poggendorf battery.
Ponci battery.
Potassium chlorate battery.
Prism battery.
Pulvermacher battery.
Quicksilver battery.
Reservoir battery.
Sal ammoniac battery.
Sand battery.
Secondary battery.
Sea battery.
Siemens-Halske battery.
Single-fluid battery.
Smee battery.
Spiral battery.
Standard battery.
Storage battery.
Sulphate of lead battery.
Sulphate of mercury battery.
Thermo-electric battery.
Thomson battery.
Tom thumb battery.
Tray battery.
Triple-fluid battery.
Trouvé battery.
Trough battery.
Tyer battery.
Urine battery.
Varley battery.
Voltaic pile.
Walker battery.
Wollaston battery.

See also the following: —

Ergstrom. Howell. McCarthy. Slater. Gutensohn. } "*Scientific American Sup.*," 3791.
Plush . . . . . . "*Scientific American Sup.*," 2751.
Watson . . . . . . * "*Scientific American Sup.*," 524.

The lists commencing on the next page include all that is important in galvanic batteries up to date, so far as covered by patents.

Gal-van'ic Cur'rent. (*Electricity.*) The direct current from the galvanic battery. The primary current.

Gal'van-i-zing. Treated on p. 939, "*Mech. Dict.*"

"Pickle the article six or eight hours in water containing about 1 per cent. of sulphuric acid held in wooden vessels; the acid requires to be renewed from time to time, according to the quantity of iron pickled. After pickling, scour and wash well in clean water. Keep the article under clean water (in which a little freshly burnt lime has been stirred) until ready for the next process. Immerse in chloride of zinc for one or two minutes until a skin of fine bubbles is formed on the surface. Chloride of zinc may be formed by saturating hydrochloric acid with metallic zinc until effervescence ceases, then decanting and adding a little sal-ammoniac. Dry the article on a heated iron plate, then immerse it in a bath of molten (not glowing) zinc until it acquires the temperature of the zinc bath. The surface of the molten zinc should be protected by sal-ammoniac, or some other substance. In some cases there is a partition at the surface of the bath, one portion of the surface being protected with sal-ammoniac, the other with a layer of charcoal. Beat the article while hot, to remove the excess of zinc." — *Molesworth.*

Galv. electric bath, *Potin* . . * "*Scientific Am.*," xxxiv. 54.

A carefully written and full article on the zincing of iron surfaces, "*Scientific American Supplement*," 2798.

Iron . . . . "*Iron Age*," xxiii., Jan. 16, p. 9.
"*Manufacturer & Builder*," ix. 157.
Bath . . . . * "*Scientific American Sup.*," 2560.

Gal'van-i-zing Fur'nace. The bath of molten zinc in which iron is plunged to coat it.

The galvanizing furnace of Thum, of Laubach, Germany, is a reverberatory in which the zinc bath is heated from above. It has a fireplace and a chimney at each end, the part of the hearth connecting the two being arched over. The rest of the rectangular hearth is perfectly open above, so that the heat-conducting power of the metal is relied upon to keep it at the proper temperature in that part of the hearth. The slabs of fresh zinc are introduced through doors communicating with the hot ends.

GALVANIC BATTERIES. LIST OF UNITED STATES PATENTS.

Names.	Number.	In Positive Cell.		Diaphragm.	In Negative Cell.		REMARKS.
		Metal.	Liquid.		Liquid.	Metal.	
Coad, P.	2,521	-	-	-	-	-	Plunging, with vertical scale.
Plumbe, Jr., J.	2,984	-	-	-	-	-	Cell has spout for pouring.
Harrington, D.	4,176	-	-	-	-	-	
Olmstead, A. D.	6,362	-	-	-	-	-	Plates or wires inserted through perforated cap.
Drescher, L.	9,447	zinc.	-	flannel.	-	copper.	Voltaic pile; perforated plates.
Farmer, M. G.	9,530	-	-	-	-	-	Porous cell, partly glazed.
Pulvermacher	9,571	-	-	-	-	-	Plates depend from hinged lid.
Chester, C. T.	12,855	-	-	-	-	-	Overlapping clamp for plates.
Hull, A. G.	17,095	-		-	-	-	Battery for electrizing the blood.
Seaver, E.	19,209	zinc.	water.	sulph. copper in	sulph. cop.	copper vessel.	
Elmendorf, J.	19,245	zinc.	-	porous cell.	-	platinum.	Pole wires attached to electrodes with fusible alloy.
Doyle, G	19,759	zinc.		-	-	copper.	Plate clamps are screwed.
Grenet, Jr., E.	25,503	zinc.	-	partly imperv.	-	charcoal on lead.	Agitates excitant by current of air.
Avery, T. C.	25,710	zinc.	H_2SO_4.	porous cell.	HNO_3.	bifurc. plat.	Zinc amalg. outside with mercury, lead, or tin, rosin, tallow.
Vergues, M.	28,317	zinc cell.	H_2SO_4.	porous cup.	nitric ac.	platinized coke.	Platinum strips around central glass cylinder.
Kirchof, C.	31,545	platinum.	nitr. acetates of	-	-	platinum.	Secondary battery.
Chester, C. T.	38,146	-	lead, potash, fc.	-	-	-	Attaching carbon electrode.
Hill, E. A.	39,571	zinc.	sodium chloride.	-	sulph. copper.	copper.	Gravity battery.
Reissue	2,502	-		-	-	-	
Frazer, E. J.	40,537	zinc.	-	-	-	copper.	Removable zinc rest on rubber gasket on cap.
Freed, G. W.	43,014	zinc.	dilute acid.	-	-	copper.	Plates fit in grooves in vessel; tight gutta percha cover.
Brown & Baldwin	47,389	mal. iron bars.	-	porous cell.	-	gas coke.	Single negative with several positives on neg. cell; perforated cover.
Blackie, J.	49,824	zinc.	acid.	-	-	silver.	Zinc wholly immersed rests in mercury cup.
Chester, C. T.	51,144	-	-	-	-	-	Platinum-faced clamp for carbon.
Farmer & Smith	51,442	-	-	-	-	-	Thermo-electro. Alloy of antim. and zinc over enameled metal core.
Splitdorf, H.	52,617	zinc.	-	-	-	carbon.	Wire connection and clamp.
Percival	53,668	-	-	porous plate.	-	-	Secondary pile with carbon electrodes.
Leclanché, G. L.	55,441	zinc in sand	chl. hyd. amm.	sand.	carb. copper.	copper.	Jar corked and sealed.
Reissue	5,769	-	-	-	-	-	
Ogden, A. S.	55,892	-	-	-	-	carbon.	Wire connects by platinum with carbon.
Dixon, J.	57,687	zinc.	-	-	-	graphite and clay.	Neg. forming porous cell insulated by rings from zinc.
Fritz, H.	63,032	zinc.	hot acid.	-	-	copper vessel.	Single fluid. Air-tight case.
Bruso, P.	63,848	-	-	-	-	-	Pivoted adjustable connecting arm.
Leclanché, G. L.	64,113	zinc.	chl. hyd. amm.	sand or sawdust.	graph. and per-	graphite.	Also secondary battery with carbon electrodes.
Reissue	5,768	-	-	-	ox. mang.	-	Alkaline solution, powdered graphite.
Nichols, G. W.	68,779	-	sod. chl. and	-	-	-	Insulates the whole apparatus.
Boulay, C.	70,791	zinc.	sulphur.	porous cell.	sulph. cop. nitr.	copper.	Sealed by shellac and brick dust. Liq. to excitants thr. porous walls.
Garratt, A. C.	72,628	zinc.	vinegar.	cloth.	pot.	brass.	Voltaic pile with space between plates.
Fritz, H.	74,905	zinc.	hot acid.	porous cell.	-	copper vessel.	Containing vessel forms outside element.
Garratt, A. C.	79,567	zinc.	-	-	-	copper.	Voltaic pile. Plates in contact at edges.
Fleury, A. L.	79,819	-	-	-	-	-	Steam impinging on points generates electricity.
Palmer, H.	82,981	zinc.	-	cloth or paper.	-	copper.	Voltaic pile. Elements have wire connections.
Chester, C. T.	86,134	zinc.	-	-	-	carbon.	Inverting of battery.
Gerger, J. J.	86,221	zinc.	-	-	-	copper.	The zincs projects horizontally between the coppers so as to interlock.
Garratt, A. C.	89,036	zn. or magnes'm.	vineg., sea-water.	-	-	copper or bronze.	Pairs separated by strips of rubber.
Calland, J. A.	96,199	zinc.	sulph. zinc.	-	sulph. cop. [acid.	copper.	Imp. gravity fixtures, supports, etc.
McPherson, J. R.	97,949	fc. jar met. chips.	acid or sal amm.	porous cell.	per-ox. mang. nit.	carbon.	Cock for draining.

GALVANIC BATTERIES. LIST OF UNITED STATES PATENTS (*Continued*).

Names.	Number.	In Positive Cell.		Diaphragm.	In Negative Cell.		REMARKS.
		Metal.	Liquid.		Liquid.	Metal.	
Hoe, P. S.	99,192	-	-	-	-	-	Rectangular glass box lined with paraffine.
Meyer, C. W.	102,295	-	-	-	-	-	Portable medical battery; induction coils, etc.
Hill, J.	103,331	merc. and zinc.	-	-	-	cop. wire cloth.	Zn. in annular glass suspended from rim of outer cup. Cu. above zn.
Chutaux, T.	105,042	zinc.	-	-	-	carbon.	Plunging and inverted magazine. Liquid falls from cell to cell.
Chutaux, T.	105,043	zinc, iron.	-	sand.	granulated coke.	carbon.	Zinc in lower; iron in upper cells.
Robertson, O. W.	105,252	-	-	-	-	-	Insulator cell support.
McCracken, E. D.	106,383	-	-	-	-	-	Switch for connecting.
Kidder, J.	108,602	zinc.	-	-	-	platinum.	Neg. electrode coiled around suspended core. Elastic plug.
Farmer, M. G.	109,603	-	-	-	-	-	Thermo-electr. Pairs in curved tiers around heat.
Cook, D. M.	110,206	-	-	-	-	-	Several porous cups in one cell.
Cook, D. M.	113,399	-	-	-	-	-	Several porous cups in one cell wrapped with paper and wire.
Farmer, M. G.	113,864	ant. and zn. alloy.	-	mica.	-	Ger. silver cu.	Thermo-electric.
Hill, E. A.	114,005	zinc.	-	-	-	-	Quoit-shaped zinc suspended from rim of cell.
Hill, E. A.	114,006	zinc.	H_2SO_4.	-	sulp. cop.	copper.	Zinc suspended from rim of cell. Central tube supplies sulp. copper.
Klinkerfues, W.	114,950	zinc.	-	-	-	carbon.	Gas lighting auxiliary flame from gas of battery.
Powel, J. W.	115,519	-	-	-	-	-	Plunging. Trough-plates slide through elastic cover.
Little, G.	115,936	-	-	-	-	-	Automatic switch: alternating batteries.
Kidder, J.	116,451	zinc.	-	-	-	copper.	Separate binding post for each cell, with switch connection.
Drescher, L.	117,057	zinc.	-	-	-	carbon.	Grenet form modified.
Prevost, E.	119,175	conical zinc.	-	carbon cup.	nit. sod.; bichr.	carbon	Insulating collar round carbon opposite top of zinc.
Bastet, L.	119, 98	zinc.	H_2SO_4.	porous cell.	pot. H_2SO_4.	carbon.	Perforated partition in porous cell.
Himmer, V.	119,763	zinc.	H_2SO_4.	small cup; half	sulp. cop.	copper.	Sulp. in short cup saturated by tube from inverted globe.
Kidder, J.	119,855	-	-	height.	-	-	Plates in one leg of L-shaped cell. Plunged by tipping.
Callaud, J. A.	120,034	zinc.	sulph. zinc.	-	sulp. cop.	copper.	Gravity. With positive vertically adjustable.
Robbins, J. A.	120,327	tin.	-	-	-	carbon.	
Leland, E. J.	120,651	zinc.	sol. sulp. ac.	porous carb. cup.	sulp. merc.	platinum.	
Kidder, J.	120,750	-	-	-	-	-	Sliding cell coupler. Trough battery.
Klinkerfues, W.	122,389	zinc.	-	-	-	carbon.	Gravity; gas lighting; cell around gas pipe; turning on gas excites bat.
Robbins, J. A.	128,660	zinc plates.	-	porous cell.	-	carbon plates.	Elements duplicated.
Linke, C. A.	129,148	zinc.	-	-	-	carbon.	Negative depolarized by jet of steam.
Davis, A. G.	129,465	-	-	-	-	-	Insulating cell support.
Phelps, G. M.	130,593	zinc.	-	-	-	copper.	Gravity; zinc of peculiar shape and adjustable.
Wilder, W. J.	132,997	corrug. zinc.	-	porous cup.	-	copper.	Outer surface of zinc varnished.
Davis, A. G.	134,364	zinc.	-	-	-	copper.	Star-shaped elements; central tube; perforated cork stopper.
Thomas, J. H.	136,191	-	-	-	-	-	Insulating support collects leakage.
Lockwood, R. M.	137,556	zinc.	sol. sulp. acid.	-	sulp. cop.	spiral cop. wire.	Gravity.
Bastet, L.	138,602	zinc.	nitr. hyp. sulp.	porous cell.	nit. sod. and H_2SO_4	carbon.	Zinc for magazine, with gauze bottom. No amalgamation.
Wolf, A. L.	142,052	zinc.	sod.	-	ozone.	carbon.	Air or ozone injected through tubes.
Edison, T. A.	142,999	zinc.	sulp. zinc.	-	sulp. cop.	copper.	Gravity. Hor. copper plates between liquids to protect zinc against cu.
Ashcroft, E. H.	145,143	-	-	-	-	-	Non-freezing battery.
Lockwood, R. M.	149,320	zinc.	sol. sulp. acid.	felt.	sulp. cop.	copper.	Gravity. Zinc supported by insulating columns from copper.
Breslin, M.	149,635	zinc.	sulp. zinc.	-	sulp. cop.	copper.	Gravity. Negative in pyramidal form.
Clamond, C.	151,568	zinc.	-	-	-	antimony.	Thermo-electric.
Nolf, A. L.	153,841	zinc.	-	-	-	carbon.	Carbon cell with impervious coating.
Snow, W. D.	155,209	zinc.	earth.	earth.	-	carbon.	Several plates. Obtains intensity as well as quantity.
Arthur, R.	157,778	zinc fragments.	H_2SO_4.	porous cell.	HNO_3	carbon.	Perforated earthen jar holding zn. Has a cavity in floor for mercury.
Bryan, J. C.	160,152	zinc.	sulphur, earth.	-	-	copper.	Plates partially imbedded in sulphur.

Leiter, J.	161,246	-	-	-	-	-	Two-story. Pl. above. reserv. below. Forces liq. up. Autom. water feed.
Davis, W. M.	162,806	zinc.	sulp. zinc.	porous cell.	sulp. cop.	copper.	Bell rung when salt is exhausted.
Keegan, V. E.	163,318	zinc.	water.	sulp. acid in porous cell.	nitr. ac.	carbon.	Outer porous cell surrounded with coil of wire conn. to zinc.
Dechert, H. P.	165,312	-	-	-	-	carbon.	Neg. broken carbon in perforated tube of cop., lead, clay, gutta-percha.
Leclanché, G. L.	165,452	zinc.	chl. amm.	-	conglom. grap per ox. mang.	-	
Kidder, T.	166,012	-	-	-		-	Plunging. Adjustable plates, shallow cell; partitions for rapid filling.
Hill, E. A.	167,173	zinc.	H_2SO_4.	leaden plate.	sulp. cop.	copper.	Sulp. copper introduced through central leaden tube. Gravity.
Dawson, B. F.	167,510	zinc.	-	-	-	copper.	Agitator between negative and perforated positive.
Duhem, C.	169,529	zinc.	sulp. zinc.	-	sulp. cop.	copper.	A suppl. positive plate attachable to the zinc.
Lockwood, R. M.	170,864	zinc.	sol. sulp. ac.	porous cup.	sulp. cop.	copper.	Zinc in porous cup which rests on cu. supported by sulphate.
Kinemund, F. C.	175,112	-	-	-	-	-	Portable; plunging; trough; sliding cell connector.
Warden-Muirhead	175,884	slotted zinc.	chl. amm.	perforated cell.	graph. mang.	graphite.	Battery sealed.
Bliss, G. H.	176,270	zinc.	sulp. zinc.	-	sulp. cop.	copper.	Gravity; adjustable zinc; aux. copper disk above copper solution.
Brunelle & Mohr	177,066	zinc.	sulp. zinc.	-	sulp. cop.	copper.	Receiver att. to feeding tube between zn. and cu. to catch zn. residue.
Pulvermacher, J. L.	177,273	zinc.	vinegar.	fibr. absorbent.	-	copper.	Voltaic pile. Disk-shaped elements.
Einbigler, R.	177,996	-	-	-	-	-	Float regulates supply to service pipes of cells.
Watson, J. E.	178,215	zinc.	sulp. zinc, acet. lead, water.	-	sulp. cop.	perforated lead.	
Byrne, J.	182,101	-		-	-	plat. plated cop.	
Kidder, J.	182,293	zinc.	-	-	-	carbon.	Portable. Plunging. Two sets of cells, induction coils, etc.
Cerpaux, J.	182,802	zinc.	earth.	wood.	-	copper.	To be imbedded in earth
Parrish, M. W.	183,201	zinc.	-	-	-	copper.	Zn. supp. by copper hangers which compl. circuit when zn. is removed.
Byrne, J.	183,748	zinc.	-	-	-	cop. coated with lead and plat.	
Dechert, H. P.	184,005	-	-	-	chl. calcium.		
Van Tenac, C. L.	184,932	zinc wire.	chl. zinc.	blot. pap. or sand.	chl. silver.	silver foil.	Hard rubber ends; soft rubber sheathing.
Bastet, L.	185,160	zinc. [nit.-chr. ac.	bi-chr. pot. H_2SO_4.	porous cell.	nit chr. ac. H_2SO_4	carbon.	
Brush, C. F.	185,288	zinc.	sod. chloride.	-	oxychl. lead.	lead.	Gravity.
Parrish, M. W.	189,779	zinc.	-	-	-	cop. in two sec'ns.	Double connecting spring clips. Siphon connecting from cell to cell.
Jennison, C. R.	190,684	zinc.	acid.	-	-	carbon.	Portable battery. Commutator, etc.
Hussey, C. A.	195,762	zinc cup.	-	-	-	copper.	Plunging. Rotating plates.
Wray & Wray	197,196	-	-	-	-	-	Thermo-electric.
Hussey, C. A.	291,924	bottomless zn. cup	-	por. cell perf. bottom.	-	carbon.	Absorbent material surrounding plates.
Boekel, W.	203,405	zinc.	bichr. pot.		-	carbon.	Grenet form. Cup held by spring catches.
Cutten, E. B.	206,166	zinc.	sulp. zinc.	cloth, paper, sponge, pulp.	sulp. cop.	copper.	Tray battery; pressed together by a spring.
Griscom, W. W.	207,270	-	-		-	-	Perfluent battery. The plates form the partitions.
Lander, G.	208,614	met. sulphuret.	-	fibrous material.	-	perf. plate.	
Kreis, A. C.	210,460	zinc.	-	-	-	carbon.	Leclanché arr. Impd. clamp for carbon.
Bartlett, F. C.	210,835	zinc.	-	-	-	carbon.	Plunges by lifting trough. Water-tight cover.
Bastet, L.	211,213	zinc.	salt water.	porous cell.	mixt. carb., ant.	antimony.	
Drawbaugh, D.	211,322	zinc, felt.	earth.	-	coke.	copper.	Zinc in felt and copper in coke.
Ehrenberg, C. A.	215,899	-	urine.	-	-	-	
Wilson, W. S.	216,774	zinc, sulph. sod.	sand, per-ox. and sod. nitrate.	porous cell.	sod nitr. H_2SO_4.	carbon.	Porous cup.
Rogers, W. H.	217,023	-		-	-	carbon.	Amalgam between carbon and yoke.
Jablochkoff, P.	219,056	fused nitrates.	-	-	carbonaceous	matter.	Closed receiver for gases emitted.
Hopkins, G. M.	219,477	zinc.	-	cell porous half way down.	-	copper.	Liquid raised by plungers into contact with plates.
Fitch, D. H.	219,631	zinc.	merc'c, merc's, or amm. chl.		-	carbon in merc.	Gravity.
Thomson-Houston	220,507	zinc.		copper.	-	copper.	Intermediate plate for depositing positive metal.
Anderson, R. C.	223,212	zinc.	chl. amm.	porous cell.	oxal. chrom.	carbon.	Adjustable magazine. Perforated platinum bottom.
Converse, G. A.	224,378	zinc cup.	-	cloth.	-	platinum.	Flexible cap. Zinc fits inner surface of cell.
Maynard, W.	224,343	zinc.	-	-	gran. retort carb.	platinum.	
Doyle, J.	224,404	-	-	-	-	-	Automatic supply from magazine by clock-work.
Tommasi, F.	227,076	zinc.	-	-	-	carbon.	Two-story; liq. raised by displacement; ann. groove with merc. supp. zn.
Schlumberger, R.	227,448	zinc.	sulp. ac.	-	sulp. cop.	copper.	Gravity. Inverted reservoir with two connecting pipes.
Lockwood, W. V.	227,805	zinc.	sal. am.	porous cell.	per ox. lead, H_2SO_4	carbon.	
Watts, J. H. C.	227,865	-	-	-	-	-	Battery case.
Bartlett, S. H.	228,972	-	-	-	-	-	Plates in upper cell sep. from lower chamber by plugged partition.
Bartlett, S. H.	328,973	-	-	-	-	-	Cell slides vertically in a reservoir and has valves below.
Hardy, M. A.	229,122	-	-	-	-	-	Liquid forced up into cells by pneum. pressure from reservoir below.
Cheever, J. H.	233,601	zinc.	hydr. chl. ac.	porous cell.	chl. calc., coke.	carbon.	The coke and chl. calc. in alternate layers in the sealed porous cup.
Leclanché, G. L.	234,413	zinc.	chl. am.	-	per ox. mang.	carbon.	Conglomerate negative containing salt.
Delafield, A. F.	237,830	zinc box.	-	-	-	copper spiral.	Negative rotated by a crank. Single fluid.

GALVANIC BATTERIES. LIST OF BRITISH PATENTS.

Name.	Date.	Number.	Positive. Metal.	Positive. Liquid.	Partition.	Negative. Liquid.	Negative. Metal.
Kemp	1828	*	fluid amalga	m of zinc.	–	–	–
Becquerel	1829	*	zinc.	sulp. acid.	Gyps., porcel. clay with sea salt.	salt of copper.	copper.
Daniell	1836	*	zinc amalg.	sulp. acid.	ox gullet.	sulp. copper.	copper.
Mullins	1836	*	zinc.	chloride am.	membrane.	sulp. copper.	copper.
Grove	1839	*	zinc amalg.	sulp. acid.	membrane.	nitr. acid.	platinum.
Spencer	1839	*	zinc.	sulp. zinc.	brown paper.	sulp. copper.	copper.
Jacobi	1840	*	zinc.	sulp. acid.	thin earthenware.	sulp. copper.	lead or cu.
Bunsen	1842	*	zinc amalg.	sulp. acid.	porous cup.	nitr. acid.	coke.
Grove	1842	*	platinum.	oxygen.	acid. water.	hydrogen.	platinum.
Roberts	1842	*	zinc amalg	sulp. acid.	–	–	cast iron.
Wöhler & Weber	1842	*	iron.	dil. sulp. acid.	porous cup.	strong nit. ac.	iron.
Walenn	1849	*	zn. lead, mer.	sulp. acid	–	sulp. iron.	cast iron.
de Moleyns	1841	9,053	zinc.	ammon. chl.	sycamore. –	nit. am. sulp. acid.	platinum.
Leeson	1842	9,374	zinc or plat.	bye-products nitric acid.	porous cup. –	sulp. pot., etc.	platinum.
Bain	1843	9,745	zinc.	earth.	earth.	earth.	copper.
Piaget	1846	11,448	zinc amalg.	sulp. ac., salt water.	porous cup.	nitric acid.	charcoal.
Brett & Little	1847	11,576	zinc.	–	sand.	–	copper.
Weare	1847	11,776	perf. zinc, zinc amalg.	–	sponge, sand.	chl. calc.	cop. coke.
Highton	1848	12,039	zinc.	ammon. salt.	–	amm. salt.	copper.
Staite	1848	12,212	liq zn. amalg. in a bag, lead.	nit. or act. ac.	–	–	–
Petrie & Staite	1849	12,772	{ zinc. Wire gauze	hydro chl'ate am., nitr. pot. or punctured	porous cup. plates.	nitric acid.	carbon.
Petrie & Staite	1849	12,847	zinc amalg.	sulp. acid.	thread, asbes., gyp.	bichr. pot.	platinum.
Pulvermacher	1849	12,899	zinc.	sulp. acid.	clay, graphite and sal. amm.	nitric acid.	–
Highton	1850	12,959	zinc.	alum; soluble earthy sulph.	–	–	copper.
Weare	1850	13,142	– gold.	– (dry pile.)	sand, sponge, etc. thin paper.	chl. calc. (dry pile.)	elec. copper. plumbago.
Greenough	1851	13,613	zn. U-shaped.	–	–	–	carbon on iron plates.
Roberts	1852	13,963	tin.	aq. regia. nit. ac. or salts.	–	nit. ac. or nitrates.	platinum.
Roberts	1852	14,198	lead.	sulp. acid.	–	nitric acid.	–
Jackson	1852	14,330	–	–	fabric.	–	–
Petrie	1852	14,346	{ zinc. Decomposa-	sulp. acid. ble nitrogen-	– ous matter.	nitr. silver.	glass plate graphited.
Slater & Watson	1852	595	{ zinc.	ferrocy. pot. sulp. acid.	–	nitric acid.	iron.
Slater & Watson	1852	595	zinc.	chrom. pot. nit. sulp. ac.	–	chrm. pot.	platinized lead
Slater & Watson	1852	–	zinc.	cyanogen or chrom. salt.	–	nitr. iron	iron.
Desvignes & Kukla	1853	169	lead, zn., tin.	salt.	–	nitric acid.	antim. alloys, rare metals.
Straite	1853	634	lead alloys, anti., zn., tin.	–	–	–	carbon and plat. gauze.
Fuller	1853	944	zinc.	sulp. acid.	–	–	powd. graph.
Fontainemoreau	1853	1,785	zinc.	–	–	–	charcoal.
Fontainemoreau	1853	2,003	zinc.	H. Cl.	–	chl. gas.	carbon.
Meinig	1853	2,361	Antimonic,	phosphoric, or	arsenic acids with	powdered glass	or starch.
Dering	1853	2,486	zinc.	salt.	–	acet. lead.	lead.
Weare	1854	629	zinc.		glue, paper, porous cement, sponge.	–	–
Archereau	1854	713	–	–	partly impervious conden. graphite.	–	–
Archer	1854	1,575	uses spoiled	or impure acid	s, etc.	–	–
Harrison	1854	1,714	sodium, zinc, and mercury.	hypochlorous acid.	asbestos.	–	platinum and iron alloy.
Callan	1854	1,920	zinc coated with mercury, tin, and lead.	carb. sulp. or	phos. sod. permang. or arsen. pot.	sulp. iron.	cast iron.
Callan	1854	2,455	iron and zinc	partly covered	with caoutchouc.	pyrolig. mang. acid.	
Varley	1854	2,555	zinc.	sol. of zinc.	layer of cloth.	neg. salt.	copper.
Johnson	1854	2,556	zinc.	water.	sand.	sulp. cop.	copper.
Frascara	1855	1	cast iron.	–	paper.	–	coal.
Fontainemoreau	1855	148	zinc.	H. Cl.	–	hypochl. lime.	carbon.
Fontainemoreau	1855	1,649	zinc.	chl. sod.	paper gun-cotton.	nitr. soda and H_2SO_4	carbon.
Derring	1855	2,662	–	–	–	H. Cl & crys. nitr. soda.	copper, granl. platinum.
Puls	1856	755	iron.	acid.	–	acid.	carbon.
Doat	1856	987	mercury.	iodid. pot.	–	iod. pot. and iodine.	carbon.
Derring	1856	1,546	zinc, iron.	nit. ac. & H_2	SO_4.] –	–	cast iron, carb

* Not patents, but discoveries.

GALVANIC BATTERIES. LIST OF BRITISH PATENTS (*Continued*).

Name.	Date.	Number.	Positive.		Partition.	Negative.	
			Metal.	Liquid.		Liquid.	Metal.
Fontainemoreau	1856	2,290	rolled zinc.	sulp. pot.	-	-	copper.
Cumins & Hunter	1857	680	zinc.	-	-	-	steel.
Pulvermacher	1857	2,411	zinc.	bi hr. and bi-sulp. pot, salt.	-	-	carbon.
Burleigh & Danchell	1857	3,164	-	-	-	-	carbon, gummy cement.
Weare	1858	165	zinc.	chl. calc.	board.	chloride cop.	copper.
Hunt	1858	282	-	-	graphite cell.	nitric acid.	-
Newton	1858	296	aluminium.	sulp. acid.	cup.	nitric acid.	carbon.
Mennons	1858	805	lead.	sulp acid.	cup.	nitric acid.	carbon.
Hipp	1858	2.187	zinc.	chl. zinc.	sawdust.	sulp. cop.	copper.
Mennons	1858	2,439	zinc wire.	-	-	-	copper wire.
Meidinger	1858	2,818	zinc.	sulp. zinc.	-	sulp. cop.	copper.
Marçais	1858	2,888	zinc amalg.	sulp. mercury, sulp. acid.	-	bichr. pot.	metalized carbon
Barclay	1858	2,937	zinc wires.	-	earth.	-	copper wire.
Newton	1859	1,696	insulat. amag. on zinc.	-	cup, partly impervious.	nitric acid.	two platinum plates
Beardmore	1859	1,896	plates of an	earth battery	in deliquescent salts.	-	
Siemens	1859	2,503	zinc.	-	paper pulp; sawdust.	sulp cop.	copper.
Mennons	1859	2,922	zinc.	-	-	sulp. lead.	tin.
Vergnes	1860	211	zinc.	-	-	nitr. ac. in oxygen.	platin. coke.
Mapple	1860	486	-	-	carbon pot. coated inside with platin.	-	-
Silver & Barwick	1860	994	-	-	gum and gypsum.	-	-
Morris & Mapple	1860	1,515	imbedding car	bon in the sur	faces of glass vessel	s.	
Thomson & Jenkin	1860	2,047	zinc.	sulp, acid.	sawdust.	sulp. cop.	copper.
Hirsch	1861	1,147	earth battery.	-	-	-	-
Callaud	1861	1,503	zinc.	sulp. acid.	-	sulph. of protox. merc.	carbon.
Tolhausen	1861	2,127	uses chlor-hy	drate and oleic	acid.		
Morris *et al.*	1861	2,298	zinc.	sulp. acid.	wood or bar	chl. nat. sod.	oxide copper. copper ore.
Henley	1861	2,464	zinc in merc.	sulp. acid.	-	-	rough copper electro silv'd.
Pulvermacher	1861	2,656	zinc wire.	acid.	thread.	acid.	copper wire.
Dickson	1862	340	iron, zinc, lead, carbon.	sulp of alk. and earths.	double porous cen.	acids charged with chl. gas.	sub-sulp. cop. platin. iron.
Cook	1862	1,550	zinc.	water.	sand.	sulp. cop.	copper.
Stillé	1863	1,732	zinc.	chl. or nitr. pot.	charcoal and tan.	nitr. ac.	cast iron or carbon.
Varley	1865	619	zinc.	H_2SO_4.	oxi. or carb. zinc.	sulph. cop.	copper.
Piggott	1865	2,218	zinc.	-	chl. calc.	-	carbon.
Moseley	1865	2,421	zinc.	persulp. mer.	-	-	carbon.
Horwood & Brumfit	1866	338	covers liquids	with grease or	oil -	-	-
Leclanché	1866	670	zinc.	hydrochl. am.	sand. -	oxide of cop. carb. cop.	copper.
Carlier	1866	947	-	-	-	-	carbon and paraffine.
Martin & Varley	1866	966	the cells are	lined with resi	nous cement and ac	id sawdust.	-
Leclanché	1866	1,537	zinc.	hydrochl. am.	porous cell and sand.	perox. mag hydrochl. am.	graphite.
Leclanché	1866	2,623	zinc.	hydrochl. am.	sawdust	perox. mag hydrochl. am.	graphite.
Rowland	1868	2,836	magnesium.	sulp. magn.	porous cell.	sulp. cop.	copper.
Gedge	1868	1,258	mercury.	hydrochl. ac., chl. pot.	-	-	-
Lyttle	1868	3,129	aux. zinc.	-	clay and ox. zinc.	-	-
Lyttle	1869	1,250	zinc.	-	binox. merc. sal am.	-	copper.
Abel	1869	1,441	-	saline sol.	porous cell partly vanished.	$H_4 So_4$. bichr. sulp. iron	pot: proto. sulp. sod.
Smithers	1869	2,003	-	-	-	chloride lead.	-
Faure	1869	3,324	-	-	clay and powdered graphite.	-	-
Webers	1870	1,055	zinc.	Na. cl. or NH_4 cl.	sawdust.	perox. mang.	calcined carbon.
Fitzgerald	1870	3,308	zinc wire.	am. NH_4 cl.	paper or plaster.	lead binoxide, copper oxide, silver chl.	brass or silver vessel.
Newton	1871	974	zinc.	the sea.	-	-	copper, etc.
Lyttle	1871	1,535	zinc.	-	porous cell.	sal. amm. binox. mang.	graphite.
Highton	1871	1,643	-	-	-	-	carbon or plat. with broken cinders.
Lake	1871	2,219	zinc.	bichr. pot., lime, H_2SO_4.	-	-	carbon.
Newton	1871	2,759	zinc.	bich. and nit. pot.	-	-	carbon.
Lake	1871	3,366	zinc.	water.	-	sulp. merc. bl. ox. mang.	platinum.

GALVANIC BATTERIES. LIST OF BRITISH PATENTS (*Continued*).

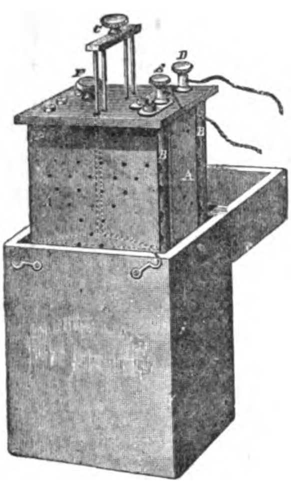
Name.	Date.	Number.	Positive.		Partition.	Negative.	
			Metal.	Liquid.		Liquid.	Metal.
Highton	1872	485	zinc.	nitr. sod.	–	salt of amm. & bi-tart. pot.	copper.
Graham	1872	807	zinc.	sulp. zinc.	parchment paper.	sulp. cop.	copper or lead.
Figatnee	1872	1,596	zinc.	feces.	lime or plaster.	–	copper.
Highton	1872	1,638	zinc.	bisulp merc.	–	carbon mang. perox. sulp. cop. amm.	carbon sulph.
Owens	1872	3,672	–	–	–	carb mang. chrom. ac. crys.	carbon.
Weber	1873	1,270	zinc.	chl. amm.	porous cell.	carbon and carburet iron.	iron.
Varley	1873	2,232	zinc.	sulp. zinc and H_2SO_4.	capillary siphon.	sulp. cop.	copper.
Fréret	1873	2,956	zinc.	bichr. pot.	porous cell partly varnished.	sulp. iron.	iron.
Verdeau	1874	3,943	iron wire.	H Cl.	porous cell.	monohydrate sulp. ac. urine nitric acid.	coke.
Bennett	1874	1,255	zinc.	sod. and pot. hydrate	diaphragm.	caustic soda. perox. mang.	graphite.
Smith	1874	3,222	zinc.	alkaline chlo. and hydrates.	–	–	carbon.
Clark	1874	3,420	zinc.	amm. salt.	–	hydrated sesqui-ox. iron.	–
Bonneyville	1874	4,453	–	sulp. acid, sulp. pot.	–	–	–
Elcock	1875	807	–	–	–	–	clay and sawdust charred.
Bennett	1875	1,169	zinc.	hydrate or protox. pot.	–	carb. mang. nitr. cobalt. pyrogallic ac.	pt. c. au co. ag. ni. fe.
Cerpaux	1875	4,289	zinc.	urine, Na. ch.	wood; sand.	–	copper.
Darkin	1876	52	–	–	–	bichr. pot.	broken graph.
Lake	1876	524	zinc.	–	paper, felt. cloth, tinder.	sulph. cop.	copper.
Pulvermacher	1876	1,900	zinc.	pulv. salt of amm.	carbon vessels.	–	platin. black.
Pulvermacher	1876	3,782	zinc.	salt.	parchment paper.	perox. mang. chl. of silver or chl. plati.	carbon.
Jablochkoff	1877	492	–	–	–	fused nitr. sod. or pot.	carbon.
Brain	1877	1,116	iron.	H. cl. chl. am.	iron ore in flannel bag paraffined.	acid.	carbon.
Varley	1877	1,702	zinc.	H_2SO_4.	porous cell.	granular graphite oxide mang.	carbon.
De Sussex & Brasseur	1877	2,194	zinc.	sea water.	–	–	carbon.
Watteville	1877	2,318	zinc, merc.	–	–	bichr. pot. ox. iron ag. cl.	carbon.
Arns	1877	2,892	zinc.	bichr. pot.	hard sandstone.	–	–
Coxeter	1877	2,997	zinc.	–	water-proof fabric.	powd. carbon. perox. mang.	copper.
Roberts	1877	4,803	zinc 8, merc. 1.	–	–	–	–
Wilson	1878	719	zinc.	Na. cl.	sand. chlorates, pot. nitr., ox. mang., in porous cell.	H_2So_4.	carbon.
Grabinger	1878	1,522	–	sulp. amm.	–	pulv. mang.	–
Fuller & Higgins	1878	3,367	amag. iron.	–	–	–	–
Adams	1878	3,718	zinc.	Na. cl.	porous cell.	chl. lime.	carbon.
Wilson	1878	4,348	iron.	nitr. and sulp. sod.	–	–	–
Slater	1879	477	nickel.	acid.	sesquicarb. of amm. in porous cell.	sulp. nickel and amm.	carbon.
Howell	1879	1,015	zinc, merc.	amm. hydro. sulp.	sulp. or nitr. acid in porous cell.	white mang. perox. mang.	charcoal.
Carlson	1879	2,905	zinc.	chl. amm. or bichr.	paper, felt, flannel.	–	copper.
Morgan & Brown	1879	3,410	zinc.	vinegar.	–	–	iron filings, graphite.
Anderson	1879	3,486	zinc.	H_2SO_4.	–	oxal. ac. bichr. pot. and acid or salt.	carbon.
Imray	1879	3,858	zinc.	bichr. pot.	water in porous cell.	acid.	carbon.
Gutensohn	1879	3,943	–	–	–	sulp. nitr. chl. or chrom. tin.	
Anderson	1879	4,346	–	–	–	sulphur H cl. perox. mang.	

Gal-va'no Caus'tic. (*Electricity.*) An electro cautery. See p. 179, *supra*.

Gal-va'no-cau'te-ry Bat'te-ry. (*Surgical.*) For performing cautery by means of the heated platinum wire.

Fig. 1128 is Dr. Dawson's depolarizing battery, which is composed of two cells, in each of which are two positive (zinc) and one negative (platinum) plates, all measuring 4½" by 6". The zincs (*A*) are perforated, and adjusted ½" apart, and between them a platinum plate is placed and held in position by uprights (*B*). On each side of the platinum plates are hard rubber or celluloid pumps or agitators (*C*), worked by means of a small knob. *D* and *E* are the connecting screws, and *F* a knob for lifting the elements out of the cells. The battery requires 2¼ pints of fluid, the action being prolonged by the moving up and down of the pumps (*C*), more or less quickly, according to the intensity of the heat desired. By this action the old and exhausted fluid between the plates is thrown out through the perforations, and fresh fluid is made to take its place.

Fig. 1128.



Galvano-Caustic Battery.

See CAUTERY ELECTRODE.

See also *Dr. J. H. Thompson's* report on Group XXIV., vol. vii., "*Centennial Exhibition Reports*," p. 53 *et seq.*

Gal-va-nom'e-ter. An instrument for measuring the force of an electric current.

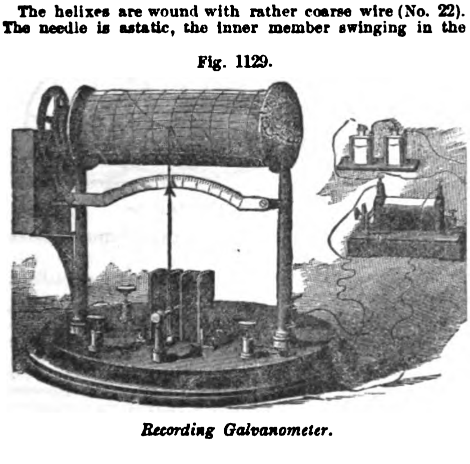
The reflecting galvanometer of Sir William Thomson is used in working submarine cables. In the astatic form it is used as a receiving instrument, placed in a box or curtained apartment, and the receiver calls off each word to an attendant who writes it down. The spot of light wanders over the scale in an apparently aimless manner, but the operator, by practice, interprets the motions.

The *siphon recorder* is a substitute for the reading of the vibratory pencil of light.

The recording galvanometer of Hopkins, shown in Fig. 1129, proceeds by the application of a disruptive spark from an induction coil.

The helixes are wound with rather coarse wire (No. 22). The needle is astatic, the inner member swinging in the

Fig. 1129.



Recording Galvanometer.

central opening in the helixes in the usual way, the outer member being located behind the helixes. The arbor supporting the needle has very delicate pivots, and carries a long aluminium index, which is counterpoised so that it assumes a vertical position when no current passes through the helixes, and the needle is unaffected by terrestrial magnetism.

The upper end of the index swings in front of a graduated scale, and is prolonged so as to reach to the middle of the cylinder carrying a sheet of paper upon which the movements of the needle are to be recorded. This cylinder is of brass, and its journals are supported by metal columns projecting from the base upon which the other parts of the instrument are mounted. The scale is supported by vulcanite studs projecting from the columns, and to one of the latter is attached a clock movement provided with three sets of spur wheels, by either of which it may be connected with the arbor of the cylinder. One pair of wheels connects the minute-hand arbor of the clock with the cylinder, revolving the cylinder once an hour; another pair of wheels connects the hour-hand mechanism with the cylinder, so that the latter is revolved once in twelve hours; while a third pair of wheels give the cylinder one revolution in six days.

This instrument is designed especially for making prolonged tests of different batteries in order to determine the characteristics. It is provided with four binding posts, one of which connects the wires of the batteries under test with the helixes. The other binding posts are connected respectively with the posts supporting the needle and with the journals of the recording cylinder. These posts receive wires from an induction coil capable of yielding a spark from ⅛" to ½" long.

The induction coil is kept continuously in action by two Bunsen elements and a stream of sparks constantly pass between the elongated end of the index and the brass cylinder, perforating the intervening paper and making a permanent record of the movement of the needle.

The paper upon which the record is made is ruled in one direction into degrees and in the other into hours and minutes. Refer to: —

Internal current, *Cooke*	* "*Engineering*," xxviii. 201.
Mirror, *Delafield* . . .	* "*Scientific American Sup.*," 2008.
Deprez	* "*Scientific American Sup.*," 3887.
Edison	* "*Scientific American*," xli. 239.
Astatic, *Faraday* . .	* "*Engineering*," xxiii. 91.
Reflecting, *Thomson* .	* "*Engineering*," xxiii. 62.
	* "*Scientific American Sup.*," 205.
Lantern, *Nipher* . . .	"*Scientific American*," xxxiv. 129.
Recording, *Hopkins* .	* "*Scientific American*," xliii. 271.
Paper on	* "*Engineering*," xxiii. 61, 91.
For testing lightning-rods, *Büchner* . .	"*Technologiste*," xxxvii. 327.

Gal-va'no-plas-tique'. 1. (*Bronze.*) A particular kind of bronze work produced by depositing a heavy coating of bronze by the galvanic process upon a plaster of paris model, and afterward removing the model.

2. (*Glass.*) M. Alexander's process rests on the application of electro-metallurgy to the decoration of glassware, mirrors, etc., either for the exterior or interior decoration of houses, furniture, etc.

The substance which serves for tracing the design on the glass is a metallic paste of good conducting power, mixed with a solvent and thinned with an essential oil. The design once executed on the glass, the latter is submitted to the action of fire in either a muffle or a furnace, and is not withdrawn until perfectly cold.

The glass is then immersed in a metallic bath and a galvanic current passed over it; by this means the metal in suspension in the bath is precipitated on the design. The glass is withdrawn as soon as the coating becomes as thick as required. Finally, if necessary, the metallic design is finished up by chiseling or other means, and is left thus; or, indeed, another layer of a like or different metal may be deposited on it. — "*Moniteur de la Céramique*."

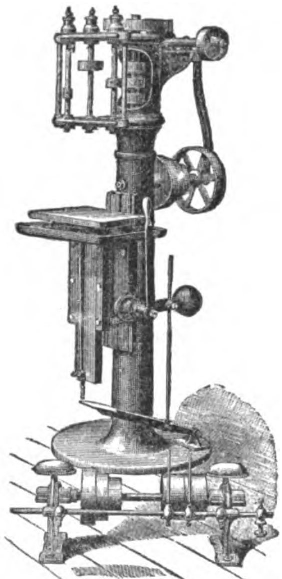
See also ELECTROTYPE.

Laboulaye's "*Dictionnaire des Arts et Manufactures*," caption "*Galvanoplastic*," vol. ii.

"*Scientific American*" . . . . xxxix. 136.

Gang. (*Sawing.*) *Round* and *live* gang are synonymous, one being the Eastern and the other the Western term for the same thing. It means such an arrangement of the saw-mill as causes the whole log to be cut up into boards at one operation. A *slabbing* gang is one by which from only the two sides of a log slabs are cut off, while the middle part remains as a thick beam. When the log is carried forward on a carriage termed a *saddle*, it is called a *saddle slabber*. After a beam has been flattened by passing through the *slabber* gang, it can be sawn into boards of equal width in the *flat* gang, when it will be straighter than if sawn only on a *round* or *live* gang. A *pony* is a single or small flat gang, used for sawing thin boards out of the best quality of timber.

Fig. 1130.



Gang Drill.

Gang Drill. A machine-tool having a number of vertical drills in a single head, each with its own belt and pulley from a common shaft, and with speed pulleys common to the gang.

The Pratt & Whitney gang drill is shown in Fig. 1130, without bands to the drill spindles, which are three in number. The counter shaft is shown detached, lying in inverted position upon the floor. The bench has vertical adjustment, and a certain amount of traverse by means of a treadle.

* *Thurston's "Vienna Report,"* ii. 223.

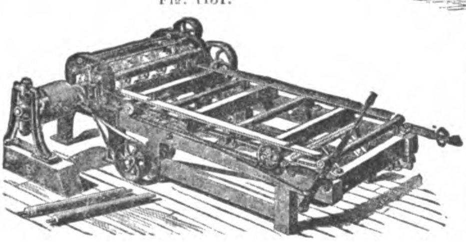
Gang Edg'er. A machine with a number of circular saws on a common mandrel, and adjustable as to relative distance, so as to split wide planks, etc., into boards or scantling of the desired width. The saws are from 3 to 6 in number.

In the Lane & Bodley gang edger the saws are not held on the mandrel by grooved collar and fork but by guide fingers on opposite sides of the saw; the guides have adjusting screws at the opposite ends of a yoke.

The stuff is fed between upper and lower rolls, the former being adjustable to admit varying thickness of stuff.

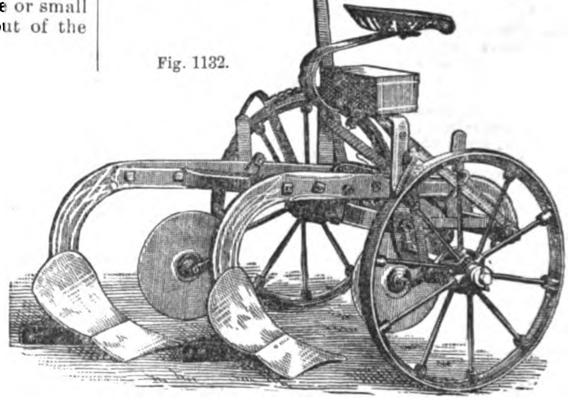
* *"Manufacturer & Builder"* . . . xi. 53.

Fig. 1131.



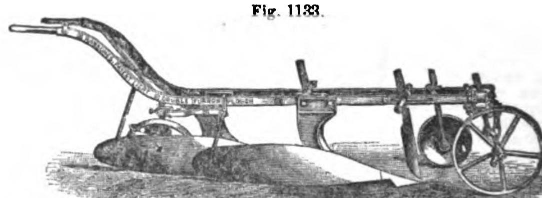
Gang Edger.

Fig. 1132.



Moline Gang Plow.

Fig. 1133.



British Gang Plow.

Fig. 1134.

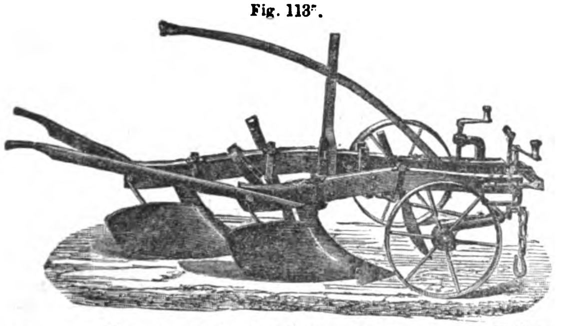
Ransome's Multiple Plow.

Gang Plow. A plow with two or more shares and mold-boards.

That shown in Fig. 1132 is the Deere gang-plow (Moline), which is all of iron and steel.

The plows are rigidly connected, rock upon the axle, and are operated by one lever. It is run by either three horses abreast, or four horses strung out in pairs, or any larger number in pairs, one wheel in the furrow. The plow is operated entirely by one lever, which locks the plows in the ground at various depths; and the same lever, in connection with a lug on the hub, lifts the plow clear of the ground for turning at the ends, without any effort of the operator. The tongue and clevis are attached to the beams by a swivel bolt,

Fig. 1135.



Meixmoron de Dombasle's Gang Plow.

giving it a free vertical motion, relieving the horses' necks of all pressure, and affording a natural draft from the ends of the beams, and from the end of the tongue.

It received a gold medal at the Paris Exposition of 1878, after the trial at Marmont, near Paris, the same summer.

Fig. 1133 is a British gang-plow, shown in two positions; the lower one illustrates the means for allowing it to travel on the surface of the ground without penetrating, in moving to and from the field and turning at the ends of the lands. Of its three wheels, one is for gage of depth; one to run in the furrow and support the plow behind the share, reducing the friction; and the third is only used to support the fore end of the plow in turning, while the rear end is supported by the stirrup-shaped piece.

Fig. 1134 is Ransome's multiple plow with three shares. The body is of the usual British type, an open frame of bar iron to the beams of which the plow standards are bolted. A single handle projects at the rear, and the depth of the furrows, or the complete removal of the plows from the soil is accomplished by a lever which governs the crank-axle of the carrying wheels, elevating or depressing the plow frame and bodies simultaneously.

Fig. 1135 is the *bisoc* of Meixmoron de Dombasle, of Nancy, France. It is composed of two plows attached to a single frame (*avant train*), which is supported by wheels, and carries the clevis, which has adjustments for land and for depth. The axle of the fore-carriage carries a long lever, projecting upward and rearward, and by the depression of the upper end the crank axle is rotated, throwing the wheels forward and lifting the front end of the plow, so that the shares leave the ground. This is used in turning at the end of a furrow, and also as a means of setting the plow for any given depth, pins on the vertical post holding the lever at any inclination. It received a gold medal at the trials at Marmont, near Paris, Exposition of 1878.

American, British, and French, * *Knight's Report*, "*Paris*, Paris, 1878 . . . . *Expos. Repts.*," v. 28–49.
* "*Sc. Am.*," xxxix. 163.
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Howard, Br. . . . . * "*Eng'ing*," xxvi. 471.
* "*Sc. Am.*," xxxviii. 409.
Ransome, Br. . . . . * "*Eng'ing*," xxvii. 436.
Stanley . . . . * "*Sc. Am.*," xlii. 306.

Gang Press. One for operating upon a pile or row of objects in a gang.

Seen in some forms of oil and stearine presses; see also FILTER PRESS, where the cases are in gangs. See also CHEESE PRESS; HOT-PRESS; HYDRAULIC PRESS.

Gang Saw. Several saws in a frame or on a spindle, acting simultaneously, either gate or circular. See Fig. 2157, p. 942, "*Mech. Dict.*" See GANG.

"The vast systems of roller gang mills in America have no parallel in the world." — *Richards.*

"A circular saw for edging and squaring, with a gang for slitting the stocks at one operation, is the equipment of a modern saw-mill. This outfit is, of course, duplicated many times in a large mill. At St. Anthony, in Minnesota, there are as many as 12 such mills in a single establishment."

"The speed of the teeth, or the number of teeth that operate in a given time, is the exponent of the performance of saws. The rate of feed varies with the timber; and saw-mills, like other machinery, are governed by mechanical laws, which admit of theoretical demonstration.

"A single reciprocating saw of 30″ stroke, 180 a minute, has a cutting movement of 450′ in the same time. In a gang of 20 saws, making in a minute 150 strokes of 24″, the cutting movement in the aggregate is 6000′ per minute." — *Richards.*

Marston . . . * "*Scientific American*," xxxvi. 6.
Snyder . . . * "*Manuf. & Builder*," xi. 175.

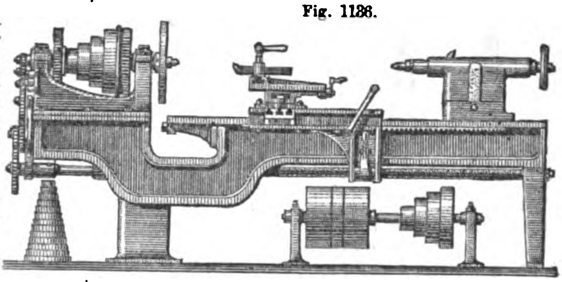
Gan'try. (*Gawntree.*) A scaffolding or frame, carrying a crane or other structure.

See TRAVELING CRANE, Fig. 6623, "*Mech. Dict.*"
OVERHEAD CRANE, Fig. 3451, "*Mech. Dict.*"
STEAM CRANE, Fig. 5652, "*Mech. Dict.*"

Gap'-bed Lathe. One with an opening in the bed or shears to allow a larger object to be turned. Technically: to increase the *swing*.

With traveling crane, *Watson* . * "*Engineering*," xxvii. 154.
* "*Iron Age*," xx., Aug. 9, p. 1.
* "*Sc. Am.*," xxxvi. 255.

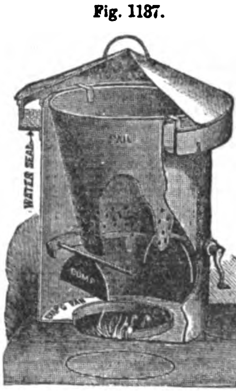
Fig. 1136.



Gap-bed Engine Lathe.

Gar'bage Burn'er. A self-sealing pail for holding kitchen garbage. It is suspended within an outer cylinder adapted to be placed on a stove, so that the garbage may first be dessicated and then dumped into the stove.

Fig. 1137.



Garbage Pail.

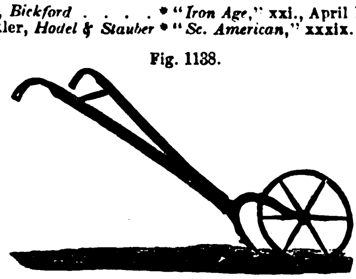
Pavement garbage box, *Jonas*, Br., * "*Engineer*," xlix. 190.

Garbage furnace, *Foote*, * "*Scientific American*," xl. 198.

Gar'den En'gine. A pump for watering the garden. See AQUAPULT, HYDRONETTE, IRRIGATOR, etc.

Pump, *Bickford* . . . . * "*Iron Age*," xxi., April 11, p. 5
Sprinkler, *Hodel & Stauber* * "*Sc. American*," xxxix. 370.

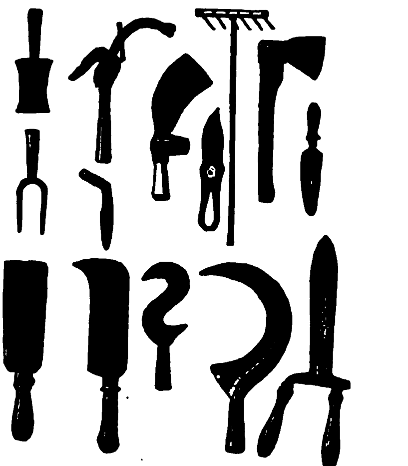
Fig. 1138.



Garden Plow.

Gar'den Net. One placed over fruit trees or vines to guard against depredation by birds.

Fig. 1139.



French Garden Tools.

Gar'den Plow. A small hand plow for cultivating vegetables in rows. It has a variety of hoes. See Fig. 1138.

Gar'den-ers' Tools. Fig. 1139 shows a variety of French garden tools: for digging, cultivating, trimming, pruning, and transplanting.

Gar'den Syr'inge. See AQUAPULT; IRRIGATOR; SPRINKLER, etc.

Gas. See under the following heads: —

Air-gas apparatus.
Back log.
Bye-pass.
Carburetor.
Coke fork.
Coke manufacture.
Compensator.
Consumers' test meter.
Double-gate valve.
Exhauster.
Exhauster governor.
Fire-damp detector.
Fire-damp photometer.
Fire-damp test.
Gas absorber.
Gasalier.
Gas analyzer.
Gas and coke furnace.
Gas apparatus.
Gas bag.
Gas bath.
Gas blow-pipe.
Gas burner.
Gas burner regulator.
Gas compensator.
Gas compressing pump.
Gas condenser.
Gas detector.
Gas drip pump.
Gas economizer.
Gas engine.
Gas exhauster.
Gas exhauster governor.
Gas-fitter's torch.
Gas furnace.
Gas generating furnace.
Gas governor.
Gas grate.
Gas heater.
Gas holder.
Gas indicator.
Gas lantern.
Gas lighter.
Gas light governor.
Gas lighting.
Gas lighting torch.
Gas liquefaction apparatus.
Gasing machine.
Gas machine.
Gas-main drill.
Gas making.
Gas meter.
Gas meter cock.
Gas oven.
Gas pipe.
Gas pipe connection.
Gas pipe valve.
Gas pressure gage.
Gas process.
Gas producer.
Gas prover.
Gas purifier.
Gas range.
Gas regulator.
Gas soldering apparatus.
Gas stove.
Gas tar pump.
Gas tester.
Gas trap.
Gas tube vise.
Gas valve.
Gas verifier.
Grisoumeter.
Illuminating power meter.
Jet photometer.
Nitrogen gas apparatus.
Nitrous oxide apparatus.
Overflow gage.
Oxygen gas apparatus.
Ozone apparatus.
Ozonizer.
Photometer.
Pressure and vacuum gage.
Pressure and vacuum register
Red litmus paper.
Retort furnace.
Scrubber.
Siphon gage.
Specific gravity apparatus.
Station meter.
Steam jet exhauster.
Sulphur and ammonia test.
Tell tale.
Tempering Gas heater.
Test meter.
Thermometer.
Turmeric paper.
Water gas.

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	"*Scientific American Sup.*," 2757.
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Schwackhoefer, Austr.	* "*Engineer*," xlv. 95.
Apparatus, *Lowe* . . .	* "*Min. & Sc. Press*," xxxvii. 137.
	* "*Eng. & Min. J.*," Nov. 20, 1875.
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Melville	* "*Amer. Gas-light Jour.*," July 3, 1876, p. 9.
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Burner	* "*Scientific American Sup.*," 2772.
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	* "*Scientific American Sup.*," 3963.
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	* "*Scientific American*," xxxiv. 211.
	* "*Engineer*," xliii. 170.
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	* "*Scientific American Sup.*," 1507.
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Bischoff	"*Van Nostrand's Mag.*," xx. 148.
	"*Iron Age*," xxii., Feb 6, p. 11.
	* "*Scientific American*," xxxix. 390.
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	* "*Scientific American Sup.*," 339.
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Clerk, Br.	* "*Engineer*," xlviii. 24.
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Gilles & Humboldt .	* "*Scientific Amer.*," xxxvii. 178.
	* "*Engineer*," xliv. 39.
Hugon, 1858 . . .	"*Vienna Exp. Rept.*," iii. A , 167.
	* "*Van Nostrand's Mag.*," xx. 148.
Hurd, Br.	* "*Engineering*," June 25, 1880.
	* "*Scientific Amer.*," xxxviii. 356.
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	"*Van Nostrand's Mag.*," xx. 148.
Mead, 1794	"*Van Nostrand's Mag.*," xx. 148.
Otto	"*Van Nostrand's Mag.*," xx. 148.
	* "*Scientific American Sup.*," 339; * 1853, * 2323.
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Symes . . . . . . "*Scientific American Sup.*," 1617.
Producers, *Bicheroux* . * "*Iron Age*," xxvii., Jan. 20, p. 1.
Parkes . . . . . * "*Iron Age*," xxvii, Mar. 16, p. 1.
Tessié . . . . . * "*Iron Age*," xxiv., Aug. 14, p. 1.
* "*Engineering*," xxix. 318.
* "*Scientific American Sup.*," 3820.
* "*Engineering*," xxviii 457.
Wilson . . . . . * "*Iron Age*," xxiv., Oct. 23, p. 1.
"*Am. Man.*," July 16, 1880, p. 12.
Ziebarth & Pulsch . . * "*Engineer*," xlv. 110.
Prover, *Goodwin* . . . * "*Amer. Gas-light Jour.*," July 3, 1876, p. 4.
Purifier, *Brown* . . . * "*Scientific American Sup.*," 2757.
Pelouze & Andouin, Fr. * "*Engineer*," xlix 350.
Still . . . . . . * "*Scientific American Sup.*," 914.

Regulator	* "*Manufact. & Builder*," x. 181.
Adams	* "*Scientific American*," xxxix. 806.
Borrodaile	* "*Engineer*," l. 218.
"Imperial" . . .	* "*Scientific American Sup.*," 1713.
Steam boilers, for,	
Martin	* "*Scientific American*," xxxvi. 262.
Schooley	* "*Engineer*," xlviii. 153.
Stott, Br.	* "*Engineer*," xlix. 210.
Retorts, setting . . .	* "*Scientific American Sup.*," 348.
Vertical, *Bennie*, Br. .	* "*Engineer*," xlii. 176.
For machines,	
Kannel & Towsley	* "*Scientific American Sup.*," 2.
Saver, *de Palos* . . .	* "*Scientific American*," xlii. 164.
Shale, from	"*Scientific American*," xxxiv. 112.
Tar pump	* "*Scientific American Sup.*," 1412.
Tester	* "*Scientific American Sup.*," 2757.
Edinburgh	"*Scientific American Sup.*," 44.
Giroud	* "*Manuf. & Builder*," viii. 262.
	* "*Scientific American Sup.*," 539.
Paper by *Harcourt*, Br.	"*Van Nostrand's Mag.*," xv. 361.
	* "*Engineer*," xlv. 240.
Newman & Duesbury, Br. . . .	* "*Scientific American Sup.*," 2177.
New York	"*Scientific American*," xxxvii. 163.
Orsat, Fr.	* "*Scientific American Sup*," 3988.
Saddler & Silliman .	* "*Engineer*," xliv. 161.
Schwackenhoefer, Austr.	* "*Engineer*," xlv. 95.
Stevenson, Br. . . .	* "*Scientific American Sup.*," 4004.
Valve	* "*Scientific American Sup.*," *1428, * 1439, * 1552, * 1584, * 1601.
Walker	* "*Journal of Gas Lighting*," 1877.
	* "*Scientific American Sup.*," 1552
Bryan, Donkin & Co. .	* "*Scientific American Sup.*," 1526.
Mann & Owen . . .	* "*Scientific American Sup.*," 1584.
Wentwood & Wright .	* "*Scientific American Sup.*," 1601.
Washer & Scrubber.	
Anderson, Br. . . .	* "*Engineering*," xxviii. 43.
Patterson, Br. . . .	* "*Engineering*," xxviii. 313.
Saville	* "*Scientific American Sup.*," 1026.
Well, "Delamater" . .	"*Scientific American Sup.*," 1267.
Papers on	"*Sc. Amer. Sup.*," 90, 439, 757.
Pennsylvania . . .	"*Scientific American*," xxxvi. 136.
Wyandotte	"*Scientific American Sup.*," 1427.
Wood, from	"*Min. & Sc. Press*," xxxvii. 98, 115.

See *Bowditch*, "*Analysis, Technical Valuation, Purification and Use of Coal Gas.*"
Colburn's "*The Gas-works of London.*"
Perkin's "*Gas & Ventilation.*"

Gas'a-lier'. An arrangement of standard or drop, with branches and burners, adapted for the consumption of illuminating gas. The word is a clumsy imitation of *chandelier*.

Gas An'a-ly'zer. An instrument for determining the presence and quantity of the gases obtained by the destructive distillation of coal.

The following gases are produced: —

Ammonia (NH_3).	Acetylene, etc. (C_2H_2).
Sulphureted hydrogen (SH_3).	Carbonic oxide (CO).
Carbonic acid (CO_2).	Light carbureted hydrogen (CH_4).
Air, or oxygen and nitrogen.	Hydrogen (H.)
Bisulphide of carbon (CS_2).	
Olefiant Gas (C_2H_4).	

The first four of these gases on the list, although often present in well-made gas, are generally considered impurities, and by right should not be there.

The first analysis is qualitative to ascertain presence, to determine the order of precedence in the removal. The apparatus admits the gas to be bubbled up through the liquid charged with reagent.

The following reagents are used in the various tests: —

1. Dilute sulphuric acid.	8. Solution sub-chloride copper in hydrochloric acid.
2. Solution nitrate silver.	9. Lime water.
3. Solution arsenious acid.	10. Red litmus water.
4. Solution iodine.	11. Solution acetate lead.
5. Bromine	
6. Solution caustic potassa.	
7. Solution pyrogallate potassa.	

See "*American Gas-light Journal*," reproduced in part in * "*Scientific American Supplement*," 1767.

Gas and Air Mix'er. An instrument designed to mix a given proportion of air with gas made from petroleum, or its residuums, or tar, oil, rosin, or any rich hydro-carbon, so as to produce the best results from the combustion of either, through ordinary gas burners. Gas 60, air 40, is the usual proportion.

Gas and Coke Fur-nace. Many attempts have been made to obtain at the same time and operation gas for lighting and coke for metallurgical operations, by coking the coal in closed furnaces, from which the gas was conducted to the hydraulic main.

Pauwels, in 1849, established an apparatus of this kind at Ivry, in the suburbs of Paris, and his plan was subsequently improved by Pérate, resulting in the arrangement now used at Vilette, Paris, and elsewhere. See Plates XVI., XVII.

The distillation chamber is constructed of brick, and is of sufficient size to contain 6000 kilos of coal. It is open at each extremity, and the sole is horizontal. The coal is brought in wagons, which run on rails placed above the battery of parallel chambers, in order to be discharged into the chamber at an opening provided in the arched ceiling. Workmen spread it evenly over the floor to the height of the springing of the arch, equal to 0.60 to 0.70 m. of depth.

The sole of the furnace is heated by the circulation of flame beneath it, and serves, while the chamber is being recharged, as a reservoir of the heat produced during the latter part of the preceding operation. There is but one fire to each chamber.

The chambers are placed side by side and are closed at each extremity by an iron door, working in fixed iron guides on the jambs of the furnace mouth, and luted with fire-clay during the operation.

The gas escapes by a pipe *T*, which pierces the vault and communicates with a general conduit, a hydraulic valve *H* preventing back-lash of gas when the chamber is opened for recharging.

The distillation of a charge, containing 5 or 6 tonnes, occupies 72 hours. When it is terminated, the doors are unclamped, the luting removed, and the hydraulic valve fastened down. The free gas in the chamber escaping around the doors is lighted, and the doors are lifted by means of a winch, which travels on rails above each face of the battery of chambers. These rails are founded on the iron stay-structure of the furnace front.

The coke is removed by a pushing apparatus which, entering at one doorway, — that to the right in the longitudinal vertical section, — crowds the coke out at the other door on to a stone or iron floor which is on a level with the sole of the coke chamber. This floor is subdivided by walls in prolongation of the divisional walls between the respective chambers, and which are about the height occupied by the coke when in the chamber. These walls form a sort of cell for the coke into which it is pushed and where it is smothered by a covering of cinders and allowed to cool for 24 hours.

The figures in Plates XVI., XVII., represent the Pauwels-Pérate system as applied at Villette, Paris.

Fig. 1140 is a vertical transverse section on the line *A' B'*, Fig. 1143, and passing through the axis of the charging hole *G* by which coal is introduced into the chamber *C*. Above it is seen the wagon *W* in which the coal is brought, and which runs upon the rails.

Fig. 1141 is a transverse vertical section following the line *A, B, C, D*, Fig. 1143. It passes through the furnace *F*, and shows the diving flues *V V*, to the flues *X X*, leading to the chimney *Y*, which is common to all the furnaces in the battery. Dampers are placed in the diving flues to regulate the draft.

Fig. 1142 is a front elevation at the end where the coke pusher is operated, the right hand in the longitudinal vertical section.

Fig. 1143 is a vertical longitudinal section through the center of the chamber and the furnace beneath. It shows the entrance conduit *G* for the coal; the pipe *T*, by which the gas escapes from the chamber and the hydraulic valve *H* which isolates the gas conduits from the chamber when the latter is recharging. *W* shows the coal wagon on the track and *W'* an empty wagon on another pair of rails. The winches, *K K*, move on their respective tracks above the front and rear faces of the battery, and serve to lift the heavy iron doors which close the ends of the chambers of distillation.

Fig. 1144, Plate XVII., is a plan passing on a line just beneath the sole of the chamber and above the furnace. It indicates the circulation of the flames under the sole. The draft passes along the center and reverts back along each side, as shown by the arrows at the end of the division walls, *M M*. *V V* are the diving flues leading to the flues *X X* and chimney, *Y*, previously mentioned. The brick pillars *a a* support the sole, like those in the Roman *hypocaustum*, which, in fact, the furnace arrangement much resembles. See Fig. 2629, p. 1160, "*Mech. Dict.*"

Figs. 1145 and 1146 show the coke discharger, the first-named figure being a plan view and the other an elevation. The discharger has two principal portions; the lower one, *P'*, resting upon several pairs of wheels, *R R*, of which one pair only is shown in the views, in order to bring the illustration within reasonable space. By means of these wheels and the rails, *T*, the coke-pusher is brought opposite to any one of

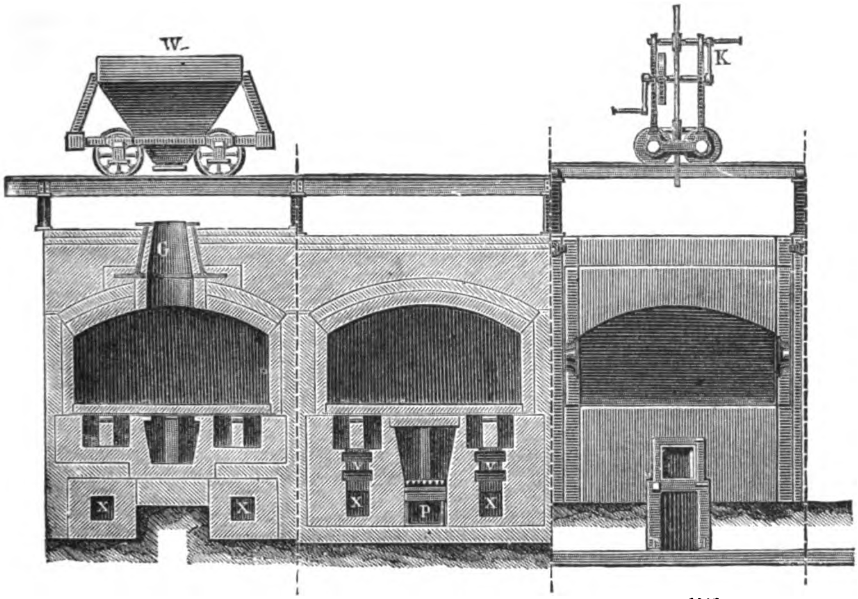


FIG. 1140. *Front Elevation*

FIG. 1141. FIG. 1142. *Transverse Vertical Sections.*

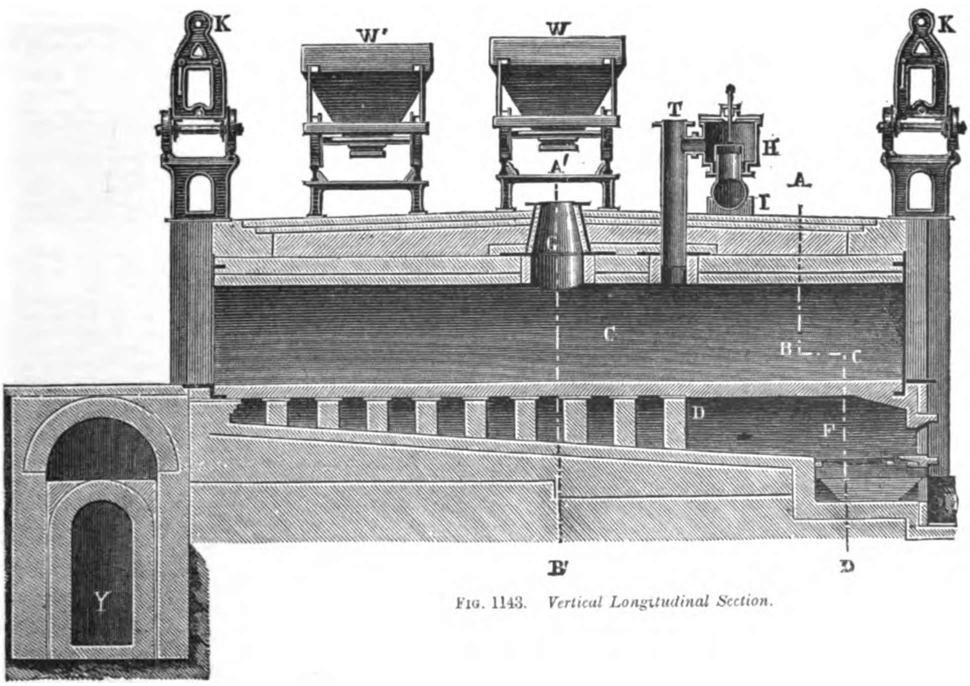


FIG. 1143. *Vertical Longitudinal Section.*

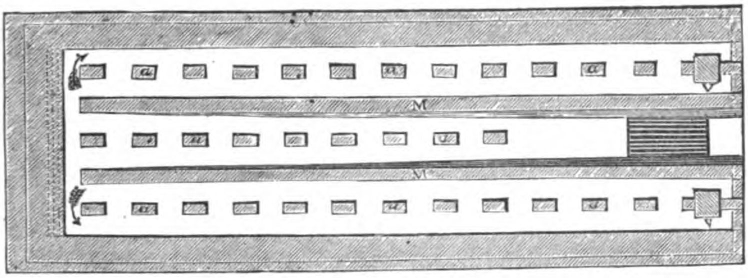


FIG. 1144. *Horizontal Section through Furnace.*

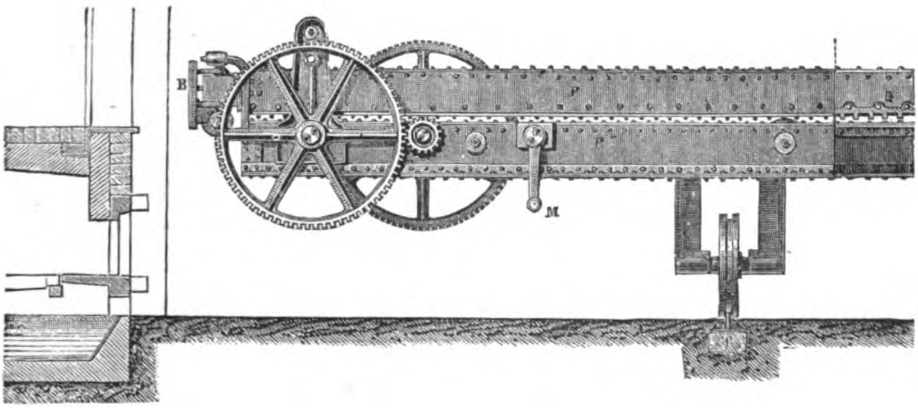


FIG. 1145. *Side Elevation of Coke Discharger.*

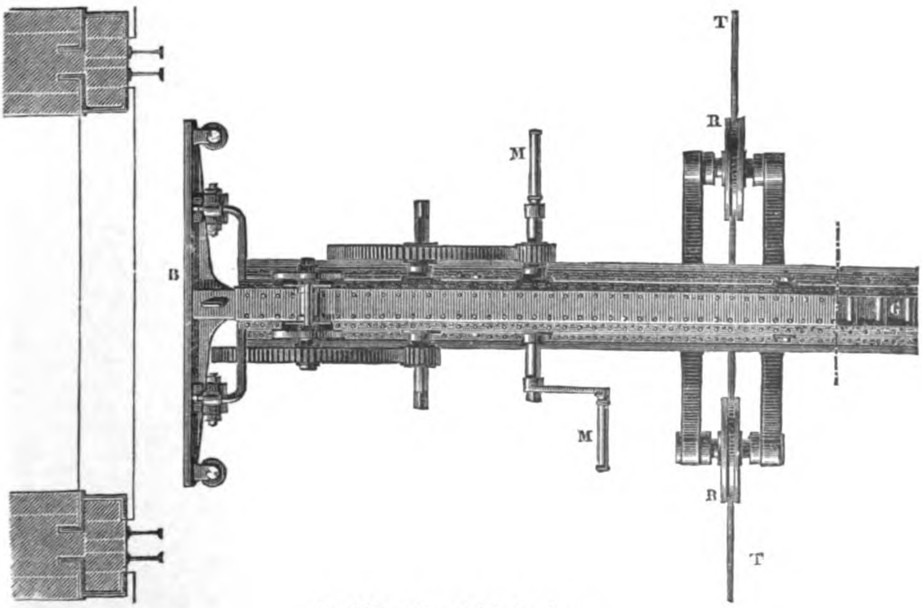


FIG. 1146. *Plan of Coke Discharger.*

the coke chambers, and, the doors of the latter being open, the upper portion, *P*, of the apparatus, armed at the end with a shield, *B*, is projected by means of the cranks, *M M*, and the gearing, acting upon a rack, *G*. The pusher, *P*, slides upon rollers on the carriage, *P′*, and the shield, *B*, has rollers at its ends which guide it in the coke-chamber to prevent its injuring the walls.

The coke oven of McLanahan & Co., Hollidaysburg, Pa., seems to be somewhat on this plan. Each chamber or oven is 22′ × 3′ and 7′ high, and a row of them looks like an arcade. The bottom and sides of the ovens are combustion chambers, in which is burned the gas liberated from the coke. The ovens are closed by iron doors at the ends.

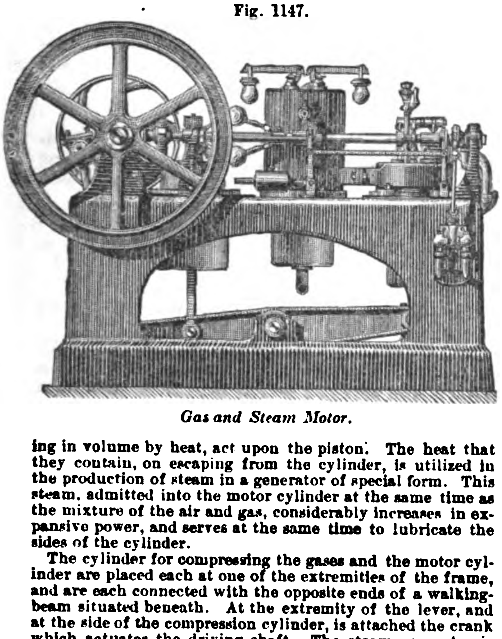
The ovens are charged by hopper-filling trucks, which run on rails above the ovens; two filling holes to each oven aid in distributing the coal. The discharge is effected by a steam ram, which moves to and fro on a railway in front of the ovens. At the end of a long rack is a head which fits the oven, and this is pushed by powerful gearing, and expels the coke at the opposite doorway, the coke being left on the cooling ground at the other side of the oven. The ram being then withdrawn, the doors closed, the covers taken from the filling holes, the oven is recharged before it has had time to cool. The charge of an oven is 8 tons, and it is coked in 72 hours, the time occupied by the ovens at Villette. The produce is 6 tons of coke.

"*Scientific American Supplement*" . . . . . . 107.

Gas and Steam Mo′tor. A machine operating through the combined forces of compressed gas and steam.

Simon's motor combines air, compressed gas, and steam The two former are aspirated and compressed in a cylinder, where they are mixed, and whence they pass into the motor cylinder above a jet of gas kept constantly burning. There they burst into flame, burn without explosion, and increas-

Fig. 1147.



Gas and Steam Motor.

ing in volume by heat, act upon the piston. The heat that they contain, on escaping from the cylinder, is utilized in the production of steam in a generator of special form. This steam, admitted into the motor cylinder at the same time as the mixture of the air and gas, considerably increases in expansive power, and serves at the same time to lubricate the sides of the cylinder.

The cylinder for compressing the gases and the motor cylinder are placed each at one of the extremities of the frame, and are each connected with the opposite ends of a walking-beam situated beneath. At the extremity of the lever, and at the side of the compression cylinder, is attached the crank which actuates the driving shaft. The steam generator is situated in the center, between the motor and compressing cylinders.

In the great variety of motors acting by expansible gases and air, the three — air, gas, and steam — have been combined in numerous ways. The history of the subject has been sketched in GAS ENGINE, pp. 947-949, "*Mech. Dict.*" See also GAS ENGINE, p. 881, *et seq.*, *infra*.

See also GAS, STEAM, AND AIR MOTOR, *infra*.

• "*Scientific American Supplement*" . . . . . 2889.

Gas and Wa′ter-tight Cloth.

A large, smooth piece of so-called gutta-percha paper is placed between two pieces of shirting, and then passed between heated rollers. The outer pieces of shirting combine in the most intimate way with the inclosed gutta-percha to form a material which is impenetrable by gas and water. It may be made still denser and more resistant by being coated on both sides with copal lac. The substance is conveniently flexible, and will remain proof against variable influences of weather and external temperature. It can be applied to all those purposes for which water-proof material is used, and it is well adapted to form gas-tight membranes for regulators of pressure of compressed gas, bags or sacks for dry gas meters, as also dry gas reservoirs. — *Dr. Hirzel*, of Leipsic.

Hirzel . . . . . "*Scientific American*," xxxix. 338.
"*Iron Age*," xxii., Aug. 1, 19.

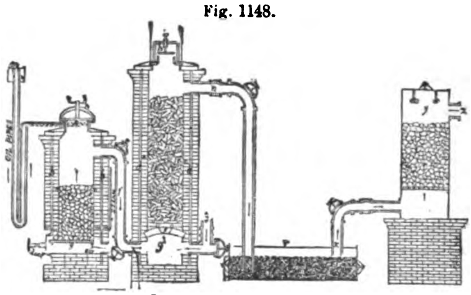
Gas Ap′pa-ra′tus. The Lowe gas-producing apparatus is shown in Fig. 1148.

Beginning on the left, the consecutive apparatus are — the generator, super-heater, washer, and scrubber.

The operation is as follows: —

The generator is kindled through door at base; charged

Fig. 1148.



Lowe's Gas Apparatus.

with anthracite from top and closed; the valve at top of super-heater being opened, and outlet at right of same closed.

Blast is applied below grate bars of generator, which, passing upward through same, and downward by connecting pipe, enters base of super-heater and passes upward through the perforated arch and the mass of loose fire-brick out into smoke-stack.

The gases thus carried from the coal into bottom of super-heater are met there and ignited by an air-blast, evolving an intense heat. When the anthracite is at cherry red, the second is white hot.

The blast is then shut off, top of super-heater closed, and its outlet opened. Hot steam is introduced below into the incandescent coal, while crude petroleum, led through trapped pipes, is simultaneously dropped thereon from above. The resulting gases pass off together into and through the super-heated fire-brick, by contact therewith being made permanent, and thence go through washer, scrubber, etc., to holder.

Melville's process, 1805-1813, is among the earliest in the history of the industry, and is shown in "*American Gas-light Journal*," • July 3, 1876, p. 9.

See CARBURETOR, GAS MACHINE, etc. See list under GAS, *supra*.

Gas Bag. (*Gas.*) A device to stop the flow of gas in a pipe or main during repairs or alterations. A hole is tapped, the collapsed bag inserted, and then inflated by means of the service cleaner or other air-pump. They are made with or without valves, either of rubber or of cloth.

Gas Bath. See BATH HEATER, Figs. 243, 244, pp. 82, 83, *supra*.

Gas Bat′te-ry. (*Electricity.*) One which has two platinum or other electrodes, one in oxygen, and the other in hydrogen, in two inverted cups, their edges submerged in acidulated water.

Invention of *Grove*. See elaborate form of the apparatus, Fig. 37, p. 2526. "*Scientific American Supplement.*"
Ganot's "*Physics*," • 1877, p. 729.
du Moncel, Paris, 1856, p. 122.
Noad, London, 1859, p. 293.

See also BEQUEREL BATTERY for his oxygen gas battery, which was the first constant battery, the first double fluid battery, and the first to use a porous cell.

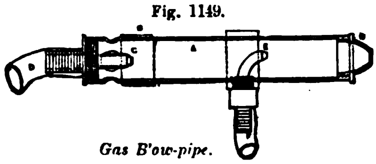
See dissertation on Gas Batteries, *Niaudet*, American translation, 242.

Gas Blow′-pipe. Fig. 1149 shows Wenham's gas blow-pipe, as adapted for the mouth blast or foot bellows.

D is the elastic pipe connecting with an ordinary gas burner, and *F* the elastic tube carrying air from the mouth or bellows. *A* is a brass tube into which the gas nipple *C* and air-jet *E* intrude. *G* is a split ferrule which slips on the tube *A* and regulates the area of air opening according to the supply of gas.

When there is a full supply of gas, and these orifices are quite open, with a strong mouth blast, the spire of flame issuing from the end at *B* will be 4″ or 5″ in length, perfectly

Fig. 1149.



Gas Blow-pipe.

stationary and quiet, and ending in a fine point. If the heat be too great for the purpose required, and the gas supply has to be turned down, the air-regulating ferrule *G* must also be drawn back, else the flame will be extinguished. When properly adjusted, either for maximum or minimum heats, this instrument in either case gives the required pointed flame, and as the orifice of the air jet at *E* is rather smaller than that generally used in an ordinary mouth blow-pipe, a continuous blast can easily be kept up without intermission.

Diameter of nozzle orifice at *B*, .23″; four openings at base, .23″; diameter of orifice gas at nipple at *C*, .07″; orifice of air or blow-pipe jet *E*, .02″.

See also BRAZING BLOW-PIPE, Fig. 421, p. 130, *supra;* and Fig. 2165, p. 946, "*Mech. Dict.*"

Gas Boil'er. 1. A form of steam boiler in which coal gas is used as fuel. In the coal and petroleum regions, especially the latter, there are instances of the escape of natural gas which are largely used in steam boilers and metallurgic furnaces. See p. 944, "*Mech. Dict.*"

Otherwise, the gas boiler is usually a small vertical boiler in which gas is used instead of other fuel, for various reasons: compactness, cleanliness, saving in insurance, convenience of starting fire, easiness of regulation. To keep the boiler at a uniform working temperature, or just to keep up steam, or draw the fire, very small amount of attendance is necessary.

Fig. 1150.

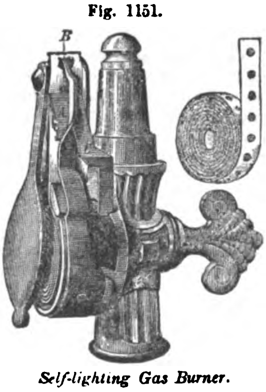
Portable Gas Boiler.

Under CROSS-TUBE BOILER, VERTICAL BOILER, suitable forms of boilers are shown.

2. A small boiler for bath, conservatory, or domestic uses. When used for green-houses it is fixed outside the house, and the upper and lower portions of the boiler are connected by wrought-iron pipes in which the water circulates, as in the ordinary water heater. In the form shown the boiler is portable, and has an enamel lining.

Gas Burn'er. Fig. 1151 is Stockwell's self-lighting gas burner. It has a chamber with a coiled strip of paper, on which are dots of fulminating compound. By turning the key, the paper coil is partly unrolled, and a pellet exposed to the action of a spring hammer at *B*, which causes a flash and thus ignites the gas instantly.

Fig. 1151.



Self-lighting Gas Burner.

A is a bent piece of metal, the lower portion of which enters a slot in the rear wall of the chamber, and has a projection below at right angles, which enters a circular hole in the disk, so that the rotating of the latter, in one way or the other, by the key, causes said piece to ascend or descend. The square upper end of the piece presses against the tape, and consequently raises and unwinds the same, as the key is turned vertically. At the same time, the piece *A* pushes back the spring hammer *B*, until the bend in the former at *C* is reached, at which point the hammer is released and carried forward by the spring, strikes one of the dots of fulminate, explodes the same, and so lights the gas. The arrangement of parts is such that the hammer does not fall until just as the key is placed so as to turn the gas fully on, which insures ignition. Each roll of tape contains 135 fulminate dots.

Chaussenot's gas-burner, adjudged the prize de la "Société d'Encouragement," 1836, is described in *Laboulaye's* "*Dictionnaire des Arts et Manufactures,*" ed. 1877, article "*Eclairage,*" tome iv.

Parissot's, ditto.

See also	* "*Scientific American Sup.*," 2772.
For heating, *Ehret* . .	* "*Scientific American Sup.*," 460.
McGeorge	* "*Scientific American,*" xliii. 312.
Self regulating, *McMillan* . . .	* "*Scientific American,*" xxxv. 4
Paper by *Pattinson* .	"*Scientific American Sup.*," 291.
Sugg, Br.	* "*Scientific American Sup.*," 3968.
Argand, *Sugg*, Br .	* "*Engineer,*" xlvii. 106.
And lantern, *Sugg*, Br.	* "*Engineering,*" xxvii. 142.
Self lighting, *Stockwell*.	* "*Telegraphic Journal,*" vi. 248
	* "*Scientific American,*" xxxiv. 211.

See also BUNSEN BURNER, p. 146, and BURNER, p. 147, *supra*, and p. 2411, "*Mech. Dict.*"

Gas Bur'ner Reg'u-la'tor. A device to cause a constant delivery to the jet notwithstanding changes in pressure in the main. It is usually a hollow cone lifted by the pressure of gas and protruding into a hole in the septum which divides the chamber from the burner.

* "*Scientific American Supplement*" 2291

Gas Check. A ring at the rear of the chamber of a cannon which prevents the escape of gas rearwardly in breech-loading guns. Also known as an *obturator*.

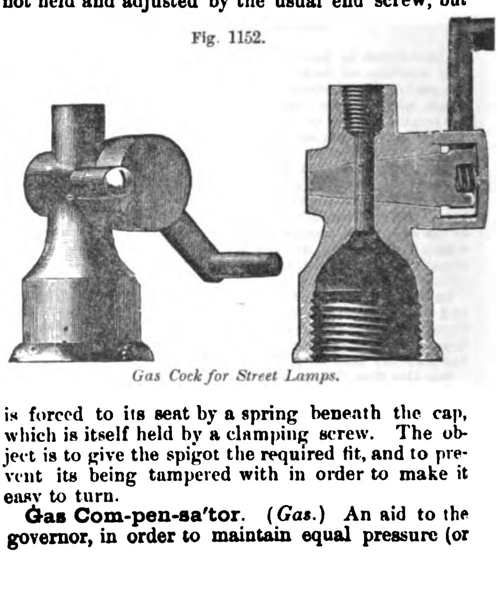
Broadwell's, Fig. 60, Appendix L, "*Ordnance Report,*" 1877, copper and steel gas check. App. II, 4 * *Ibid.*, 1879, p. 74.

* "*Engineer*" . . . . xlvi. 439.

Gas Cloth. See GAS AND WATER TIGHT CLOTH, *supra*.

Gas Cock. Fig. 1152 shows Peck's gas cock for burners of street lamps. It is conical in shape, is not held and adjusted by the usual end screw, but

Fig. 1152.



Gas Cock for Street Lamps.

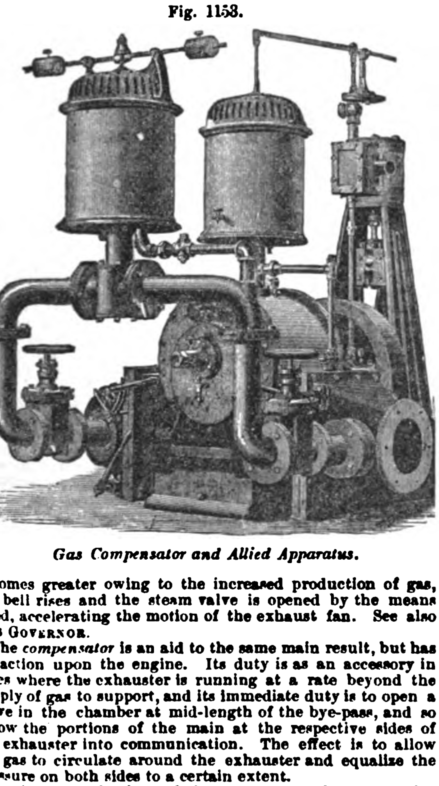
is forced to its seat by a spring beneath the cap, which is itself held by a clamping screw. The object is to give the spigot the required fit, and to prevent its being tampered with in order to make it easy to turn.

Gas Com-pen-sa'tor. (*Gas.*) An aid to the governor, in order to maintain equal pressure (or vacuum, as the case may be) in the action of the exhauster. The latter is assumed to be of a capacity in excess of the possible need, and its action under the circumstances of the varying production of gas, in different seasons, portions of the day, during the changing of retorts, etc., requires automatic compensation. For this purpose it has a *governor*, *compensator*, and *bye-pass*.

Fig. 1153 shows a convenient disposition of the whole apparatus arranged in compact form upon a single bed plate. Made on a scale for works of moderate size it occupies but 6′ × 5′ space in the exhauster room and includes engine, exhauster, governor, compensator and bye-pass.

The exhaust fan is driven by the engine on the right, the fly-wheel shown in the cut being upon the fan shaft. Above the case is the governor, in which is a bell raised by the pressure of gas beneath it and by means of the vertical stem and counterbalanced lever operating the throttle valve of the engine. When the pressure under the bell in the governor

Fig. 1153.



Gas Compensator and Allied Apparatus.

becomes greater owing to the increased production of gas, the bell rises and the steam valve is opened by the means cited, accelerating the motion of the exhaust fan. See also GAS GOVERNOR.

The *compensator* is an aid to the same main result, but has no action upon the engine. Its duty is as an accessory in cases where the exhauster is running at a rate beyond the supply of gas to support, and its immediate duty is to open a valve in the chamber at mid-length of the bye-pass, and so throw the portions of the main at the respective sides of the exhauster into communication. The effect is to allow the gas to circulate around the exhauster and equalize the pressure on both sides to a certain extent.

Passing into the base of the compensator is seen a pipe carrying gas. The weight of the bell within is compensated by the lever arms above, the weights being slipped towards or from their fulcra according to the adjustment required.

Gas Com-press'ing Pump. Pumps for condensing gas for car-lighting purposes are used by the Pennsylvania Railway, storing the gas in tanks 9′ 11½″ long, 12″ diameter, with cubic capacity of 12,995″. The gas is obtained from the city main and condensed to a pressure of 300 lbs. per square inch. From these it is conducted to reservoirs under the cars.

* "*Engineering*" . . . . xxiii. 397.
Bouret . . . . . . * "*Scientific American*," xxxviii. 73.
Brush . . . . . . * "*Scientific American Sup.*," 800.

See also GAS LIQUEFACTION APPARATUS.

Gas Con-den'ser. (*Gas.*) The multitubular condenser is an apparatus for condensing the tar from the gas.

It consists of a cast-iron box, or series of boxes, with two horizontal diaphragms or partitions, one near the top, and the other near the bottom; the upper and lower spaces thus formed are connected by cast-iron pipes, usually about 4″ in diameter, placed as closely together as possible. The middle space of the box is filled with water, surrounding the pipes.

A series of boxes is thus arranged side by side, the gas is admitted into the lower space and passes up through the pipes to the upper space; from there it goes to the top space of the next box, down the pipes to the bottom space, thence into the next box, up the pipes, and so on, thus traveling up one set and down the other until the temperature of the gas is reduced sufficiently low by the water surrounding the pipes to cause the tar, etc., to be deposited in the lower space, from which the tar is run off into cisterns constructed for the purpose. The water surrounding the pipes is admitted from the end of the series of boxes opposite to that at which the gas enters, so that the water surrounding the pipes through which the gas first passes is the warmest (the heat having been acquired by the flow of gas), and that at the end where the gas leaves the condenser is the coolest. In this way the cooling of the gas goes on gradually, and is not too sudden in its change of temperature at any point, and the rapidity of cooling is easily controlled by regulating the amount of fresh water admitted to the condenser.

This form of condenser is largely used in this country, but is almost unknown in Europe, where, as a general thing, the temperature of the air is relied upon to cool the gas, which is passed through pipes exposed to the air out of doors for the purpose. The great advantage of the multitubular method is the control it gives to the rate of cooling.

Herring & Floyd's multitubular condenser, "*American Gas-light Journal*," * July 3, 1876, p. 13.
Mackenzie's surface condenser with bye-pass, *Ibid.*, p. 12.
Cross . . . . * "*Scientific American*," xxxix. 22.
Pelouse & Andouin, Fr. . * "*Engineering*," xxv. 489.

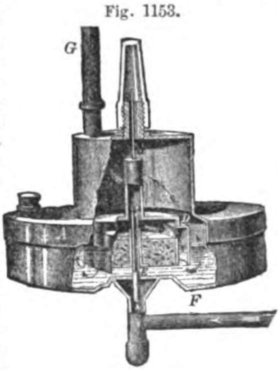
Gas Con-duct'or. (*Metallurgy.*) The downcast shaft at the side of a blast furnace, leading the heated gases from the top of the furnace to the hot-blast oven (*B*, Fig. 2588, p. 1134, "*Mech. Dict.*"), for heating the feed air of the furnace. Four such downtakes are shown in Fig. 5222, p. 2223, *Ibid.*

Gas De-tect'or. (Fr. *cherche-fuites.*) A torch for detection of leaking joints in pipes or gas apparatus.

Gas Drip Pump. A plumber's hand-pump, for removing water of condensation collected in gas piping.

Gas E-con'o-mi-zer. A carburetor for enriching gas by passing it through a hydrocarbon liquid. *F* is the pipe from the meter, and *G* the pipe leading to the burners. A float, *D*, slides upon a tube, *E*, and rests upon the hydro-carbon liquid in the chamber *A*. The gas is driven in the direction of the arrows, through the hydro-carbon, being enriched in its passage, and has always the same quantity of liquid to rise through, as the edge of the float *D* is equally submerged whatever the depth of liquid.

Fig. 1153.



Gas Economizer.

Gas saver, *de Palos* . . . "*Scientific American*," xlii. 164.

Gas En'gine. Gas engines are divisible into two systems: —

1. That system in which the expansive force of the gases acts directly upon the piston and, through this, upon the other moving parts, as in the Lenoir and Hugon engines, and

2. That in which the force of the explosion urges the piston (which for the moment is free) until a partial vacuum is created below it, when the atmospheric pressure is brought to act, and at

the return stroke produces the effective work. This includes the Otto and Laugen engine.

The upright Otto-Langen gas used at the Centennial Exhibition of 1876 has been superseded by the *Otto* horizontal gas-engine.

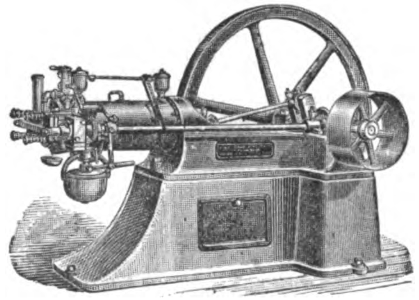
In the *Otto-Langen* engine coal gas and air are mixed in such proportions as to give a mildly explosive compound, and are admitted under a piston which slides air-tight in a vertical cylinder open at top.

The piston-rod urges the shaft only in an intermittent manner; it is geared to a pinion on the shaft which engages the shaft by means of a friction pulley only on the down stroke. On the up stroke the piston is driven violently by the expansive force of the gases till the pressure of the mixed products equals the atmospheric pressure, and is carried beyond this point by acquired momentum. It stops only when the work of the atmospheric resistance has absorbed the accumulated work in the piston. There results a rarefaction under the piston, so the down stroke is urged by atmospheric pressure aided by the weight of the piston. This descent is the effective stroke of the engine, for it is only then that the piston-rod is connected to the driving-shaft.

A variable automatic governor is attached. The piston-rod has teeth on one side working in a pinion, and is steadied by slides on the other side.

"This method of employing the effects of the explosion only indirectly has yielded good results economically; affording one-horse power for a consumption of one cubic meter of gas per hour, in place of 2.7 m., as in the Lenoir and Hugon engines. But the noise of the engine, as in the former cases, is quite unendurable, and has led to its rejection." — "*Armengaud.*"

Fig. 1154.



Otto Gas Engine.

The Otto gas engine consists mainly of a jacketed cylinder, with piston, slide valve, and governor, having a cut-off mechanism to regulate the supply of gas according to the varying load on the engine. The pressure utilized for the production of the power is generated in the cylinder, and at once used therein to propel the piston. This pressure is due to the combustion of a mixture of common coal gas and air, which is ignited by a small flame, carried from a burning gas jet outside into the cylinder by the motion of the slide. A small part only of the charge is combustible, which, on ignition, serves to expand the remainder, thus avoiding the shock, due to explosion of the whole charge.

In the Otto engine (as also in the Simon) the mixture of air and gas is compressed before explosion, so that the initial pressure at the moment of ignition is 12 atmospheres.

"The two ideas of previous compression of the mixed gases and a gradual combustion, instead of a violent explosion, distinguish the improved engines from the old forms. [Hugon and Lenoir.]

The Otto engine resembles externally a single acting steam engine. It has a single horizontal cylinder, open at one end and closed at the other, with a head furnished on the inner side with a conical cavity. The piston is connected by a crank with the shaft of the fly-wheel. Behind the cylinder is the supply chamber, which is furnished with a direct connection with the main shaft. The piston at the in-stroke does not reach the end of the cylinder, but leaves a space equal to about two fifths of the capacity of the cylinder. This is the compression chamber.

"The cylinder serves the double purpose of compression pump and working cylinder, which is perhaps not the least of the characteristics of the new system.

"The complete cycle of motions in the Otto engine is accomplished only by two complete revolutions of the working shaft, or four strokes of the piston. It comprehends the four following phases, namely: —

"1. The piston makes an up-stroke, drawing in the explosive mixture of gas and air;

"2. The inlet cock closes and the piston returns, compressing the gaseous mixture;

"3. At the moment the down-stroke is completed, and while the tension of the gases is somewhat above two atmospheres, the mixture is inflamed, and the consequent expansion causes the piston to make an up-stroke.

"4. The piston returns, driving out the expanded and cooled gases.

"Thus, of four strokes of the piston, only one (the third) conveys motive force to the shaft.

"The second consumes power; the other two have no appreciable effect.

"Such a method of working calls for a heavy fly wheel, the accumulated work of which accomplishes the compression of the gases.

"A special regulator to the engine intercepts the supply of gas and delays the ignition whenever the velocity becomes too great. Furthermore, the engine works without noise — a great advantage over the Otto and Langen motor.

"The effective working power of the engine is of course the difference between that afforded by the expansion of the gases and that absorbed by the compression. The indicator diagrams show a regular curve of pressures very different from the line of abrupt changes exhibited by the Lenoir engine.

"The regular decrease of pressure in the Otto engine is due to the method of burning the mixed gases The combustion is retarded, so that the heat developed is absorbed by the gases at a rate that is in better accord with the motion of the piston.

"M. Otto has accomplished this by his method of mixing and admitting his gases. He employs two different mixtures; one of fifteen parts air to one of illuminating gas, which he calls his 'feebly explosive mixture:' the other of seven parts air to one of gas, is called his 'strongly explosive mixture.'

"During the working of the engine, and at the moment when the gases are about to be ignited, the contents of the cylinder are: products of the preceding explosion, atmospheric air, hydrogen and hydro-carbon gases. These are not uniformly diffused, but owing to the position and action of the valves, the most combustible portion is at the bottom of the cylinder at the point of ignition, and the combustibility probably decreases quite regularly from the bottom of the cylinder to the piston

"The result of this condition is a *prolonged* explosion, and the force of expansion is less of the nature of a shock than in the previous engines.

"In order to insure combustion with proper rapidity, a jet of 'strongly explosive mixture' is made to traverse the mass at the critical moment." — *Armengaud.*

The Gilles gas engine combines the two plans of action in the same engine.

The pressure produced by the ignition of an explosive gaseous mixture in the cylinder of the engine is applied to propel two pistons in opposite directions, that is to say, a working-piston and a loose piston, the former of which is connected by crank with a driving-shaft, and the latter of which is free, but is temporarily held by a clamp after its propulsion by the explosion of the gaseous compound, to secure the return action of the working piston under atmospheric pressure as against a reduced pressure between the two pistons, thereby obtaining a motive power for the working piston in both directions of its stroke.

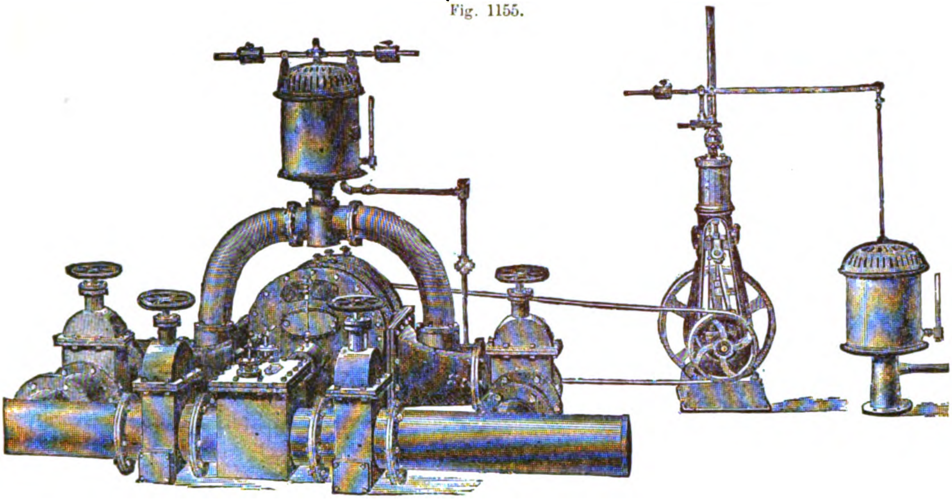
The principle of action of the Simon engine is essentially the same as the Otto, but there are some notable differences in the details. The compression is performed in a separate cylinder: upon the admission to the working cylinder the mixture is ignited by a gas flame kept constantly burning. The cylinders are vertical, and the two piston-rods connect with the same horizontal shaft.

The admission of the explosive mixture and the escape of the products of combustion are managed by valves worked by cams on the working shaft. The mixed gases are admitted in a series of small charges and inflamed successively, thereby insuring a gradual expansion.

Simon uses steam in connection with the gaseous mixture; a jet of steam from a boiler heated by the escaping gases, the water supplied to the boiler being first used to cool the working cylinder. The steam lubricates the piston.

The Bisschof engine belongs to the class that utilize the effects of an explosion to drive the piston. The cylinder is vertical, and the piston-rod connects with the shaft in such manner as to utilize in the fullest degree the effect of ex-

Fig. 1155.



Gas Exhauster.

pansion. No water is employed for cooling the cylinder; the result is secured by constructing the cylinder with projecting ribs or flanges, so as to expose an abundance of radiating surface.

Engines of small size only have thus far been constructed on Bisschof's system. Most of those made have been designed to run sewing machines, with a capacity of 1-15 to ⅛ a horse-power. The working of these costs, in Paris, two cents an hour for the former, and only five cents for the latter size.

The report on gas engines at the Vienna Exposition of 1873, vol. iii., § A, pp. 162 *et seq.*, includes notices of

Lenoir, Fr,	* Brayton, U. S.
Leavitt, U. S.	* Otto-Langen, Ger.
Hugon, Fr.	

The report by M. Armengaud, Jr., at the Conference at the Trocadéro, 1878, was printed in the "*Revue Industrielle*," and reproduced in "*Van Nostrand's Magazine*," xx. 148. It includes notices of the following: —

Papin, 1688.	*Lebon*, 1799.	*Otto.*
Farber, 1791.	*Hugon*, 1858.	*Simon.*
Mead, 1794.	*Lenoir*, 1859.	*Bisschoff.*
Street, 1794.	*Otto-Langen.*	*Ravel.*

See also GAS ENGINE, * pp. 947-949, "*Mech. Dict.*"

At Paris Exposition . . . * "*Van Nostr. Mag.*," xx. 148.
* "*Manuf. & Builder*," x. 188.
* "*Scientific Am. Sup.*," 1507.

Hurd, Br. . . . . . . * "*Engineering*," June 25, 1880.
* "*Sc. American*," xxxviii. 356.

Bissesoff . . . . . . "*Iron Age*," xxii., Feb. 6, 11.
* "*Sc. American*," xxxix. 390.

Gilles . . . . * "*Scientific Am. Sup.*," 691.

Brayton . . . . * "*Scientific Am. Sup.*," 339.

Otto . . . . * "*Scientific Am. Sup.*," 339, * 1853, * 2323.
* "*Scientific Amer.*," xxxviii. 195; * xxxix. 386
* "*Iron Age*," xxii., Oct. 31, 1.
* "*Polytechnic Review*," May, 1876, p. 49.

Paper on, *Armengaud, Fils.* "*Technologiste*," xli. 84-90.
"*Revue Industrielle*," 1878.
"*Van Nostr. Mag.*," xx. 148.

Bisschof, Fr . . . . . * "*Engineering*," xxvi. 331.

Clerk, Br. . . . . . . * "*Engineer*," xlviii. 26.

Clayton, Br. . . . . . * "*Engineer*," xlviii. 25.

Gilles, Ger . . . . . . * "*Scientific Amer. Sup.*," 691.

Vertical, *Humboldt & Gilles*, Engl. . . . * "*Sc. American*," xxxvii. 178.

Humboldt & Gilles, Br. . * "*Engineer*," xliv. 39.

Langen-Otto . . . . . * "*Polytechnic Review*," May, 1876.

Otto, Ger. . . . . . . * "*Engineering*," xxvii. 565.
* "*Engineering*," xxvi. 155.
"*Van Nostr. Mag.*," xviii. 66.

Otto & Langen . . . . *Deschanel's "Natural Philosophy*," i. 491.
* "*Eng. & Min. Jour.*," xxvi. 205.

Gas, steam, and air engine.
Simon, Br. . . . . * "*Engineer*," xlvii. 43.

Gas Ex-haust'er. A rotary fan in the gas main of the works, drawing the gas from the retorts and sending it to the holder.

Another form of exhauster is McKenzie's, which acts by means of a steam jet in the manner of an ejector in a portion of the pipe of diminished area. See STEAM-JET EXHAUSTER.

The apparatus in Fig. 1155 shows an arrangement of *exhauster* in the main-pipe circuit, a *bye-pass* arched above the exhauster, and itself surmounted by the *compensator*. To the right is a vertical *steam-engine* for driving the exhauster, and itself regulated by the *governor* on the extreme right, which is actuated by gas admitted by a pipe from the main.

Pressure of gas in the inverted bell within the governor raises the bell, and by means of the stem and the counter-balanced lever raises the valve of the engine and puts on more steam. The increased pressure in the governor is thus made to accelerate the motion of the fan in the exhauster, and remove from the retorts the gas generated. The exhauster itself may be said to be upon a sort of bye-pass, as it is a U loop lying laterally from the direct line of main shown in the foreground. In this direct line are two stop valves, and between them is a chamber with a pair of butterfly valves which act automatically in a certain contingency; that is to say, if the gas exhauster should cease to operate by the stoppage of the engine or the running off its belt, for instance, the pressure of the gas coming from the retorts would open the butterfly valves and prevent the stoppage of the circulation, which might otherwise burst the retorts. The stop valve on each side of the safety-valve chamber is to cut the latter out of the circulation when it may be necessary to examine or remove it.

The principal bye-pass, on which the exhauster is situated, has also its stop-valves by which it can be cut off, when necessary. The bye-pass shown in arched form above the exhauster is in order to keep a certain equal pressure in cases where the exhauster may be working at a speed beyond the power of the retorts and subsequent apparatus to supply. It is common to provide an exhauster of somewhat more than the necessary capacity, and the bye-pass, the valve of which is actuated by the compensator, establishes a switch connection between the mains on the respective sides of the exhauster, when the difference between the pressures in the two exceeds a certain limit. The compensator is shown above the bye-pass, and is described under GAS COMPENSATOR: where is also shown another arrangement of exhauster, compensator, steam engine, exhaust-governor, bye-pass, pipes and valves.

Roots' . . . "*Am. Gas-light Jour.*," * July 3, 1876, p. 17.

Prosser & Ray's . . . . * *Ibid.*, p. 14.

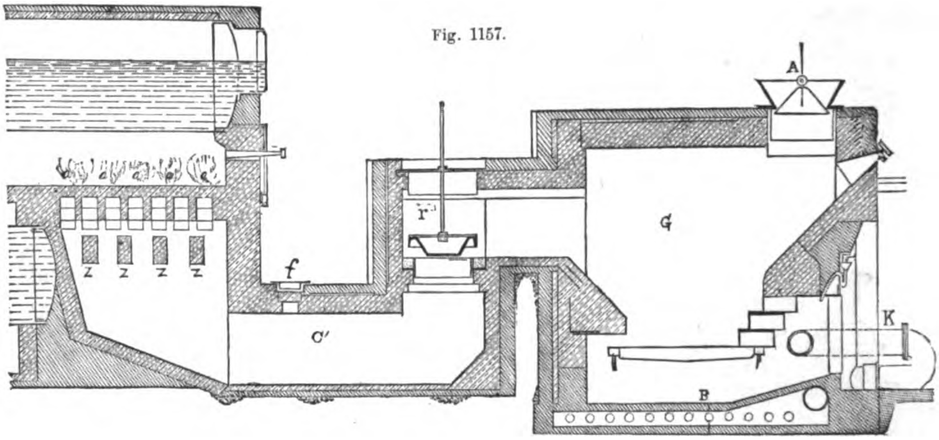
Smith & Sayres' exhauster and bye-pass . * *Ibid.*, p. 11.

McKenzie's steam jet exhauster . . . . * *Ibid.*, p. 11.

Körting . . . . . . * "*Eng. and Min. Jour.*," xxi. 464.
* "*Scientific American Sup.*," 800.

Beale, Br. . . . . . * "*Engineer*," xli. 227.

Fig. 1157.



Gas-fired Steam Boiler Furnace.

Gas-exhauster governor.
Allen . . . . * "*Scientific American*," xli. 15.
French
Art. Eclairage au Gaz. * *Laboulaye's* "*Dict.*," *etc.*, ii., Figs. 45, 46.

Gas Ex-haus'ter Gov'er-nor. (*Gas.*) An apparatus to regulate the engine driving the exhauster, so that the speed of the engine is in proportion to the pressure of the gas coming from the retorts, in order to keep the pressure in the latter (or the vacuum, as the case may be) equable. See GAS EXHAUSTER.

Goodwin "*American Gas-light Journal*," * July 3, 1876, p. 4.

Gas Fire-pot. An iron chamber heated by gas and artificial air blast, used for heating soldering irons.

Gas-fit'ter's Pump. One for discharging pipes of air, or blowing away obstructions in gas pipes.

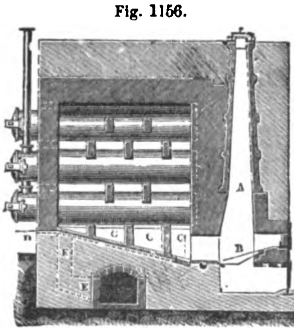
Gas-fit'ter's Torch. A form of lamp usual in the trade. It has a thick wick, and is used to detect escape of gas by applying it to suspected places.

Gas Fur'nace. 1. A furnace for distilling gas from coal, or other form of carbon.

The application of the Siemens and Ponsard furnaces to the distillation of coal in gas-works is shown under GAS-GENERATING FURNACE, Figs. 1159-1162, pp. 385-387, *infra*.

The subject of gas production is considered on pp. 944, 955, 956, "*Mech. Dict.*" An additional illustration may be

Fig. 1156.



Muller & Eichelbrenner's Gas Furnace.

given in the furnace of MM. Muller and Eichelbrenner, which has a magazine charger, *A*; grate bars, *B*, on which the carbonic oxide produced by the burning of coke is carried into flues *C C*, and mixed with air entering at *D*, while the waste products of combustion after the circuit of the retort chamber are conducted by the flue *E E* to the chimney.

2. A furnace in which coal gas from the main furnishes the combustible. See GAS HEATER; GAS STOVE; BATH HEATER; BUNSEN BURNER, etc.

Hoffmann's gas combustion furnace.
Griffin's gas furnace, for heating tubes, and for combustions in organic analysis.
Griffin's blast gas-furnaces are shown in Griffin's "*Chemical Handicraft.*"

3. A furnace in which gas from the combustibles is substituted for the combustibles themselves in the furnace proper. See GAS-GENERATING FURNACE; GAS PRODUCER, etc.

4. A steam-boiler furnace heated by gas; either coal gas from the main, or gas produced in the grate, as in the gas generating furnace.

The gas-fired steam-boiler furnace of Haupt, of Brieg, Germany, is shown in Fig. 1157.

The principle of firing is the same as in Fig. 1159, *infra*, the coal being fed at the hopper *A* into the furnace *G*, where it rests upon the grate in such thickness that the carbonic acid produced by the lower layer of fuel resting immediately upon the grate is compelled to pass through the layer of fuel above it, and there combines with an additional amount of carbon. *K* is a Koerting air injector which supplies air, previously heated to 190 C. in pipes which are built into the walls of the producer and boiler, and a portion of which are shown below the ash-pit *B*.

The volume of combustible gases passes by the fire-brick arches *z z*, and uniting with a volume of air coming in from the side is diverted into a mixing chamber, from which the combined volume issues, and is ignited at the points *a a*.

Some trouble was experienced in lighting the gas at starting in such a manner as to prevent explosion, but there seems to be no radical reason why the plan so successful in the producers of Siemens, Ponsard, Casson, and Bicheroux, should fail in the special application to steam boilers.

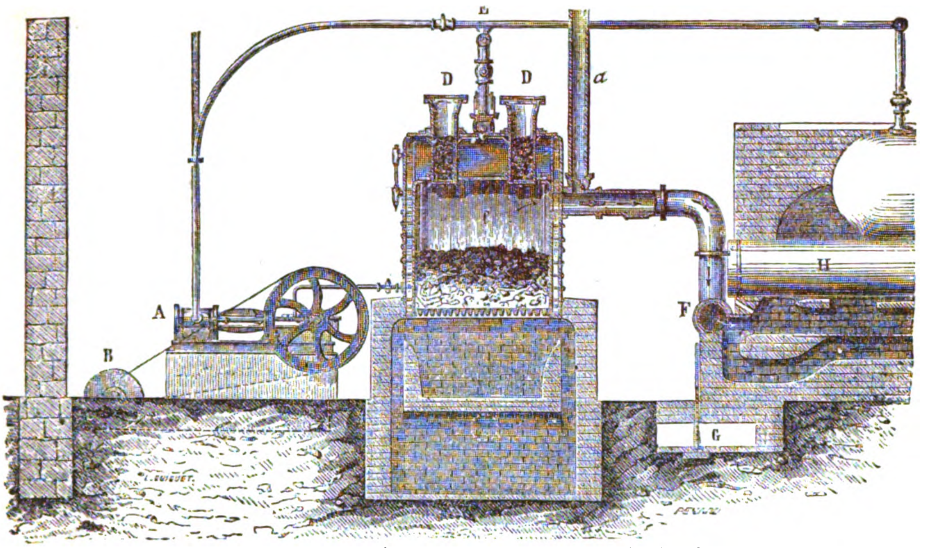
The furnace of Casson uses screened slack, supplied in a hopper and drawn down into the grate. Through the back of the grate it is blown by hot air drawn from the incased sides of the nearest stack. Hot air is likewise taken in at the top, and also at the bottom of the furnace, and makes its way to the exit of the gas from the gas furnace before it passes over the bridge of the puddling furnace, and the hot air fires the gas. The fierceness of the flame can be regulated by the quantity of air admitted, and the air is under the control of the furnace man.

See references under GAS-GENERATING FURNACE.

Gas-gen'er-a-ting Fur'nace. One in which gas from combustibles is substituted for the combustibles themselves in the operative chamber.

It is sometimes called the *Regenerator gas furnace* because in the Siemens, Bicheroux, and other systems, it is connected with the use of a *regenerator*. The Siemens (see Fig. 1159) has two pairs of chambers, each pair alternately being heated by the outgoing gases from the furnace, and forming a heating

Fig. 1158.



Beaufumé's Gas-generating Furnace. (*Section and partial elevation.*)

chamber for incoming gases for combustion and air respectively.

The Ponsard (see Figs. 1161, 1162) has a single regenerator chamber in which the draft of waste gases in one set of conduits, and of inflammable gases in the other conduits, are constant, and only divided by brick walls through which the heat of the waste is conducted to the air and carbonic oxide.

In a sense, all grate-firing may be considered as *gas generating*, inasmuch as the solid parts of the fuel are converted into gas and then burned. Thus coal parts in the grate with about 30 per cent of its weight in the form of hydro-carbon gases, and the remaining coke is also converted into carbonic oxide, and burnt into carbonic acid.

The distinction, however, which constitutes a grate-firing furnace a *gas-generating furnace*, is that the coal is in such thickness that the carbonic acid produced by the combustion of the fuel in the lower layer next to the grate is compelled to pass through the incandescent fuel above it, and thus again combine with carbon, preventing also, it may be added, the passage of unconsumed oxygen. This necessitates the admission and admixture of atmospheric air at another point besides that through the grate.

One of the first attempts in this line was the English patent of Juckes, No. 7858, Nov. 8, 1838. This had a magazine, and the coal was thrust into the fire by a piston which traversed in a hollow chamber in which the hydro-carbon gas was expelled from the coal before it reached the bed of coal on the grate. All the air was, however, admitted through the grate, so that this did not come under the present denomination, but was evidently intended as a smoke-burner or smoke preventer.

Price's English patent, 8,462, of 1873, has a magazine but no mechanical feeder, and the air is supplied only through the grate. The coal, however, in the expulsion chamber is heated by waste heat.

An early form of gas-generating furnaces was that suggested by Ebelman, but much improved by Beaufumé, under whose name it is well known in France.

The apparatus is shown in Fig. 1158. It has a furnace, *C*, with a grate enveloped in a double casing of boiler iron, like a locomotive furnace. Water circulates in the interval between the casings, and above is a steam dome. Steam passes by a pipe from the steam dome to a steam pump, which supplies water to the jacket. Fuel is introduced by means of two chargers, *D D*, which have valves above and below to prevent the exit of the hot gases from the furnace *C*. The upper valves being lifted, coal is placed in the chargers *D D*, and these valves being then closed the lower valves are opened and the fuel dropped on to the fire. The same device for feeding fuel to the furnace may be seen in Bennett's steam engine, U. S. patent, August 3, 1838 (Fig. 52, p. 21, and Fig. 81, p. 39, "*Mech. Dict.*"), which has several other points of similarity to the Beaufumé furnace.

The small engine *A* also drives a blower *B*, which forces air under pressure beneath the grates, and the ash-pit is necessarily hermetically sealed. This combustion under pressure and the sealed ash-pit are found in the Bennett patent, above cited, and also in the following patents: —

Washburn, U. S., Sept. 5, 1865.

Stillman, U. S., Aug. 9, 1864, and several others mentioned under AËRO-STEAM ENGINE and AIR ENGINE, "*Mech. Dict.*"

A portion of the air is inducted, as has been said, beneath the grating of the furnace *C*, but another part is destined for the consumption of the combustible gases beneath the steam-boiler shown at the right hand in the figure. The quantity of air devoted to the respective objects is regulated by registers.

The body of combustible in the furnace *C* is designed to be about sixty-five centimeters in height, in order that the requisite chemical combination may take place, the carbonic acid produced in the red coke-fire beneath, being converted into carbonic oxide in traversing the superior stage of fuel, combining with another equivalent of carbon to form an inflammable gas when mixed with air beneath the steam-boiler.

Steam, in regulated quantity, is injected beneath the grate, and ascending with the air is decomposed in the mass of burning fuel. The use of the steam is said to reside in serving to regulate the heat of the gas producer, and also in assisting in keeping the grate surface clear. The generation of the gases by decomposition of the steam is admitted to be at the expense of heat, but its introduction has a practical value in working, and is adopted by Siemens and others.

The hot gas passes by a lateral pipe to the space beneath the steam-boilers, being mixed with air from the chamber *G* in the pipe *F*, from thence circulating in the furnace passages beneath the boiler. *a* is a chimney used in starting fires in the furnace *C*, or upon other occasions as may be necessary; valves at the point of juncture of the respective pipes determine the course of the air

The Siemens' gas-generating furnace is the most noted of the class, and is used for many purposes. Invented in 1856, it was applied in 1864 to the production of steel by the Siemens-Martin process, and received the grand prize at the Exposition in Paris, 1867. Since that it has been used in glass-making, gas-works, etc.

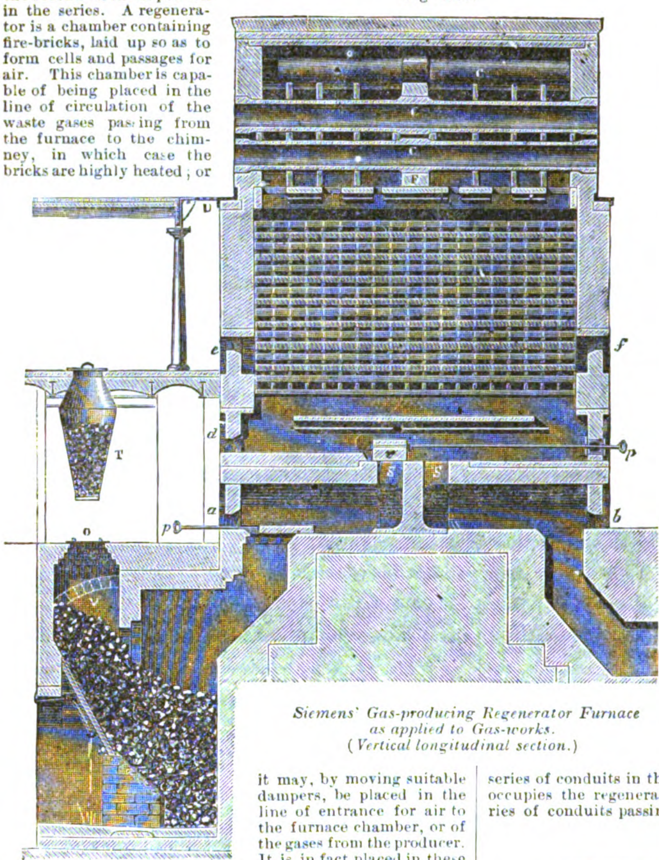
It consists of three parts: the gas producer; the regenerator; the furnace chamber. The latter may be an open metallurgic hearth, a siege full of glass pots, or a nest of gas retorts, as the case may be.

It is distinguished from the preceding by the notable absence of a forced current of air, and of the heating of the incoming air in tubes.

The furnace of the gas producer is fed through a hole above, which is closed by a cover at other times. The fuel descends an inclined plane of bricks made of refractory clay, and thence slides on to a grate surface, also inclined. The resulting gases pass upward into an exit pipe, the chemical conditions being much as in the Beaufumé furnace just described. The result of the combustion of coke, carbonic acid, passing upward through the mass of heated fuel, receives another equivalent of carbon and passes to the exit pipe as carbonic oxide, diminished in its heat by the cost of its transformation into oxide of carbon, which heat is, however, restored when the ignition takes place subsequently.

The current of heated gas passes by flues to the *regenerator*, the second essential portion in the series. A regenerator is a chamber containing fire-bricks, laid up so as to form cells and passages for air. This chamber is capable of being placed in the line of circulation of the waste gases passing from the furnace to the chimney, in which case the bricks are highly heated; or

Fig. 1159.



Siemens' Gas-producing Regenerator Furnace as applied to Gas-works.
(Vertical longitudinal section.)

it may, by moving suitable dampers, be placed in the line of entrance for air to the furnace chamber, or of the gases from the producer. It is in fact placed in these two lines of draft alternately: the first to be heated; the second to heat the aëriform matters passing through it. To secure continuity, two of such chambers are required, alternately heated and imparting heat, and in the Siemens' practice each of them are in pairs, as it is found advisable not alone to superheat the gases from the *producer* but also the air to inflame them, and to do these separately, and combine them after they are heated in the *regenerator*. Meanwhile the other pair of chambers is being heated by the gases flowing from the furnace chamber towards the chimney.

The action in the furnace chamber is according to the circumstances: whether the flame descend upon the ore or metal in the bosh, or circulate around glass-pots, or envelop crucibles filled with coal.

Figs. 1159, 1160, show the Siemens' regenerator-furnace as applied to the purpose of distilling coal for lighting gas. While his invention was first applied in steel furnaces, it has for some time been in use in gas-works, first of all in the "*Usine de Vaugirard*," belonging to the Parisian Gas Company.

The *gazogene* or *generator*, V, otherwise known as the *gas producer*, is placed below the ground level, and the gas produced, drawn by chimney draft, passes first to the *regenerators* and thence to the combustion chamber in which are the retorts *C C*. The regenerator, as has been said, is an assemblage of refractory bricks built up in such a manner as to leave between them interstices which are traversed by the waste gases from the combustion chamber on their way to the chimney.

The regenerator in the case in question has four compartments shown at $a\ a^1\ a^2\ a^3$ in Fig. 1160, which is a vertical transverse section, in a line at right angles to that shown in Fig. 1159.

At the bottom of these conduits are the dampers $R\ R^1\ R^2\ R^3$, by which the direction of the current is controlled.

Supposing the furnace to be in operation: the conduits $a\ a^1$ receive respectively, one the carbonic acid from the gas-producer, and the other the air for its combustion, the two united forming the flame beneath and around the retorts *C C*, in the combustion chamber. The proceeds of combustion descend by $a^2\ a^3$. At the end of an hour, the direction of all these currents is reversed; the air and carbonic oxide traverse the conduits $a^2\ a^3$, the bricks in which have been heated to redness, and the waste heat passes downward in $a\ a^1$, to heat that chamber in turn.

One gas producer heats 8 to 10 furnaces.

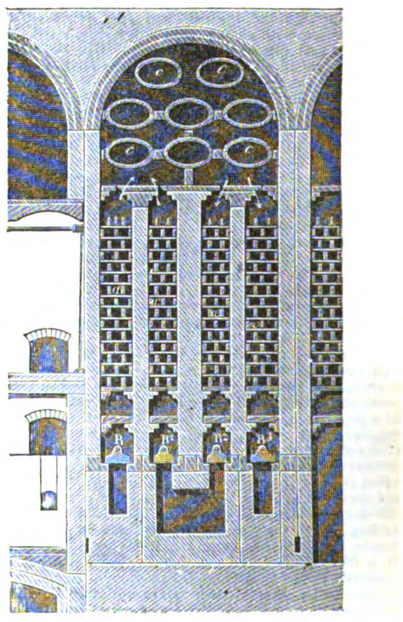
In the apparatus shown in Figs. 1159, 1160, the furnaces are fed with coke, that being the convenient fuel in gas-works, and the retorts are heated by burning the carbonic oxide.

The coke is fed into the furnace from a charger *T*, the furnace cover *O* being removed when the shutter at the foot of the charger *T* is moved aside to drop the charge into the furnace *V*. Water is shown trickling from a pipe on to the ash floor beneath the grates. *a b d e f*, Fig. 1159, are orifices, which may be opened or adjusted to verify or regulate the draft in the interior of the furnace. The dampers $R\ R^1\ R^2\ R^3$, are coupled two and two, and are operated by the draw-rod *p* to open one set of openings *s* and close the other, when the direction of draft through the generators is to be changed, as has been already explained.

The Ponsard furnace, which is shown in Figs. 1161, 1162, as applied to the same object, distilling gas in gas-works, has the same general features as the Siemens, with two exceptions to be noted. This proceeds upon a somewhat simpler plan.

1. The reversal of the direction of draft is avoided in the Ponsard regenerator furnace. The waste products of combustion follow constantly the same direction, descending from the combustion chamber and coursing through the series of conduits in the structure of hollow fire-bricks which occupies the regenerator, while the air follows another series of conduits passing upward in contact with the bricks,

Fig. 1160.



Siemens' Gas-producing Regenerator Furnace as applied to Gas-works (vertical transverse section).

Fig. 1161.

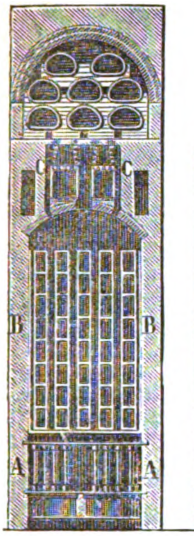
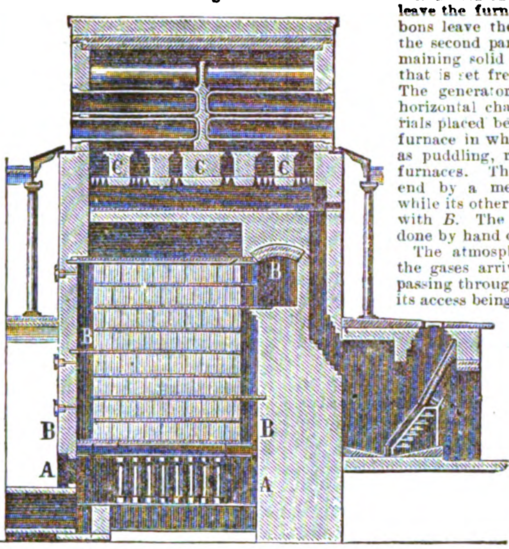


Fig. 1162.



Ponsard's Gas-generating Furnace applied to Gas-works.
(Vertical transverse and longitudinal sections.)

A is heated by the waste gases after they leave the furnace, and the expelled hydrocarbons leave the chamber *A* highly heated. In the second part, *B*, the conversion of the remaining solid parts takes place, all the heat that is set free being utilized in the furnace. The generator consists of one, two, or more horizontal chambers, made of fire-proof materials placed below, above, or by the side of the furnace in which the gases are utilized; such as puddling, reheating, zinc, glass, and other furnaces. The chamber, *A*, is closed at one end by a mechanical feeding arrangement, while its other end is open and communicates with *B*. The feeding of coal into *A* can be done by hand or by machinery.

The atmospheric air necessary for burning the gases arrives highly heated by previously passing through channels heated by waste heat, its access being regulated by valves. The waste heat, after passing through the flues, round *A*, to expel the gases from the fuel, and heating the resulting coke to a bright red heat, may then be used under boilers, etc. See also: —

Gas producer.	Regenerator.
Open hearth furnace.	Slack-burning gas furnace.
Glass furnace.	

See also the following references: —

"*Eng'ing & Mining Journal.*"

Bicheroux . * xxi. 55; xxiv. 362.
Siemens . xxvii. 93; xxix. 151, 372.
Strong (water gas) . * xxx. 315.

the other surfaces of which are heated by the descending waste current.

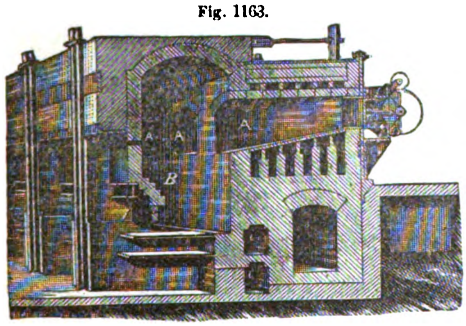
2. The carbonic oxide from the gas-producer proceeds directly to the combustion chamber, where it unites with the air which has entered at *A*, and passed from top to bottom around the heated air-ducts in the regenerator *B B*. The air occupies the space around these fire-brick ducts, while the waste heat passes horizontally through them. *C C* represent portions of the vault of the regenerator, through openings in which the heated air rises to the combustion chamber. The particular form and disposition of the air-ducts is attributed to M. Lencauchez. Ponsard's regenerator is also shown under REGENERATOR, which see.

The gas-generating furnace of Minary, of Besançon ("*Publication Industrielle*," 1868), has admission of air subsequent to the departure of the heated gases from the producer, see Fig. 3, p. 4000, "*Scientific American Sup.*," where is also shown Brook & Williams' Gas Generator, Fig. 4.

Gröbe's Gas Generator has been used at the Osnabruck Iron and Steel Works, since 1849; at the Vieille Montagne Zinc Works, and at several other places in England, Belgium, and Hanover. This furnace is founded upon the principle that the processes of expelling the hydro-carbon gases, and converting the resulting coke, require entirely different conditions. To expel the gases from the fuel, not atmospheric air is required, but only heat; while for the combustion of the coke into carbonic oxide, atmospheric air is essential. The latter process requires no heat, but on the contrary throws heat off, which is ordinarily employed for expelling the gases from the fuel, and having thus become latent, it cannot be used in the combustion chamber.

The gases contained in the coal are expelled in one chamber, *A*, and the solid remains (coke) are converted in another, *B*, and both gases so produced are burned in the combustion chamber, which is not visible on the figure.

Fig. 1163.



Gröbe's Gas-generating Furnace.

Ponsard . . . . . * "*Engineering*," xxv. 450.
Tessié . . . . . * "*Eng'ing*," xxviii. 458; xxix. 318.
Jukes, 1838 . . . . * "*Engineering*," xxx. 200.
Price, 1873 . . . . * "*Engineering*," xxx. 200.
Minary, 1868 . . . . * "*Engineering*," xxx. 200.
Brooke & Wilson, 1877, * "*Engineering*," xxx. 200.
Gröbe, 1879 . . . . * "*Engineering*," xxx. 200.
Müller & Fichet . . . "*Engineering*," xxix. 2.
Hartmann (2 Figs.) . . * "*Engineering*," xxix. 2.
Heaupt (14 Figs.) . . * "*Engineering*," xxix. 2.

"*Scientific American Supplement.*"

Bicheroux . . . . * 88, 1831.
Minary . . . . * 4000.
Casson . . . . * 596.
Boëtius . . . . * 1346.
Ponsard . . . . * 2355.
Brook & Wilson . . . . * 4000.
Rickmann (glass) . . . . * 2176.
Gröbe . . . . * 4000.
Tessié . . . . * 3820.

"*American Manufacturer and Iron World.*"

Siemens . . . . * xxvi., May 7, p. 1.
Wilson . . . . * July 16, 1880, p. 12.
Tessié . . . . * xxv., Aug. 8, p. 12.

Ponsard . "*Van Nostrand's Engineering Mag.*," xxi. 252.

"*Iron Age.*"

Bicheroux . . . * xxvii., Jan. 13, p. 24; Jan. 20, p. 1.
Casson-Bicheroux . xxv., May 6, p. 1.
Siemens . . . . * xx., July 12, p. 5; Dec. 20, p. 3.
xxv., April 22, p. 13.
Parkes, Br. . . . xxvii. March 16, p. 5.
Ponsard . . . . * xxii., Dec. 12, p. 1; xxv., Mar. 25, p. 7.
Siegel . . . . . * xxvi., Oct. 7, p. 1.
Tessié . . . . * xxiv., Aug. 14, p. 1.
Gröbe . . . . . * xxvi., Oct. 7, p. 3; * xxii., Dec. 19, p. 3.
Haupt . . . . * xxv., March 11, p. 1.
Wilson . . . . * xxiv., Oct. 28, p. 1.

"*Engineer.*"

Smith . . . . * xlii. 62.
Boëtius . . . . * xliv. 5.
Rickmann (glass) . . . . * xlv. 457.
Ziebnith & Putsch . . . . * xlv. 110.
Ponsard . . . . * xlv. 231.
Bicheroux . . . . * xlvi. 91.
Jukes . . . . * l. 191.
Price . . . . * l. 191.
Minary . . . . * l. 192.
Brook & Wilson . . . . * l. 192.
Gröbe . . . . * l. 192.
Fichet, Fr. . . . . * xliv. 454.
Frew, Br. . . . . * xlv. 284.

Siemens (glass) . . "*Manuf. and Builder,*" xii. 270.
in U. S. . "*Manuf. and Builder,*" xii. 50.
Illuminating . . . * "*Manuf. and Builder,*" viii. 166–169.
Croll, illuminating * "*Manuf. and Builder,*" viii. 198.
Siemens . . . . "*English Mechanic,*" xxvii. 657.

"*Scientific American.*"

Casson-Dormoy . . . . * xl. 22.

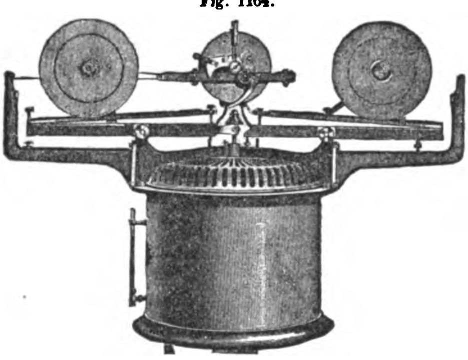
United States Patents:
212,942. *Jerzmanowski.* March 4, 1879.
213,313. *Brook & Wilson.* March 18, 1879.
216,119. *Tessié & Jerzmanowski.* June 3, 1879.

Gas Gov'er-nor. (*Gas.*) *a.* An apparatus of the nature of a regulator, to equalize the flow of gas in a pipe.

The usual method is to cause the pressure of gas to impinge upon a diaphragm to which is connected the stem of a valve, and the valve opening is diminished in proportion to the increase of pressure, and conversely.

Fig. 1164 shows Isbell's automatic gas-governor, for regulating the pressure of gas in street mains, proportioning the pressure to the necessity of the varying consumption at different periods of the 24 hours; as, for instance, a day pressure of $\frac{7}{10}''$, a night pressure of $2\frac{4}{10}''$, continued until 10.30 P. M., and then gradually diminished to a midnight pressure of $1\frac{1}{10}''$, and then gradually back to day pressure.

Fig. 1164.



Isbell's Automatic Gas Governor.

The rolling weights are governed by the clock in the center, and as they roll towards or from the clock they depress the levers on which they track, and actuate accurately balanced valves in the chamber below; the valve-rods will be seen depending from the end of each lever.

The rolling weights are connected by a chain to a sliding bar, working between friction rollers, and driven by a cam, on the main spindle of the powerful clock contained in the case. As the weights are moved in, at the proper time, by the action of the clock and cam, the valve below is opened and the pressure gradually increased to the desired point, held there, until the time set for it to be diminished, by the rolling back of the weights and the consequent gradual closing of the valve. The cam is easily and quickly secured in any position on the spindle, and has stamped upon it the hours of the day, as shown by the index.

It will be at once apparent how any desired effect can be obtained, by changing the position of the cams, or by putting on cams of different proportions.

The *Kidder-Noyes* gas governor acts by means of a balanced holder which fluctuates upward or downward upon any increase or decrease respectively of gas pressure above or below the mean for which it is set, to close or open the valve in the main.

Cox's (Br.) gas governor has the same general feature of balanced holder operating a valve.

Goodwin has a similar arrangement; and also a governor on the aneroid principle of an expanding diaphragm chamber.

Foster's governor, for tanks of compressed gas for railway cars and steamboats, has also the expansible diaphragm arrangement.

White (Br.) has a swinging flap-valve weighted with shot.

Foulis (Br.) has a double-cone valve and float.

Jones (Br.), a conical valve in perforated diaphragm.

Wharton has gravitating valves in a section forming a part of the line of pipe.

b. An apparatus on a gas exhauster to regulate by gas pressure the quantity of steam admitted to the cylinder of the engine driving the exhauster, so as to regulate the speed of the engine, and thus maintain any desired pressure or vacuum on the exhaust side. See GAS EXHAUSTER.

Goodwin's consumer's governor, "*American Gas-light Journal,*" * July 3, 1876, p. 6.
Goodwin's governor, *Ibid.*, p. 7.
Stott, Br . . . . * "*Engineering,*" xxix. 308.
For compressed-gas tanks * "*R. R. Gaz.,*" vii., opp. p. 138.

Gas Grate. A contrivance of Dr. Siemens, in which the consumption of coke in the grate is aided by a row of gas jets; illustrating his theory of the economy of separating fuel into its constituents of coke and gas, and re-associating them at the grate or hearth.

Gas Gun. A signaling device, consisting of an explosion of gases in a pipe. Used at Howth Baily light station, Kingstown Harbor, Ireland. See Major Elliot's report, U. S. Engineers.

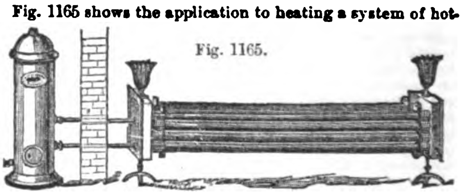
The gun is a tube of iron connected with the gas holder by a $\frac{1}{2}''$ pipe. The charge is a mixture of oxygen (3), coal gas (3), and air (2).

See also FOG GUN, Fig. 1079, p. 352, *supra*.

Gas Heat'er. 1. An application of gas as a means of heating water for domestic purposes: culinary, lavatory, conservatory, etc. See GAS BOILER, *supra.*

Fig. 1165 shows the application to heating a system of hot-

Fig. 1165.



Conservatory Heater.

water pipes for a green-house. See also BATH HEATER, Figs. 243, 244, pp. 82, 83, *supra*.

2. A form of burner for heating kettles or baths, and for laboratory purposes.

See also BUNSEN BURNER, Figs. 471–475, pp. 146, 147, *supra*, and references *passim.*

Fig. 1166.

Gas Heater.

3. A substitute for a forge in tempering drills, punches, and other small tools.

Put on a sufficient head of gas to prevent the flame from descending into the tube. For heating larger pieces, the flame should be nearly 3'' wide. The upper ends of the curved side pieces should not be more than $\frac{1}{2}''$ apart. The articles to be heated should be held in the upper part of the flame, above the central blue part and parallel with it. The larger the piece to be heated the further it should extend into the flame. The heater should be located in a dark place, and supports may be provided for greater convenience in heating heavy articles.

Fig. 1167.

Gas Heater.

* "*Scientific American,*" xxxv. 275.
And boiler, Br. . * "*Engineer,*" xlviii. 404.
For motor, *Hill* . * "*Scientific American Supplement,*" 616.

Gas Hold'er. The receptacle for gas in gas works. See *g*, Fig. 2161, p. 944, "*Mech. Dict.*"

Gas holder, large . . . . . * "*Man. & Builder*," x. 4.
Berlin . . . . * "*Engineering*" xxiii. 49.
5,680,000 cubic feet, London . * "*Engineer*," l. 175.
Receiver, Liquid . . . . . * "*Sc. American Sup.*," 2739.

Gash Vein. (*Mining.*) A metallurgic vein, wide above and narrow below.

Gas In'di-ca'tor. A device specially intended to indicate the presence of fire-damp in collieries.

Coquillon's and *Professor Deville's* are instances. See FIRE-DAMP ALARM; GRISOUMETER; CARBUROMETER.

Gas'ket. 1. (*Nautical.*) A plaited cord, used as a stopper in furling sails, etc.

2. A collar or ring used in packing; as around a piston; under a gland; beneath the rim of a fruit-jar lid, etc.

Packing gasket, *Stoy* . * "*Sc. American*," xxxvii. 406.

Gas Kiln. A kiln for firing ceramic wares by the combustion of gases.

Mendheim's, Gilmore's report, "*Centennial Exhibition Report*," vol. iii., Group II.,* p. 231.

Gas Lan'tern. The Parisian "*phare*" burner is shown in Fig. 1168.

The lantern is represented partly in elevation and partly in section, the black lines showing the section. 1, 1 are glass cylinders for conducting the air supply to the burners: 2 represents the circle of six flat-flame burners; 3 is a single jet which is lighted after midnight, or when the circle of burners is not needed; 4 is a flash light, which is kept lighted and by which the gas in the burners is ignited when turned on; 5 represents the reflectors. *A* is the lever by which the gas is turned on, and when in this position the gas passes to the circle of burners. When turned in the direction shown by the dotted lines, *B*, the gas passes only to the single jet in the center. It consumes about 40′ of gas per hour when doing its full duty.

Fig. 1168.

"*Phare*" *Burner.*

Gas Light'ing. See the following references: —

Electric, *Bogart* . . . . . * "*Sc. American Sup.*," 698.
French chambers, *Gaiffe* . . * "*Sc. American Sup.*," 456.
Automatic electric, *Fox*, Br. . * "*Engineer*," xlv. 29.
* "*Sc. Am.*," xxxviii. 187.
Burner, *Stockwell* . . . . . * "*Engineer*," xliii. 170.
Lantern and burner, "Phare," * "*Engineer*," xlix. 210.

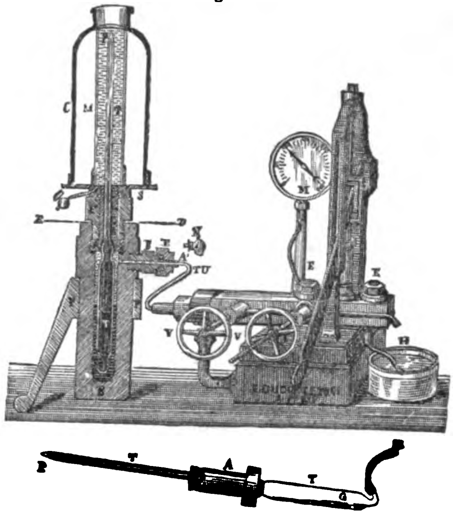
Gas Liq'ue-fac'tion Ap'para'tus. For the liquefaction of gas by pressure and cold.

Cailletet's apparatus is shown in Fig. 1169. A tube, *T*, of very fine bore toward its upper extremity, *P*, and capable of supporting a pressure of 500 atmospheres, is partly filled with the gas to be liquefied. The lower portion of the tube expands to form a capacious bulb, *T*, which is filled with mercury, and inserted in a reservoir containing mercury and water. The walls of the reservoir, *B*, are of steel, and sufficiently thick to allow pressures of 800 atmospheres to be used with perfect safety. The water is forced in by a strong pump, and, according as it enters, the mercury rises in the capillary tube, compressing the confined gas at the same time. A pressure of 200 atmospheres is attained by a few strokes of the pump, and is recorded by a metallic manometer, *E, M*. By means of a plunger, *V*, the pressure may be very gradually increased up to 500 atmospheres. Meanwhile the capillary tube may be surrounded by a freezing mixture, or by water at any desired temperature.

In the case of most gases, the manometer remains stationary when a certain pressure has been reached. This phenomenon, which is at variance with Boyle's law (a law absolutely true only for a perfect gas), occurs as soon as liquefaction begins. When an appreciable quantity of the gas has been liquefied, upon gradually diminishing the pressure the liquid begins to boil, and returns to the gaseous condition. But if the valve *V′* be suddenly opened, the gas will as suddenly expand, and, undergoing a very considerable reduction of temperature, a portion of it will be liquefied, filling the upper part of the tube with a sort of cloud or mist. These effects are readily seen with nitrous oxide and acetylene.

The proceedings of Pouillet, Faraday, Thilorier, and Cagniard-Latour, and the results of their experiments are related by *Laboulaye*, "*Dict. des Arts et Manufactures*," tome iv., cap. "*Liquefaction des Gaz*," ed. 1877.

Fig. 1169.



Cailletet's Apparatus for the Liquefaction of Gases.

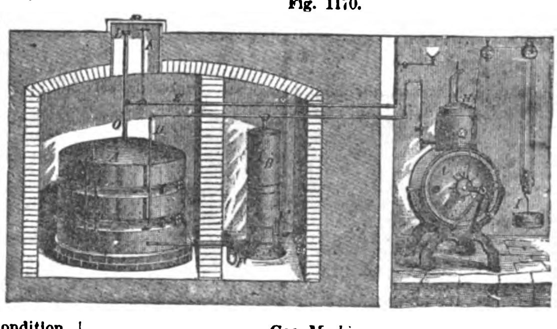
See the following references: —

Cailletet . . . . * "*Engineering*," xxv. 325, 410.
* "*Sc. American*," xxxviii. 111.
Paper on . . . . "*Sc. American*," xlii. 249.
* "*Manuf. & Builder*," x. 61.
"*Telegr. Jour.*," vi. 38, 152.
Pictet, Cailletet . . . . * "*Sc. Am. Sup.*," 2030, 2031.
High pressure apparatus for determining volume.
Cailletet . . . . * "*Scientific Am. Sup.*," 2728.
And solidification, "*Iron*" "*Van Nostr. Mag.*," xviii. 251.
Le Blanc, Fr. . . . . . * "*Scientific Amer. Sup.*," 901.
Magnus . . . . * "*Manuf. & Builder*," x. 132.
Pictet . . . . "*Sc. Am.*," xxxviii. 64, 71.
* "*Sc. Am.*," xxxviii. 147, 186.
* "*Scientific Am. Sup.*," 1783.
"*Technologiste*," xl. 2.
Densifying . . . . . . * "*Eng. & Min. J.*," xxv. 112.
"*Scientific Am. Sup.*," 2485.
"*Sc. American*," xxxiv. 386.
Solidification of gas . . . "*Iron Age*," xxi., Mar. 14, p. 7.

Gas Ma-chine'. *a.* An apparatus for carbureting air or gas. See CARBURETOR, "*Mech. Dict.*"

Fig. 1170 shows the "Victor" Gas Machine, which has some points of safety over those previously described. The air pump *C* is in the cellar; the air passes by pipe *D* to a vault at a distance from the house, and there circulates through the carburetor *A*, returning by another pipe *E* to the house service. *K* is an air escape valve; *D*, gasoline supply pipe; *I*, weight to run the air-blower.

Fig. 1170.



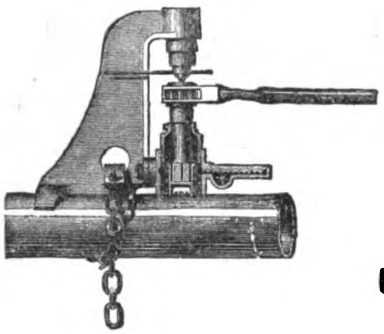
Gas Machine.

b. A gas motor. See Gas Engine.

Carburetor	* "*Am. Man.*," Feb. 14, 1879, 12.
Retort, *Kannel & Towsley* .	* "*Scientific Amer. Sup.*," 2.
Carburetor, *Maxim* . . .	* "*Scientific American*," xliii. 1.
Motor, *Otto*, Ger.	* "*Min. & Sc. Press*," xxxvii. 211.
Motor, *Langen & Otto* . .	* "*Scientific Amer. Sup.*," 420.
	Laboulaye's "*Dict.*," iv., "*Air chaud.*"
Carburetor, Springfield . .	* "*Manuf. & Builder*," viii. 88
Coal, Domestic, *Thomas* .	* "*Scientific Amer.*," xxxv. 86.
Carburetor, "Victor" . .	* "*Iron Age*," xxi., Jan. 31, p. 7.

Gas Main Drill. A tool for boring holes in mains to attach service pipes.

Fig. 1171.



Gas Main Drill.

Gas Main Valve. Preferably a double-seat valve of large size for mains.

Isbell's double gate gas main valve. "*American Gas-light Journal*," * July 3, 1876, p. 10.
Chapman's gas valve, *Ibid.*, p. 16.

Gas Me'ter.

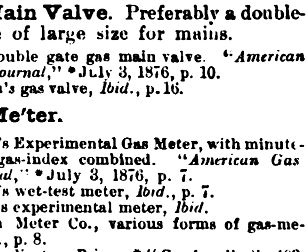
Goodwin's Experimental Gas Meter, with minute-clock and gas-index combined. "*American Gas light Journal*," * July 3, 1876, p. 7.
Goodwin's wet-test meter, *Ibid.*, p. 7.
Goodwin's experimental meter, *Ibid.*
American Meter Co., various forms of gas-meters, * *Ibid.*, p. 8.
Gas meter indicator, *Price* . * "*Sc. Am.*," xli. 403.
Hopper's double-action meter is a two-diaphragm meter, on the principle of the Glover meter, with its rigid disk and flexible leathern hinge. The two diaphragms are geared together on each side of the partition. Gas admitted in the usual way to the inside and the outside of the diaphragms alternately gives them a reciprocating motion, filling and discharging.

Gas Me'ter Cock. One end screw, the other end solder.

Gas'o-line. A product of the distillation of petroleum; the lightest capable of remaining unvolatilized at common temperatures.

Gas Ov'en. One heated by gas jets. See also Gas Stove.

Fig. 1172.



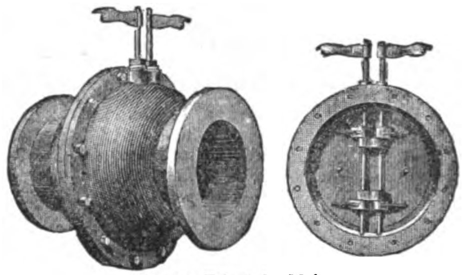
Gas Oven, or Summer Range.

Gas Pipe. The following is the London rule for gas-pipe sizes: —

For 200 lights, 2″ iron tube; 120 lights, 1½″; 70 lights, 1¼″; 50 lights, 1″; 25 lights ¾″; 12 lights, ½″; 6 lights, ⅜″; and 2 lights, ¼″.

Gas Pipe Valve. In Root's bye-pass valve, the case consists of two semi-spherical pieces, in which the seats for the doors or valves are cast in

Fig. 1173.

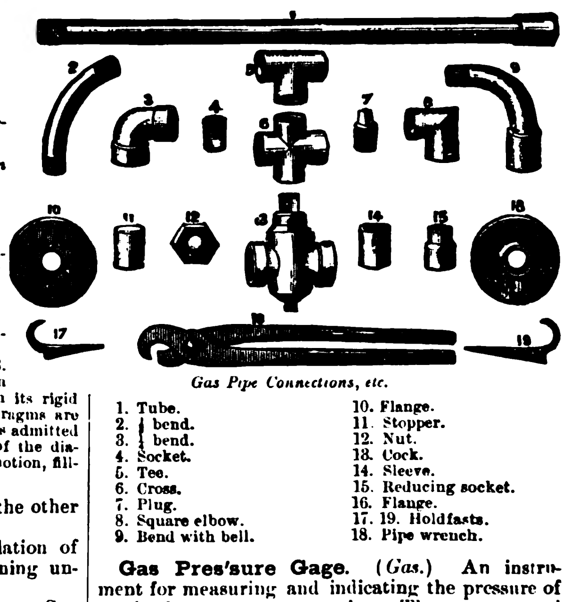


Bye-pass Valves for Mains.

solid, and being circular, the seats and joints can be adjusted and finished on a lathe at one operation.

Gas Pipe Wrench, Con-nec'tions, etc.

Fig. 1174.



Gas Pipe Connections, etc.

1. Tube.	10. Flange.
2. ¼ bend.	11. Stopper.
3. ⅛ bend.	12. Nut.
4. Socket.	13. Cock.
5. Tee.	14. Sleeve.
6. Cross.	15. Reducing socket.
7. Plug.	16. Flange.
8. Square elbow.	17. 19. Holdfasts.
9. Bend with bell.	18. Pipe wrench.

Gas Pres'sure Gage. (*Gas.*) An instrument for measuring and indicating the pressure of gas in the apparatus or mains. There are several forms, one being a bent tube, V-shaped, in which pressure in one leg causes the liquid in the bend to ascend in the other leg, which is graduated; or, conversely, vacuum causing it to descend. See Pressure and Vacuum Gage.

King's gas pressure and vacuum gage. "*American Gas-light Journal*," * July 3, 1876, p. 3.
King's pressure gages and register, * *Ibid.*, p. 4.
Goodwin's pressure gages and register, * *Ibid.*, pp. 6, 7.
* "*Scientific American Supplement*," 1201.

Gas Pro'cess.

Adams	"*Min & Sc. Press*," xxxvii. 23.
Adams	* "*Scientific Amer.*," xxxix. 15.
Mains, meters, *Chandler* .	"*Iron Age*," xvii., Jan. 13, 24.
Apparatus (coal), *Eichholz*.	* "*Scientific Amer.*," xxxiv. 63.
Making, *Eicholz*	* "*Iron Age*," xvii., May 4, p. 1.
Generator (simple)	* "*Scientific Amer.*," xxxix. 42.
Hydrogen appara., *Giffard* .	* "*Manuf. & Builder*," ix. 262.
Apparatus, illumi., *Kidd* .	"*Sc. American*," xxxv. 31.
Lowe	* "*Sc. American Sup.*," 1551.
Lowe-Strong, series of papers	* "*Eng. & Min. Jour.*," xxv.
Lowe	* "*Eng. & Min. Jour.*," xxv. 74.

Lowe	* "*Min. & Sc. Press*," xxxvii. 137.
	* "*Sc. American*," xxxv. 266.
Petroleum, *Lowe* . . .	* "*Sc. American Sup.*," 29.
	"*Sc. American Sup.*," 836.
	"*Am. Gas-light Jour.*," * July 3, 1876, p. 19.
Baltimore.	"*Sc. American Sup.*," 1811.
	"*Sc. American Sup.*," 654.
O'ney	* "*Sc. American Sup.*," 197.
Notes on, by *Patterson*	* "*Sc. American Sup.*," 1176.
Petroleum gas, *Patton*.	* "*Am. Gas-light Jour.*," July 3, 1876, p. 19.
	* "*Manuf. & Builder*," ix. 220.
Pintsch	"*Iron Age*," xxiii., May 1, p. 15.
Shale oil-works	"*Scientific Amer.*," xxxiv. 112.
Wood	"*Min. & Sc. Press*," xxxvii. 98, 215.

Symes, coal gas, "*Scientific American Sup.*," 1617.
Wrenn process for making a permanent gas from petroleum, * "*Scientific American Sup.*," 1553.
See "*Éclairage au Gaz*," by Mallet, "*Dictionnaire des Arts et Manufactures*," Paris, 4th ed.

Gas Pro-du'cer. A description of furnace in which gas is produced from coal, to be conducted to a furnace where it is mixed with air and burned. The *gas producer* is the first of the three essential parts of a Siemens' furnace, and is illustrated under GAS-GENERATING FURNACE, which see. See also,

Bicheroux	* "*Iron Age*," xxvii., Jan. 20, p. 1.
Parkes, Eng. . . .	* "*Iron Age*," xvii., March 16, p. 5.
Tessié, Lorraine . .	* "*Engineering*," xxix. 318.
	* "*Iron Age*," xxiv., Aug. 14, p. 1.
Tessié	* "*Engineering*," xxviii. 457,
	* "*Scientific American Sup.*," 3820.
Wilson	"*Amer. Manuf.*," July 16, 1880, p. 12.
	* "*Iron Age*," xxiv., Oct. 23, p. 1.
Ziebarth & Pulsch .	* "*Engineer*," xlv. 110.

Gas Prov'er. (*Gas.*) *a.* A means for testing the quality of gas. This is a chemical operation, (1.) turmeric or red litmus paper, or (2) acetate of lead paper being used to detect ammonia and sulphureted hydrogen respectively. See GAS TESTING APPARATUS; SULPHUR TESTING APPARATUS; GAS VERIFIER.

b. A test for pressure of fire-damp in mines. See GRISOUMETER; CARBUROMETER; FIRE-DAMP DETECTOR.

c. A means for measuring accuracy of meters. See METER PROVER; CONSUMERS' TEST METER.

d. A means for testing the illuminating quality of gas. See JET PHOTOMETER; PHOTOMETER; TEST METER.

e. A means for testing the levity of gas. See SPECIFIC GRAVITY APPARATUS.

Goodwin, "*American Gas-light Journal*," * July 3, 1876, p. 4.

Gas Pu'ri-fi'er. In Mackenzie & Isbell's apparatus and process for reviving and deodorizing the material in the purifying boxes of gas-works, the air is drawn through the openings in the covers, and through the material in the boxes, by the action of a steam-jet exhauster. No steam engine or rotary device of any kind is needed. The air passing through the purifying material takes up the ammonia and sulphur compounds; mingles with the steam; passes through a condenser or washer, where the steam is condensed and the foul matter removed; the air escaping practically pure.

"*American Gas-light Journal*," * July 3, 1876, p. 12.

Braun	* "*Scientific American Sup.*," 2757.
Pelouze & Audouin, Fr.	* *Engineer*," xlix. 350.
Still	* "*Scientific American Sup.*," 914.

Gas Reg'u-la'tor. Another name for the GAS GOVERNOR, which see. An apparatus to cause an equal quantity of gas to pass a gate; contracting the area of the passage as the pressure — and consequent rate of passage — increases; and conversely.

Adams	* "*Scientific American*," xxxix. 306.
Borrodaile	* "*Engineer*," l. 218.
"Imperial"	* "*Scientific American Sup.*," 1713.

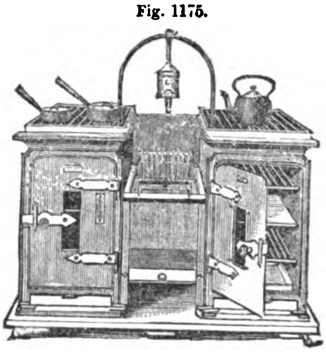
For steam boilers, *Martin*	* "*Sc. American*," xxxvi. 262.
Schooley	* "*Engineer*," xlviii. 153.
Stott, Br.	* "*Engineer*," xlix. 210.
	* "*Man. and Builder*," x. 181.

Gas'si-ot's Cas-cade'. (*Electricity.*) A beaker, internally coated with tin foil to within a short distance from the top, is placed on a glass disk resting on the plate of an air-pump. The whole is covered with the glass receiver, from the top of which depends a glass-covered conductor reaching nearly to the bottom of the beaker, the end of the conductor being exposed. Upon passing a high-tension current from the said conductor to the plate of the machine, and exhausting the receiver, a continuous electrical discharge takes place, passing up out of the cup, and in a cascade form, to the supporting plate.

"*Philosophical Magazine*" . . . . vii. 854.

Gas Range. A form of cooking-stove heated by gas jets, and having the conditions of the range

Fig. 1175.



Gas Range.

as distinct from the stove. It is fitted with 2 ovens, with thermometers attached; also with 5 burners on top for boiling, preserving, stewing, and broiling. See also GAS STOVE, and references *passim*.

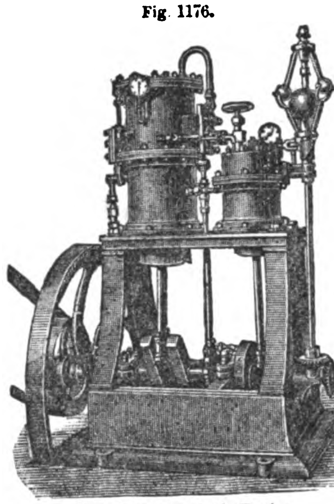
Gas, Steam, and Air En'gine. An aëro-gas engine with steam added. The gas is not used explosively but for the rapid expansion of atmospheric air previously compressed in a cylinder forming part of the engine. A small steam generator is heated by the combustion of the gas and the hot exhaust gases from the power cylinder, the steam being used in the latter to increase the power of the engine.

Simon's engine has two cylinders, one in which air is compressed in mixture with a determinate quantity of gas, and the other into which the mixture passes and is ignited by a constantly maintained flame, the air reëxpanding from the pressure due to its compression, and under the influence of the heat of combustion of the gas and partial combustion of the air.

Fig. 1176 is a perspective view, and Fig. 1177 a sectional elevation of the engine.

In Fig. 1176, *A* is the pumping or compression cylinder; *B* the piston working therein; *C* the connecting-rod, connecting it direct with the crank shaft *G*, on which is the fly-wheel *H*, and bevel wheels *Y*, which by means of the shaft *X* work the governors *O*, connected with which is a sliding cam, *D*, sliding on a feather in the shaft *X*, and connected with the governors, so as to be drawn upwards when, owing to the increased speed of the engine, the balls fly apart. The effect of this is to allow the runner at the end of the slide valve *E* to fall on the narrower part of the cam *D*, and thus to open the air passage *F*, and the gas passage *K*, for a shorter time, admitting less gas and air until the pressure falls, and the speed of the engine is reduced, when the runner of the slide valve *E* again rides on the wider part of the cam *D*. A spring, not shown in the drawing, gives the return motion to the slide valve *E*, and maintains the runner in contact with the cam *D*. After passing through *F* and *K* respectively, the air and gas pass into the chamber *L*,

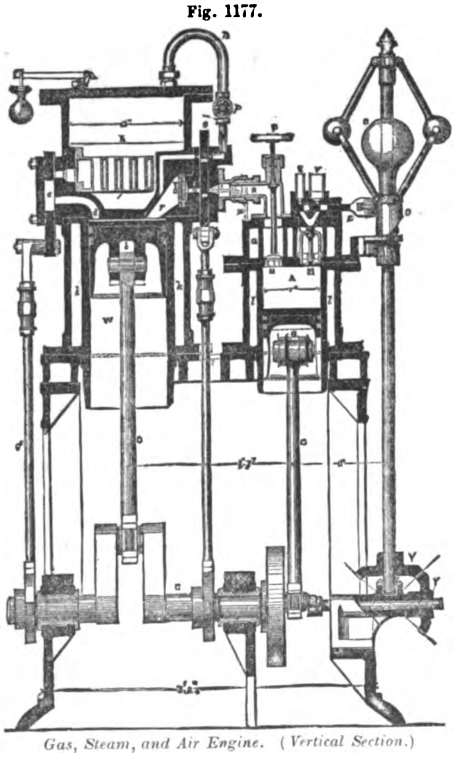
Fig. 1176.



Gas, Steam, and Air Engine.

whence they are drawn through the valve M into the cylinder A by the down-stroke of the piston B. By the return stroke of the piston B the gas and air are compressed and discharged partly through the pipe R into the combustion

Fig. 1177.



Gas, Steam, and Air Engine. (Vertical Section.)

cylinder, and partly into a receiver, Q, from which the internal constant flame at T is supplied; N is a back-pressure valve: P is a stop valve. When this is screwed down the compressed mixture cannot pass into the pipe R, and the motion of the engine is arrested; R being a tube through which the compressed contents of the air-pump A pass to the slide valve S, worked by the rod g, and which admits the mixture through perforated brass disks and wire gauze at T into the interior of the working or combustion cylinder W. A small pipe, Z, also proceeds from the receiver, Q, to the interior of the cylinder W, opening at the point indicated by the black spot under T; b is the piston in the cylinder W, and c the rod connecting it with the crank shaft G; d is the outlet for the exhausted gases to the slide valve e, actuated by the connecting-rod f, which admits them to an arrangement of tubes in the water chamber h from which they are afterwards led away through the exhaust port indicated into the center of the tube space. The water in h is in communication with the water in the jacket or casing, k, surrounding the cylinder W. This water is also in communication with a similar casing or jacket, l, surrounding the cylinder A. The heat of the combustion in the cylinder and the heat of the exhausted gases generate steam in the chamber h, which passes by the pipe n, opened or closed by the stop valve p, and a port, V, in the slide-valve S, into the passage r, and thus into the cylinder W. The water employed is first admitted into the jacket of the compression cylinder, where it keeps that cylinder sufficiently cool, and is at the same time slightly heated. From this jacket it passes to that of the working cylinder, and gains in temperature while it cools the cylinder, and thence passes to the steam generator h. To start the engine it is first turned a few revolutions so as to compress air and gas in the cylinder A, some of which passes into the space Q. A small cock in the pipe Z is then opened, and a plug opposite the spot under T is withdrawn and the gas ignited. The plug is then replaced, and the pipe Z sustains a constant flame in the interior of the cylinder W at T, through which flame the mixture of gas and air compressed in A passes, and in thus passing is ignited. The consequent expansion causes the piston b to make a down-stroke, imparting motion to the crank shaft G, and at the same time the piston B of the cylinder A compresses and discharges into the pipe R and the receiver Q a fresh supply of gas and air. The momentum acquired by the fly-wheel brings the piston b of the cylinder W back to its highest position, and the above described action is repeated.

Gas Stove. Fig. 1178 is a parlor or office stove. It is of cylindrical form, and is fitted with a highly polished copper reflector, and is designed to use illuminating jets only. The heat is thrown into the room by reflection from the copper reflector, also by radiation from the hot-air chamber, the heated air passing into the room through outlets in top of stove.

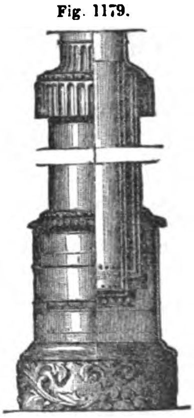
This stove is designed for use in bath and hall rooms where a connection cannot be made with flue.

A stove 27″ high, 8″ diameter, requires 8″ cubic of gas per hour.

Fig. 1178.

Parlor Heater.

Fig. 1179.



English Gas Stove.

Fig. 1179 is a view of an English office gas-stove, partly in elevation and partly in section.

It has an annular pipe pierced with numerous holes for the exit of gas, and situate in an ornamental cylindrical casing to which the air has access. This circle of lights is surmounted by a system of cylinders in cast-iron which absorb the heat developed by the combustion of the gas, and part with it to the surrounding air.

Fig. 1180 shows an adaptation for cooking-stoves. The joint is in the roasting oven, and the heat is reflected from the congeries of gas jets above it.

The baking oven is heated from below and by the heat passing through the flues around it, to the boiler plate above.

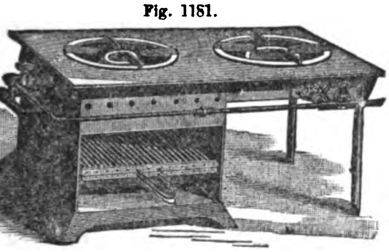
Fig. 1180.

Gas Cooking Stove.

Fig. 1181 is a combined furnace and sub-flame broiler; requiring no special description.

Gas heaters of various kinds are described and shown under specific heads, such as BUNSEN BURNER; BURNER; GAS BLOW-PIPE; GAS HEATER; GAS BOILER; BATH HEATER, etc.

Fig. 1181.



Furnace and Broiler.

Gas Tar Pump. A device to enable the tar pump to be constant in its stroke and action, but limiting the amount of tar raised to the quantity running into the well; keeping a constant level in the well, though the product of tar be irregular.

"*Scientific American Supplement*" . . . . . * 1412.

Gas Test'ing Ap'pa-ra'tus. *a.* The test for ammonia in illuminating gas is to allow a jet of the gas to blow upon a piece of turmeric or reddened litmus paper; for the detection of sulphureted hydrogen use similarly acetate of lead paper.

Hugh Young's apparatus is founded upon this method, pieces of turmeric and acetate of lead papers being suspended in a small glass receiver over an inlet of gas passing to a burner. This testing apparatus is only qualitative.

Dr. Letheby's quantitative sulphur testing apparatus has a meter, governor, and tube leading to a Leslie burner, under which is a beaker containing the requisite quantity of standard liquor ammonia, over the beaker is a glass funnel passing up through the burner, and covering the burner is a trumpet-shaped glass tube which discharges into a large glass condensing cylinder with bent glass tube at an angle of 45° at its farther end.

The *Gas referees' apparatus*, London, has points of similarity to the Letheby apparatus, but uses carbonate instead of liquid ammonia, and its condenser is vertical and contains marbles and has a sealed discharge pipe for liquid of condensation. See SULPHUR TESTING APPARATUS.

The apparatus for taking the specific gravity of illuminating gas is a modification of the Bunsen method (*Bowditch*, 1867, p. 237) by efflux through a fine opening in a thin plate of metal. See SPECIFIC GRAVITY APPARATUS.

In the use of Goodwin's apparatus for the analysis of coal gas, the proceeding is first by qualitative analysis to determine the presence of certain gases: this will decide the order of precedence in their removal. See GAS ANALYZER.

The apparatus consists of graduated glass tubes through solutions in which the gas is bubbled. The re-agents, formulæ for making them, and the directions for procedure in analysis, are in a pamphlet. W. W. Goodwin, Philadelphia, 1877.

b. The gas tester used by the city of Paris is an arrangement of meter, time counter, balance, and photometer. A given amount of gas, passing in a given time, and having a certain gravity, is lighted at a burner and this is compared with a carcel burner of given power, the two lights being simultaneously observed through a tube, the field of vision of which is divided by a vertical plate. See PHOTOMETER.

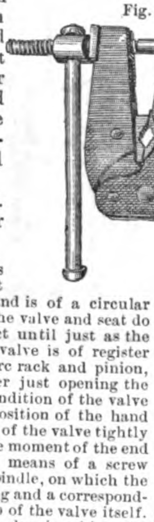
Analysis and Apparatus . .	"*Scientific Am. Sup.*," 2757.
Testing (Edinburgh)	"*Scientific Am. Sup.*," 44.
Giroud	"*Man. & Builder*," viii. 262.
	* "*Scientific Am. Sup.*," 539.
Tests, on, *Harcourt*, Br. . .	"*Van Nostr. Mag.*," xv. 361.
	* "*Engineer*," xlv. 240.
Transmitter, *Newman & Duesbury*, Engl.	* "*Scientific Am. Sup*," 2177.
New York	"*Sc. Amer.*," xxxvii. 163.
Analysis apparatus, *Orsat*, Fr.	* "*Sc. Amer. Sup.*," 3983.
Testing apparatus, *Sadler & Silliman*	* "*Engineer*," xliv. 101.
Analyzing apparatus, *Schwackhoefer*, Aust. .	* "*Engineer*," xlv. 95.
Testing app., *Stevenson*, Engl.	* "*Sc. Amer. Sup.*," 4004.

See also COAL TESTING APPARATUS, Fig. 651, p. 206, *supra*.

Gas Trap. A device to prevent the reflux of gas from the sewer. See SEWER TRAP.

Gas Tube Vise. One specially designed for work upon wrought iron tubes, collars, and couplings. It stands on the floor and has serrated jaw-pieces; the jaw-stock rotatable in a vertical plane.

Fig. 1182.

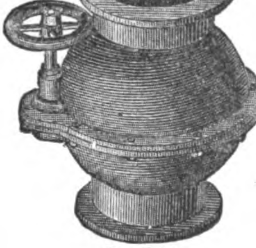


Universal Gas Tube Vise.

Gas Valve. A stop valve for gas mains.

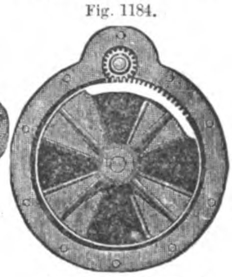
In Root's gas valves the valve seat is cast solid with the case and is of a circular form. In closing, the valve and seat do not come in contact until just as the valve is shut. The valve is of register form moved by an arc rack and pinion, one turn of the latter just opening the valve, so that the condition of the valve can be told by the position of the hand wheel. The closing of the valve tightly against its seat at the moment of the end of its motion is by means of a screw cut on the central spindle, on which the movable valve is hung and a corresponding screw on the hub of the valve itself. Fig. 1185 shows a valve in which the parts involved in friction do not come in contact with gas. Fig. 1186 shows the Eddy valve, which is seated by a rocking bar at the back, operated by the plunger screw.

Fig. 1183.



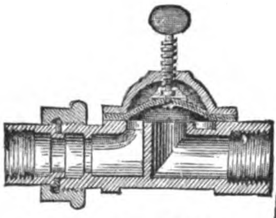
Gas Valve.

Fig. 1184.



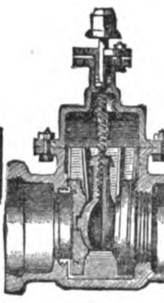
Gas Valve. (Interior.)

Fig. 1185.



Diaphragm Valve.

Fig. 1186.



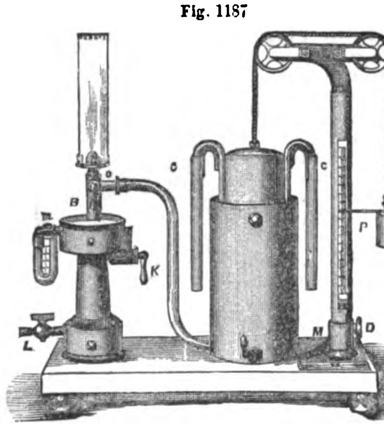
Eddy Valve.

See also, for French gas valves, article by Mallet, *Laboulaye's* "*Dictionnaire des Arts*," etc., tome ii., Figs. 103, 106, cap. "*Eclairage au Gaz.*"

See: "*Sc. Am. Sup.*," * 1428, * 1439.
Walker . . . . . . "*Jour. of Gas Lighting*," * 1877.
"*Scientific Amer. Sup.*," * p. 1552.
Bryan, Donkin, & Co . "*Scientific Amer. Sup.*," * p. 1526.
Mann & Owen . . . . "*Scientific Amer. Sup.*," * p. 1584.
Westwood & Wright . . "*Scientific Amer. Sup.*," * p. 1601.

Gas Ver'i-fi'er. An apparatus intended to verify whether the gas comes up to a given standard. Giroud's apparatus is shown in Fig. 1187.

Fig. 1187



Apparatus for Estimating the Value of Gas.

It consists, first, of a reservoir or gasometer, of which the movable part is balanced by a variable counterpoise *P*, to which a needle is attached moving along a scale, so as to measure the amount; 2d, of a burner inclosed in a glass chimney, and in the foot of which are three cocks, *L*, *K*, and *A*, and also a pressure-gage, *m*. It is proposed to be used in the following manner: The gas is entered at *L*, and ignited, and the height of the flame regulated by the cocks *L* and *K*, so as to be 4″ high. The cock *B* is a two-way cock, which, if the handle is turned to a horizontal position, sends the gas into the gasometer. This is then done for the space of exactly one minute, and if the gasometer is raised 5″, the gas is equal to the standard of Paris; if it has risen less it is better, if more it is inferior.

It will be seen that this manipulation is based upon trying how much gas will be consumed in one minute in order to produce a flame of given constant size, and this trial again is based upon the fact that the more inferior a gas is the more it will shorten a flame, and consequently the more be required to produce a flame of given length, and the richer a gas is in carbon the longer will be the flame, and less will be required to give a flame the standard length.

The test is thus independent of photometric experiments, by which the amount of luminosity is determined.

See also GAS TESTER, *supra*; and PHOTOMETER, *infra*.

Gas Vul'can-i'zer. A small muffle heated by gas and used in vulcanizing dental bases. The cover is secured by three set-screws, which play in a movable screw collar, and produce direct pressure upon the packing joint. The thermometer bulb is immersed in a mercury bath outside the steam chamber. Fig. 1188.

Gas Wash'er. (*Gas.*) A tall cylinder in which the gas is brought in contact with a falling stream of water in order to precipitate the tar.

Fig. 1188.

Dentists' Iron-clad Boiler.

Washers and scrubbers, Br.
Anderson, * "*Eng'ing*," xxviii. 43.
Washers and scrubbers, on, Br.
Patterson, * "*Eng'ing*," xxviii. 313.
Saville . * "*Sc. Am. Sup.*," 1026.

Gas Well. Information on gas-wells in the following: —

"Delamater"
"*Scientific American Sup.*," 1267.
"*Scientific American Sup.*," 90.
"*Scientific American Sup.*," 757.
(Pennsylvania.)
"*Scientific Amer.*," xxxvi. 196.
Wells of Pennsylvania.
"*Scientific American Sup.*," 439.
(Wyandotte). . . . . "*Scientific American Sup.*," 1427.

Gate. 1. The passage leading fluid metal into a mold.

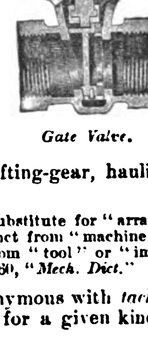
The large opening into which the metal is first poured is termed *pouring* gate. The recess below, or in connection with the pouring gate, for skimming the iron, is termed a *skimming* gate; the little passages from the skimming gate to the mold are *sprue* gates, usually *sprues* only: those openings by which the supply of iron is kept up after the casting is poured are *feeding* gates.

2. References to gates in hydraulic works and for inclosures: —

Flood gate, *Rhea* . . . * "*Scientific Amer.*," xxxiv. 278.
Flood valve drainage,
Salford, Br. . . . . * "*Engineer*," xlvii. 138.
Railway gate, *Brenton*, Br. * "*Engineer*," xlviii. 259.
Farm gate, *Cooksey* . . * "*Scientific Amer.*," xxxviii. 326.
Sliding and swinging.
Shopbell . . . . . * "*Scientific Amer.*," xxxv. 179.
Gate closer, *Kohnman* . * "*Scientific Amer.*," xliii. 38.
Gate valve . . . . . * "*Man. & Builder*," xii. 88.

Gate Valve. A valve for water or gas main. A stop-valve. Jenkins' gate valve has a disk of compressible packing held to its seat by a wedge-shaped follower.

Fig. 1189.



Gate Valve.

Gat'ling Gun. The machine gun of Gatling is illustrated on pp. 249, 250, and Plate VI., "*Mech. Dict.*" See also GUNWALE GUN, *infra*.

According to time kept at a recent trial at Sealand Range, Chester, 1,000 rounds per minute were fired from a single gun.

Gun in ship's top.
* "*Sc. Am.*," xxxviii. 227.
Recent improvements.
* "*Sc. Amer.*," xxxv. 114.
* "*Sc. Amer.*," xl. 367.

Gear. 1. A combination of parts to effect an object, as lifting-gear, hauling-gear, draw-gear, valve-gear.

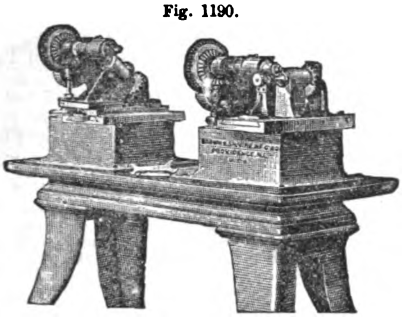
It is a useful word, serving as a substitute for "arrangement" or "apparatus." It is distinct from "machine" or "engine," in one direction, and from "tool" or "implement," in the other. See GEAR, p. 960, "*Mech. Dict.*"

2. (*Fishing.*) A term synonymous with *tackle*: the special rig or arrangement for a given kind of fish or fishing, such as —

Deep-sea gear.	Bottom gear.
Short hand-gear.	Flounder gear.
Shark gear.	Cod hand-line gear, etc.

Gear Cut'ter. Fig. 1190 is the Brown & Sharpe automatic bevel and spur gear-cutting machine. Two machines are shown on the same stand; one is designed for cutting spur and the other bevel gears. They are specially intended for the gears of sewing-machines and other light work.

Fig. 1190.



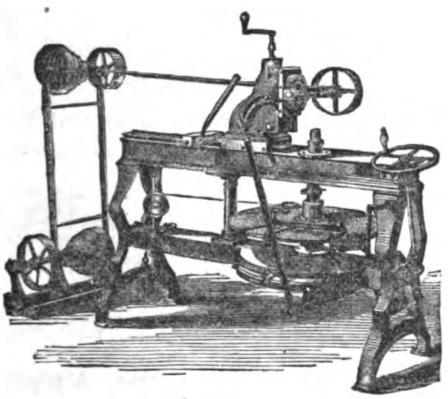
Gear-cutting Machine.

The machine is automatic to the extent of revolving the wheel from tooth to tooth, cutting through for each tooth, and stopping when the wheel is completed.

Upon the machine for bevel wheels, the movement of a lever places the wheel in position for making the second cut, when the same movements are repeated, completing the wheel. The spindles run in anti-friction boxes, provided with means for compensation for wear.

Fig. 1191 is another form of machine, adapted to cut spur, spiral, and bevel gears up to 54″ diameter.

Fig. 1191.



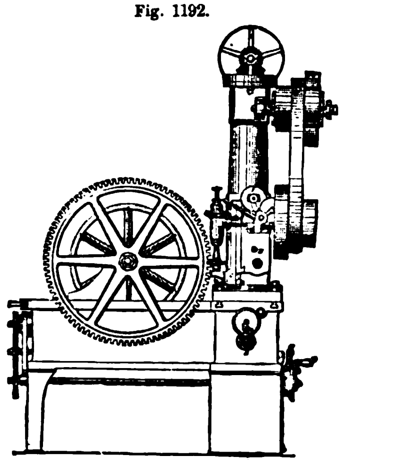
Gear Cutter.

The cutter is mounted upon shears like those of a lathe, and driven by counter gearing. The index-wheel is placed horizontally beneath the shears, and is worked by a lever.

Fig. 1192 shows Sellers' gear-cutting and wheel-dividing machine.

It is arranged for cutting both spur and bevel wheels, has a capacity up to 54″ diameter of wheel, 12″ face, and will cut a number of small spur-wheels of same size at one time. It is entirely automatic, performing all its work after adjustment, without attention of workman, to the completion of the wheel being cut or divided. The division is obtained by a tangent wheel and worm, and the designated number of teeth is obtained by use of change wheels, and the turning of the handle for change 1, 2, or 3 times, as may be called for on the schedule of division. This turning of the handle, however, and all other motions, are done by the machine itself. Thus, a blank wheel being put in place, and the proper cutter adjusted to depth of teeth, length of stroke of cutter-head, etc., the cutter will pass across face of wheel, cutting space between two teeth, will then return at a quick pace to the starting side of wheel, the blank will then be turned to present a second space to be cut, and the cutter will start its proper motion, all the changes being made by the machine itself, not by the attendant workman. The range is from 10 to 360 teeth.

Fig. 1192.



Gear Cutter.

The Corliss bevel-gear cutter, shown at the Centennial Exhibition, was used in cutting the large bevel wheels in the underground train of gearing by which power was distributed from the large engine. These motor-wheels are 6′ in diameter, weigh 3,000 pounds, have 14½″ face length of tooth, 4″ depth. The machine was illustrated in "*Harper's Weekly*," July 29, 1876.

The machine is an application of the planing machine to the purpose of gear-cutting. It has the appearance of a large quadrant, the vertical arm 14½′ high, and has also a horizontal arm, which is a mandrel carrying on its end the wheel to be cut. Midway between the vertical and the horizontal — when cutting bevel-gear having a face angle with its shaft of 45° — is an oblique arm which carries the cutter. It looks large enough to be a piece of ordnance with an elevation of an angle of 45°. This arm has beneath it the cutting tool, which is reciprocated by rack and pinion, its effective stroke being the downward. The arm oscillates on a center coincident with the axis of the pinion which drives the planer bar.

The angle of this arm in the frame depends upon the angle of bevel to be cut, and the capacity of the machine may be said to range from 15° to 75°, though these are unusual ranges.

The bevel-wheel, having been cast in the sand with its teeth approximately the shape required, is bored out and slipped on to the mandrel, where it is secured. On the rear end of this mandrel is the wheel, 15′ in diameter, and graduated so that any proportion of a circle can be turned at a time, according as the wheel may be desired to have 60, 64, 120, 200, or any other number of teeth. In the particular instance of the miter wheels for the train of the machinery building at the Philadelphia Exhibition, the number of teeth required on the wheel was 54, and one row of holes in the face of the wheel is 216 in number, so the wheel must be moved four holes for each successive tooth, and rigidly secured by pin and clamp before cutting.

A flat plate of steel is made of exactly the contour of tooth required, certain invariable rules being observed in the shape, while certain other elements of proportion are variable, and must be determined by the *pitch*, or distance from center to center of cogs measured on a certain line, the radius of the wheel, and what not, so that the teeth shall roll nicely upon each other and not rub. This is a complex matter to determine, and then a delicate one to execute. This pattern of tooth is secured in the quadrantal or arch-shaped member of the frame, a mandrel on the end of the arm lying against it, and slipping down against the pattern as the cutter is fed along down the tooth after each stroke, the pattern swerving the arm laterally to the necessary extent. This is the adjustment for *shape of teeth*.

The *cut of the tool* is adjusted by regulating the position of a pin of the feed motion to or from the center of oscillation of an arm. At the end of each down stroke a shifting gear ships the belts and a quick *gig-back* motion results, which is again shifted to the *feed* as the planer reaches the upper end of its stroke.

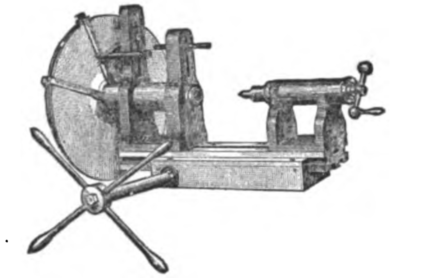
In Comly's process for making pressed gearing the wheels are made of wrought iron or steel, the teeth being forged or pressed by the action of a die revolving in contact with the heated blank wheel, which also revolves at the same time.

Grube's bevel wheel cutter (German), was shown in the German section of the Machinery Hall, Philadelphia, 1876.
Ingold (Chaux de Fonds, Switz.), exhibited at the same time and place his cutter for dressing the teeth of watch and clock wheels to give the epicycloidal form.

Gear-cut'ting At-tach'ment. Fig. 1193 shows Pratt & Whitney's gear-cutting attachment to the Universal Milling Machine.

It is designed for cutting larger and heavier wheels than can be cut with the ordinary apparatus belonging to the machine. It swings 13″, and is furnished with a 20″ index

Fig. 1193.



Gear-cutting Attachment.

containing 4,294 holes. It will divide all numbers to 75 and all even numbers to 150. Arbors fitted to the universal milling machine can be used in this attachment. The screw with set-nuts over the spindle supports the wheel while being cut.

Gear-cutting att. for lathes,
Mills . . . . * "*Sc. American*," xxxiv. 166.
Sellers . . . . "*Thurston's Vienna Report*," iii. 215.
* "*Sc. American*," xli. 54.
Brown & Sharpe . . . . * "*Sc. American*," xxxvii. 271.
Molding machine, *Scott* . * "*Thurston's Vienna Report*," iii. 321.
Cutter action, *Gleason* . . * "*Sc. American*," xxxviii. 409.
Planer action, *Gleason* . . * "*Sc. American*," xli. 150.
Elliptic gearing . . . . * "*Sc. American Sup.*," 21.
Regular rotary into irr. rot. * "*Sc. American Sup.*," 715.
Odontograph, *Stolp* . . . * "*Sc. American*," xxxviii. 22.
Toothed and frictional, article "*Engrenage*," * tome iv., ed. 1877, *Laboulaye's* "*Dictionnaire des Arts*," etc.

Geared Brace. A boring tool in which the drill or bit is rotated by hand crank and bevel gear.

Geared Lo'co-mo'tive. A locomotive in which the motion of the engine is conveyed by gearing to the traveling wheels. Such is common in road-rollers and traction engines. *Vide* Figs. 4360, 4361, 4363, 4364, pp. 1952, 1953, "*Mech. Dict.*" The same plan has been adopted in locomotives for ascending heavy grades.

Geared locomotives, built by Lewin, Poole, England, for Guinness & Co., Dublin, are shown in the British journals. They are for use in the brewery yard. The width of the engine is 4′ over all.

The engine has but one cylinder, 6¼″ in diameter, and with a stroke of 8″. The motion of the engine is conveyed by steel gearing to the traveling wheels, which are also of cast steel. When running at 280 revolutions per minute the speed of the traveling wheels is six miles per hour. A wrought iron clutch gear is arranged on each engine, so that they can be used for driving other machinery on the premises. The piston, valve-rods, and all pins are of steel. The engine is carried on a strong bed-plate, fixed to wrought iron brackets riveted to the boiler, and suitable provision is made to allow of the expansion of the boiler. The regulator and other gear are all on the outside. The boiler is made with double riveted longitudinal seams. The ordinary working pressure of steam is 140 lbs. per square inch. At the front end of the engine two buffers are fixed in the ordinary way, but the back or foot-plate end is made semi-circular, and is provided with a radial draw, to enable the engine to pass with the wagons round the very short curves which are frequently met with on the brewery premises; the sharpest of these is 12′ radius; the gage is 22″. There are also several inclines on the line, the steepest being 1 in 30, and up to this a load of 16 tons is frequently taken, the engines being capable of pulling a load of about 40 tons on the level. * "*Scientific American*," xxxvii. 247.

Geared Scroll Chuck. A lathe or drill chuck in which the motion of a scroll plate acts upon gears on the jaw-pieces to cause the jaws to advance and recede concertedly, preserving equal distance from the axial center of the lathe. See *g, i, k*, Fig. 1287, p. 548, "*Mech. Dict.*," and Figs. 874–876, pp. 275, 276, *supra*.

Gear Tooth Gage. A scribing and testing gage, used in connection with a gear cutter for marking the depth to which the cutter should penetrate. Gages are made for all regular pitches, from 4 to 32 pitch, inclusive, one answering for each pitch.

When using a gage for any given pitch, a slight mark can be made on the wheel opposite where the first space is to be cut, and the cutter set just to the right depth by it.

Ged'des Har'row. A field harrow made of two V's inverted, and hinged to a central bar, so as to give flexibility to the tool when passing over ridges and inequalities.

Fig. 1194.

Geddes Harrow.

A and V harrows are well-known forms and are shown under Harrow, "*Mech. Dict.*," and, compounded with circular sections, under Harrow, *infra*.

Geis'ler Tube. An instrument in which light is produced by an electric discharge in rarefied air and gases. The colors are varied by using different gases.

Prof. Morton's Lecture, "*Electric Light*."
* "*Scientific American Sup.*," 2404, 2645.

Gel'a-tine, Blast'ing. An explosive invented by Nobel, composed of

Nitro-glycerine	94 to 95
Collodion	6 to 5

It is viscous, can be cut with a knife or scissors; is not affected by water, like dynamite, and its power is much greater,

Gelatine dynamite . . "*Iron Age*," xxii., Nov. 28, p. 5.
Blasting . . . . . "*Scientific American Sup.*," 2598.
"*Scientific Amer.*," xxxviii. 210.

*See Blasting Gelatine, 105, *supra*.

Gel'a-tine Cop'y-ing Pro'cess. A popular process for copying letters or orders, as a substitute for manifolds, is as follows: —

The original is written or drawn with thick aniline ink, generally Poirrier's "Violet de Paris," on ordinary smooth paper. Lay the writing upon an elastic cake of a special preparation contained in a shallow tray, press the paper on and take it off after two minutes. The greater part of the writing will be found to have been absorbed by the elastic cake, from which a number of reprints may be obtained, generally from 40 to 50. The cake must be wiped with a wet sponge if it has not been used for a length of time, and should always be kept in a cool place. As soon as the necessary number of copies has been taken, the writing must be at once removed from the cake by washing with cold or warm water, according to its nature, there being two different compositions, the preparation of which is described by Prof. Dr. V. Wartha, as follows: Warm a mixture of 100 grams of the finest gelatine with 400 to 500 cubic centigrams of a pasty precipitate of sulphate of baryta, and then add 100 grams of dextrine and from 1,000 to 1,200 grams of glycerine. The mass is allowed to cool until it is just possible to pour it, when it is transferred into shallow tin trays. If the cake be too hard, glycerine must be added. Another composition, which is said to yield sharper copies, but with which it is necessary to use warm water to remove the ink after use, is the following, preferred by Professor Wartha: 100 grams of gelatine, 1,200 grams of glycerine and 500 cubic centigrams of sulphate of baryta.— "*Dingler's Journal*."

Various names have been given to the process, some of them acceptable and others absurd: hectograph, polygraph, copygraph, lithogram, etc., etc.

An excellent ink, which will yield 100 copies, is readily prepared by dissolving rosaniline in a cold, saturated solution of oxalic acid. It must be allowed to dry spontaneously.

The pad may be made of 4 oz. gelatin dissolved in 6 oz. water, and 20 oz. glycerine, sp. gr. 1.26, previously warmed, stirred in. Any air bubbles in the gelatin are removed before the addition of the glycerine. A cheaper compound which answers equally well, but is rather darker, consists of Scotch glue, 6 oz.; water, 8 oz.; glycerine, 20 oz. These qualities make a slab 10 × 13 × ½″.

Any number of colors may be used in the original drawing, and Mr. Norman Lockyer has suggested that it would be of much use in laboratories, for the multiplication of original sketches of biological specimens, and even for spectra charts, and so save much of the time spent in making duplicate copies.

Herr Adler's gelatine printing process is as follows: —

"Use for writing or drawing a concentrated solution of alum, to which, in order to render the writing or drawing visible upon the paper, a few drops of some aniline color is added. Before laying the writing or drawing upon the gelatine surface, pass a damp sponge over the latter, and allow the moisture to sink in for a few minutes, so as to have a greater effect upon the alum. Then lay the written side downward upon the gelatine, and after the lapse of a few minutes, on removing it, the writing will be found reversed and eaten into the gelatine film as if it were engraved. By means of an india-rubber roller a little common printing ink is spread over the plate and absorbed by the lines sunk by the alum, and rejected by the moist gelatine. The paper is laid down upon it and smoothed over it by the flat hand. When removed, this paper will have upon it the impression of the writing or drawing. For each succeeding impression the plate must be inked, as in lithography, by the india-rubber roller. A considerable number of impressions can be taken."

See: —

Houlgrave . . . . * "*Scientific American Sup.*," 2763.
"*Van Nostrand's Mag.*," xxii. 431.
Copying process . . . * "*Scientific American*," xl. 104.
Printing . . . . . "*Scientific American Sup.*," 2868
Manufacture of gelatine * "*Scientific American Sup.*," 402.

See also COPYGRAPH; HECTOGRAPH; MANIFOLD; COPYING PENCIL, and references *passim*.

Gems, Ar'ti-fi'cial. The base is strass obtained by melting together —

Carbonate sodium . . . . 6 drachms.
Burnt borax . . . . 2 drachms.
Saltpeter . . . . 1 drachm.
Minium . . . . 8 drachms.
Pure white sand . . . . 1.5 oz.

To color, add: for the gems named —

Sapphire . . . . . . 10 gr. carb. cobalt.
Opal . . . . { 10 gr. ox. cobalt. 15 gr. ox. mang. 25 gr. protox. iron. }
Amethyst . . . . . 5 gr. carb. perox. mang.
Gold topaz . . . . . 30 gr. ox. uranium.
Emerald . . . . . . { 20 gr. protox. iron. 10 gr. carb. copper. }

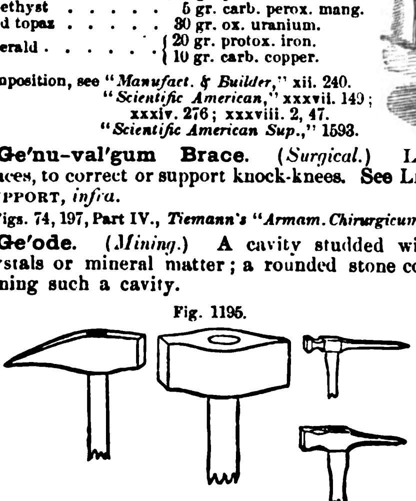
Composition, see "*Manufact. & Builder*," xii. 240.
"*Scientific American*," xxxvii. 149; xxxiv. 276; xxxviii. 2, 47.
"*Scientific American Sup.*," 1593.

Ge'nu-val'gum Brace. (*Surgical.*) Leg braces, to correct or support knock-knees. See LEG SUPPORT, *infra*.

Figs. 74, 197, Part IV., *Tiemann's "Armam. Chirurgicum."*

Ge'ode. (*Mining.*) A cavity studded with crystals or mineral matter; a rounded stone containing such a cavity.

Fig. 1195.



Geological Hammers and Picks.

Ge'o-log'i-cal Ham'mer. One for hewing hard rocks, or for extracting fossils from rocks. The larger sizes are for breaking and crushing, and the smaller for trimming. See Fig. 1195.

Ge'o-met'ric Lathe. Elaborate illnstrated article on geometric lathes, the applications to engraving, medaling, and turning, 43 illustrations, article "*Tours Composés*," Figs. 25, etc., *Laboulaye's "Dictionnaire des Arts et Manufactures,"* tome iv. See also GEOMETRIC LATHE; ROSE-ENGINE LATHE, "*Mech. Dict.*"

Ge'o-scope. An instrument to demonstrate the movement of the earth. *Mancel de Percival.* "*Technologiste*," xl. 470. See also ARMILLARY SPHERE; COSMOSCOPE; ORRERY; TELLURIAN, etc.

Ger'man Sil'ver. The recipes given vary greatly in proportions, while still generally preserving the trinary composition.

Kirk gives the following; which compare with recipes on pp. 63, 964, "*Mech. Dict.*:" —

	Copper.	Nickel.	Zinc.	Iron.
German silver . .	80	20	33.5	–
Better	100	50	50	–
White copper / Chinese packfong	41	17	13	1
Hard	8	2	4	1
Harder	16	4	8	3
Finest	16	8	7	–

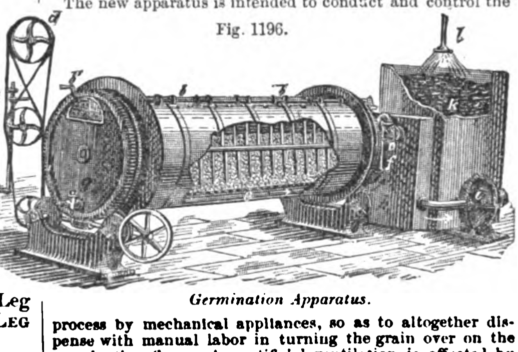
Analysis . . . . . . "*Scientific American*," xxxv. 166.
Compositions . . . . "*Iron Age*," xxi., March 14, p. 5.

Ger'man Steel. (*Metallurgy.*) A metal obtained from spathose or bog ore by treatment with charcoal.

Ger'mi-na'tion Ap'pa-ra'tus. An apparatus invented by M. Gruber, in which the malting of grain is conducted; including the steeping, couching, and flooring; the kiln drying is a subsequent process. See MALT DRYER; MALT MILL, etc.

The new apparatus is intended to conduct and control the

Fig. 1196.



Germination Apparatus.

process by mechanical appliances, so as to altogether dispense with manual labor in turning the grain over on the germinating floor. An artificial ventilation is effected by means of a current of humid air passing downward through the grain. This ventilation keeps the mass at a relatively low degree of temperature (54° F. to 56° F.), and at the same time draws off the carbonic acid gas as fast as it is produced. Moreover, the thorough turning over of the grain, and its complete division by the periodical rotation of the cylinder, in which the germination takes place, insure a most regular and uniform development of both rootlets and plumule.

Fig. 1196 shows the apparatus. It consists of an iron cylinder, which by means of an endless screw receives a slow rotatory movement. The letters refer to the following parts:

b. Longitudinal openings for charging and emptying the apparatus.

b'. Handle for opening and closing the above.

c. Sheet-iron gratings for admission of moistened air.

d. Mechanical appliances for giving motion to the cylinder.

e. False bottom of perforated sheet-iron supporting the grain, and through which the air is drawn downwards.

f. Pipe for drawing out the air.

g. Tap for admitting and drawing off the steep water.
h. Exhaust chest.
i. Fan.
k. Chamber for moistening the air by filtering it through porous substances kept constantly saturated with water.
l. Shower of water on the moistening chamber.
o. Valve for regulating the draft of air.
p. Rake for dividing the layers of grain during the rotation of the cylinder.

Gruber . . . . * "*Scientific American Supplement*," 2686.
* "*Scientific American*," xxxvii. 152.

Ges'ten-ho-fer Fur'nace. One in which the burning of the sulphur from the powdered ore accomplishes its calcination.

The sulphurous vapor is used to make sulphuric acid, and the acid employed to make soda from common salt.

See notices under CALCINING FURNACE, p. 152, *supra*.

Gibbed Lathe. A lathe the carriage of which has a bar which grips beneath the overhang of the bed, beneath which it is secured by a wedge known as a *gib*, to prevent the riding up of the carriage.

In a *weighted* lathe, on the contrary, the carriage is held down upon the shears by a weight suspended beneath the carriage.

Gif'fard In-ject'or. See INJECTOR.

Gild'ing Press. A book-binder's press, for gilding covers and edges of books.

The edges of books, and hand-work on backs and covers, is done while the book is clamped in a press, 3, Fig. 1578, p. 668, "*Mech. Dict.*"

On a larger scale the full-arch or half-arch press is on the principle of 1, Fig. 1577, *Ibid.*

Gild'ing. Attaching an overlay of gold.

Gilding by dipping. — Dissolve 10 grams of gold in 40 grams of hydrochloric acid, and 15 grams of nitric acid; throw down the gold as fulminating gold by means of spirits of ammonia; filter, and wash. In the mean time dissolve 100 grams of cyanide of potassium in as small a quantity of water as possible, and then dissolve the gold upon the filter with the cyanide solution. Pour this solution again and again over the filter until all the brown particles are dissolved, when the gilding solution is prepared by the addition of 1 liter of distilled water. Into this solution, while warm, dip the metallic object to be gilded, and when drawn out it will have all the appearance of polished gold. — *Ebermeyer.*

Gilding on Glass. — Gold, chemically pure, is dissolved in aqua regia (1 part nitric, and 3 parts hydrochloric acid). The solution effected, the excess of acids is evaporated on a water-bath till crystallization of the chloride of gold takes place; it is then taken off and diluted with distilled water of such quantity as to make a solution containing 1 grain of gold to 200 cubic centimeters of liquid: a solution of caustic soda is then added until the liquid exhibits an alkaline reaction. The solution of gold is now ready for reduction. As a reducing agent, an alcoholic solution of common illuminating gas is used. This is prepared by simply attaching a rubber tube to a gas-jet and passing the current of gas for about an hour through a quart of alcohol. This liquid (which should be kept in a closed vessel) is added in quantities of from two to three cubic centimeters to 200 cubic centimeters of the alkaline solution of gold before mentioned: the liquid soon begins to turn to a dark green color, and at length produces the metallic layer of gold of known reflecting power. — *Dodon* in "*Moniteur de Ceramique.*"

Designs or ornaments of any kind can be produced on glass or ivory, by painting, with a very fine camel-hair pencil, nitro-muriate of gold over the designs. Hold the glass or ivory thus painted over a bottle, in which hydrogen is being generated; in a short time the design will shine with considerable brilliancy, and will not tarnish upon exposure to the air. The thickness of the coating of gold is not more than the ten millionth part of an inch. Another method, in which the use of hydrogen is dispensed with, is to mix gold powder with borax and water; then paint the lines and ornaments with it. When quite dry, the glass is to be put into a stove, heated to a high temperature. The borax is vitrified, and cements the gold with great firmness to the glass. — "*English Mechanic.*"

See: Glass . . "*Scientific American*," xlii. 42; xxxix. 104.
Dodson . . "*Min. and Scientific Press*," xxxvii. 407.
Iron Work . . "*Iron Age*," xvii., April 20, p. 15.
"*Scientific American*," xxxvi. 291.

Gill Net. (*Fishing.*) A flat web net fastened at one or both ends, and arranged by floats and weights carefully proportioned to float near the surface of the water, at an intermediate depth, or at the bottom.

When it floats with the tide it is called a *drift* net.

The gill-net captures a fish by entangling it in its meshes.

The gill-net of Lake Michigan, and salmon-net of the St. Lawrence, are shown on pp. 256, 257, "*Report of U. S. Commissioner of Fish and Fisheries*," vol. i., Part I., 1873.

The *stake*-net is a form of gill-net.

The gill-nets for white fish, used on the Great Lakes, may serve as an instance.

"The gill-netting in use on the Great Lakes is knit from linen thread, two and three ply (25-4, 2-cord, and 30-50, 3-cord), from eleven to twenty-two meshes in depth, 3¾ to 5″ mesh. The nets, when hung or mounted for use, contain from one to three pounds of webbing, and range in length from 60 to 120 yards, and in depth from 4½′ to 6′. They are set in gangs of from three to five nets, and three to five gangs are laid out in one setting usually by aid of sail-boats or steamers.

"For floating the upper line, round or octagonal floats of bark, or wooden pickets about 2½′ in length, are used. Sinkers are of lead or stone. The nets are set in from 20 to 100 fathoms of water, the lead-line resting upon the bottom. They are taken out once a week and dried.

"They are used principally for the capture of the white-fish (*Coregonus albus, etc.*), and the lake trout (*Salmo namaycush*), though most of the common lake fishes are taken in these meshes. Sea-Island cotton (3, 4, 5, and 6 thread) is being largely substituted for linen in their manufacture.

"The weight of the twine preferred by fishermen varies in different localities, that used in Green Bay being the finest, that in Lake Erie next, then Lakes Michigan and Superior, and heaviest in Lake Huron. Lake Ontario consumes about 5,000 pounds of netting annually, Erie 7,500, Huron 6,000, Michigan 20,000, Green Bay 2,500, and Lake Superior 5,000. The aggregate length of this netting is probably about 4,575,000 yards." — *Bulletin U. S. National Museum.*

Gin. Cotton gins are of four principal kinds, the *roller*, *comb*, *saw*, and *needle* gins. The comb is Spanish (*almarraes*), and has mechanical importance.

The roller gin is found throughout India, Malaysia, and China, and has received its proximately perfect development in the Macarthy gin and its relatives.

The Macarthy double roller gin made by Platt Bros., of Oldham, England, has, as its name implies, two rollers instead of one, the feeding hopper being between the two. In the familiar Macarthy gin a reciprocating blade is employed in conjunction with a fixed blade and roller, but, in this later form of gin, two reciprocating blades come into action alternately. A simple contrivance regulates the feeding, making it uniform, and another regulates the pressure of the knifes, called in the American Macarthy gin, *stripper blades*, so as to adapt them to the work of the moment, and allow an obstruction to pass through without clogging or arresting the machine, or breaking the knife or stripper-bar.

The rollers are covered with walrus leather, far more durable, and, from its peculiar texture, superior to sole leather. Each roller rotates in contact with a fixed knife, dragging by its rough surface the fibres of cotton between itself and the knife. Besides these parts there are moving knives, to each of which is attached a grid, or series of fingers. At each elevation of the moving knives, which rise alternately, the grids attached thereto lift the cotton to the elevation of the fixed knife edge and of the exposed surface of the rollers. On the descent of each moving knife the seeds which have been separated from the fiber are disentangled by the prongs of the moving grid passing between those of the lower or fixed grid about 750 times per minute, and are, by this rapidity of action, flirted out.

The turn-out is from 120 to 190 pounds of cleaned cotton per hour. The machine was shown in operation at the Paris Exposition of 1878. It was there stated that 10,000 of the double Macarthy gins were in use in India; and 5,000 of the single Macarthy in Egypt.

The double action knife roller gin is made by Dobson and Barlow, of Bolton, England.

It is entirely self-feeding and self-acting, and the motion for detaching the cotton from the seed differs from that in any other make of gin. The leathern roller is solid, being composed of round disks of walrus leather with a square shaft through the center. These disks are pressed together mechanically with so much force that when withdrawn from the pressure they form a perfectly solid body. The knife-roller consists of a number of disks fitted obliquely on a wrought iron shaft; it revolves continuously in one direction, the knives gently moving the seeds to and fro while the leathern roller draws the cotton from them until the seeds are perfectly stripped, when they fall unbroken into a receptacle provided for them on one side of the machine, while the cotton is delivered in a continuous fleece at the other side.

When worked at the prescribed speed, a 40″ knife-roller gin is capable of ginning the following quantities of seed cotton per hour. —

Dhollerah, 300 lbs.
Candeish, 333 lbs.
Madras, 307 lbs.
Dharwar-American, 230 lbs.
American uplands, 329 lbs.
Egyptian, 690 lbs.
Sea Island, 387 lbs.
Brazilian K, 460 lbs.
Tinnevelly Madras, 500 lbs.
Broach, 348 lbs.
Native Indian (various), 820 lbs.

These results were obtained from this knife-roller gin, at the trials in Manchester and India under government auspices. The double-action knife roller gin can be adapted for any kind of cotton by a change of the grid through which the seeds have to fall, and it has the merit of simplicity in construction and adjustment, large turn out of clean cotton uninjured, and having neither crank nor cam motions.

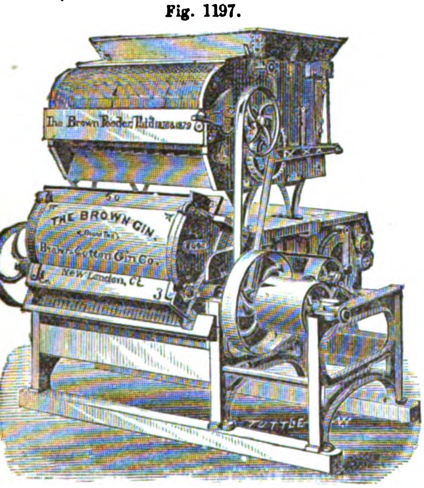
These gins are made of various sizes, with rollers 10″ long, to be worked by hand; 20″, 30″, and 40″ wide, to be driven by power.

The cleanness of work, and avoidance of damage to the staple secured by the Macarthy gin, and the large turn out of the saw-gin, are claimed to be united in this knife roller gin.

Fig. 1197 shows the Brown Saw Gin, with feeder and condenser.

The cotton is dumped into the hopper of the feeder, and is taken up by teeth on a revolving drum that runs in the semi-circular front, carried over and dropped into the hopper of the gin upon the saws that are revolving at a speed of 375 revolutions per minute. These saws run between grates or

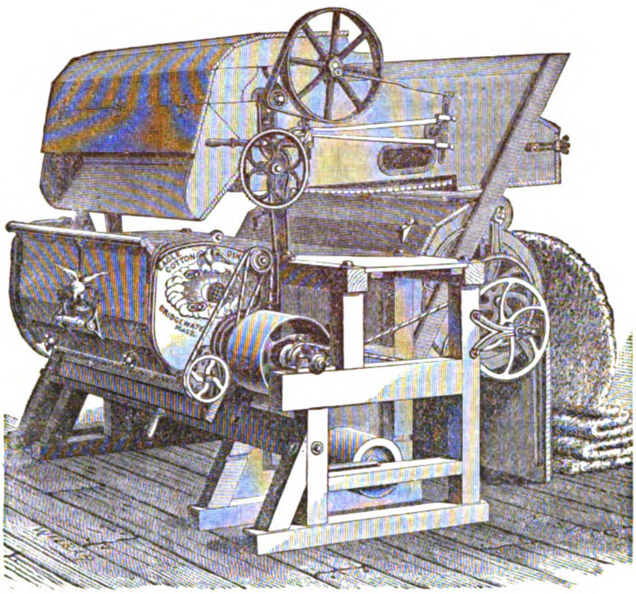
Fig. 1197.



Cotton Gin Feeder and Condenser.

bars that are set say $\frac{1}{8}$″ apart, and pick the cotton from the seed, carrying the lint cotton between the bars, where a brush is revolving at a speed of about 2,400 turns per minute. This brush wipes the cotton from the teeth of the saws, and it is carried by the current of air (caused by the revolving brush) into the condenser at the rear, when it passes between two wooden rollers and is dropped upon the floor in a pile. The saws number from say 30 to 80 in a gin, the average being about 50.

Fig. 1198.

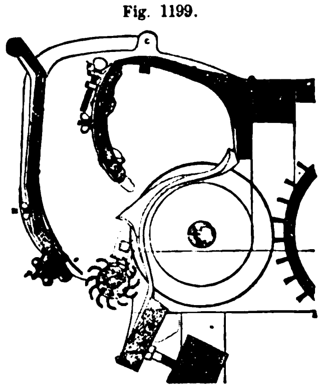


Eclipse Hulling Gin.

Fig. 1198 shows the Eclipse Hulling Gin, for working upon cotton gathered with the bolls. It consists of three parts, feeder and breaker, gin, and condenser.

The feeder and breaker, which is the upper member of the complete machine, is used to break the bolls apart before ginning, as well as to feed the gin. It has a strong, rapidly revolving cylinder with blunt points, to bring the cotton to the breast. This runs parallel with another cylinder, moving more slowly, and having wires in it bent backward. Between the two cylinders the cotton is well opened, and all the whole bolls are broken apart, putting them in such condition that the gin will easily discharge them, and at the same time knocking out a large amount of leaf and dirt. This machine picks its cotton on the under side instead of the top, as has heretofore been done.

Fig. 1199.



Eagle Cotton Gin. Sectional View.

The principle of action is described, and several illustrations are given of cotton gins, on p. 969, "*Mech. Dict.*" Fig. 1199 shows a sectional view of the breast, huller, gin-saw, and brush of the "Eagle" Cotton-gin.

The cotton is fed into the outer breast and drops upon the huller roller (*B*), and is carried by it constantly to the saws. The hulls are stopped by the projections from the ribs and the cotton is carried between them and into the inner breast, where it is ginned.

When the gin is fed by hand the inner breast is kept covered with a hinged flap so that the cotton may be pulled over it from the top of the gin. When a feeder is used, as in the perspective view, Fig. 1198, the flap is turned back so as to leave the breast open.

The Clement gin cards from the boll without breaking or tangling the fiber; avoids the separate ginning, and passes the lint from the seed to the condition of thread. Much stress is laid upon the avoiding of twisting and mixing the fiber heterogeneously, and the damage due to pressure in the bale.

The Gullett "Magnolia" Gin claims as a specialty a stationary beater consisting of 6 parallel bars in close proximity to the brush. This beater consists of thin straps of steel, running the whole length of the saws, and to which the cotton is carried, after leaving the saws, and over which it is thoroughly whipped and cleaned of dust and dirt by the brush.

The Scattergood needle-gin has needles instead of saws. The circles of needles consist of 10 segments, each removable for replacement.

Gin Block. A simple form of tackle-block, having one wheel over which a rope runs.

It has local names, such as *whip-gin*, *rubbish-pulley*, *monkey-wheel*. See Fig. 2225, p. 969, "*Mech. Dict.*"

Ging'ham Loom. A typical form has 2 harnesses and 4 boxes at each end of the lathe. Works pick and pick, and from 1 to 7 colors of filling; any shuttle can be brought into action, and any box can be skipped. Shuttle-boxes can be operated 135 to 145 picks per minute. Stop motion devices on each end stop the loom when any filling is exhausted. —*Crompton.*

Gin Pow'er. An adaptation of the horse-power to the working of a cotton gin. Usually in a story below the gin-house floor.

Gin Pul'ley. See GIN WHEEL.

Gin Wheel. (*Mining.*) A pulley for the lifting cord of the bucket used in sinking shafts. It has a swivel hook and wrought-iron frame.

Gi-raffe'. (*Mining.*) A form of cage or truck used on inclines in mines of the Pacific slope.

Gird'er Riv'e-ter. A form of riveting machine, preferably hydraulic, and suspended so as to work along the girder.

See RIVETING MACHINE, *infra*. Also, Fig. 4851, p. 1949, "*Mech. Dict.*" See KEEL RIVETER, *infra*.

* "*Scientific American Supplement*" . . 2225.

Girth Stretch'er. A frame in which saddle girths are suspended and held taut "to take the stretch out of them," as it is called.

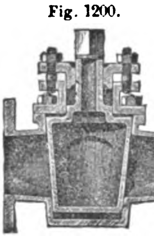
Spring saddle girth, Br. . . * "*Engineer*," xliii. 78.

Gla'ci-a'ri-um. A skating rink, with ice artificially frozen.

That at Chelsea, London, is described, with the refrigerating apparatus, in "*Engineer*," * xli. 378, 381.

Gla'cis. A glancing defense on the deck of a monitor or turret vessel to deflect a ball. See TURRET.

Fig. 1200.



Gland Cock.

Plate XXIV., *Barnard & Wright's "Report on Fabrication of Iron for Defensive Purposes*," U. S. Engineers, 1871.

Glacis and turret of "Inflexible," * "*Scientific American Sup.*," 122.

Gland Cock. A faucet held in place by a gland which can be removed to get at or pack the plug.

Glass. Subjects in GLASS are considered under the following heads: —

Aggry.
Annealing.
Aventurine.
Battledore.
Bead.
Black glass.
Blowing furnace.
Blow-pipe.
Bohemian glass.
Bottle glass.
Bottle making.
Bronzed glass.
Bullion point.
Cameo glass
Cameo incrustation.
Casing.
Cinder wool.
Chair.
Clear.
Colored glass.
Compressed glass.
Crown glass.
Cryolite glass.
Crystal.
Cullets.
Cuvette.
Cylinder glass.
Deglazing.
Devitrification.
Diamond, artificial.
Direct fire.
Doubled glass.
Drawing.
Enamel.
Enameled glass.
Enameling.
Engraved colored glass.
Engraving.
Etched enamel.
Etching.
Etching ink.
Filigree glass.
Flashed glass.
Flattening furnace.
Flattening oven.
Flattening stone.
Flattening table.
Flint glass.
Flocked enamel.
Fluted glass.
Furnace-slag glass.
Gas furnace.
Gems, artificial.
Gilding on glass.
Glass-blower's pump.
Glass-blower's tools.
Glass blowing.
Glass carving.
Glass coloring.
Glass cutter's frame.
Glass cutting.
Glass cutting machine.
Glass decorating.
Glass drilling.
Glass, enameled.
Glass engraving.
Glass etching.
Glass flooring.
Glass furnace.
Glass milestone.
Glass mold.
Glass polishing machine.
Glass press.
Glass shade.
Glass silk.
Glass silvering.
Glass, Tempered.
Glass tile.
Glass, Toughened.
Glass type.
Half-clear.
Half-crystal glass.
Hardened glass.
Hot cast porcelain.
Hyalithe.
Illuminated sign.
Iridescent glass.
Iridiated glass.
Lime glass.
Marbleized glass.
Marver.
Melting furnace.
Metal.
Metalized glass.
Mineral wool.
Mosaic glass.
Mousseline glass.
Murrhine glass.
Muslin.
Nickel plating.
Onyx glass.
Opal glass.
Optical glass.
Painting on glass.
Paper-weight.
Patent plate.
Pencil.
Pincher.
Plastic crystal.
Plastic etching.
Plate-glass.
Platinizing glass.
Ponty.
Pot.
Pressed glass.
Pucellas.
Punty.
Rolled plate-glass.
Rose glass.
Ruby glass.
Safre.
Shade.
Shears.
Sheet glass.
Silicate cotton.
Silvering glass.
Silver glass.
Slag glass.
Slag wool.
Soap.
Soluble glass.
Spring tool.
Spun glass.
Strass.
Table.
Tempered glass.
Tissue glass.
Tongs carriage.
Toughened glass.
Vulcanized glass.
Wheel engraving.
White glass.
Window glass.
Zaffer.

A glass has lately been made with phosphate of lime, by M. Sidot. He states that it is perfectly transparent and very refrangent (its index of refraction is 1.523, that of common glass being 1.525); and it can be worked like ordinary glass. It does not, like ordinary glass, dissolve all metallic oxides, but it dissolves very well oxides of cobalt and chromium. It is attacked by boiling acids, as also by potash; it is not attacked by hydrofluoric acid; and this property may render it valuable in connection with telescope glasses, for workmen who are exposed to these vapors, and who have to work in the art of engraving on glass.

According to Mr. Robert Hunt's experiments, on the effect of colored glass upon plants, the germination of seeds is prevented and young plants soon die when exposed to yellow light. With careful attention, red glass induces a sickly growth, but the leaves become partially blanched. Young plants seem to avoid the red by bending away from it, but as they arrive at the flowering stage, prefer it to blue or yellow. Blue promotes the germination of seeds and the growth of young plants, but after a certain time seems to increase the bulk rather than the strength.

Oxide of manganese when present in glass tends to correct the coloring action of the iron usually found in the sand, but allows a greater amount of heat to pass than does common glass and is consequently injurious. Mr. Robert Hunt, therefore recommended that glass be tinted with oxide of copper, which was done in the case of that employed for glazing the palm-house at Kew, with advantageous results.—"*Curiosities of Art and Literature.*"

Refer to—

Annealing, *Albert & Meyer* . . "*Iron Age*," xxi., June 6, 9.
Blowers' tools, nickel plated, *Clémandot* . . . . . "*Man. & Builder*," viii. 258.
China, glass in, colored . . . "*Sc. American*," xxxiv. 263.
Compressed, *Siemens* . . . "*Technologiste*," xxxix. 342.
"*Telegr. Journal*," vi. 106.
"*Iron Age*," xxii., July 25, p. 1.
Cutting . . . . "*Sc. American*," xxxiv 223.
Depolishing, *Matthewson* . . "*Technologiste*," xl. 7.
Paper by *Lockert* . . . . "*Technologiste*," xl. 51.
Drilling . . . . "*Eng. & Min. Jour.*," xxvi. 207.
Egyptian . . . . "*Sc. American*," xli. 248.
Engraving, *Matthewson* . . "*Technologiste*," xl. 7.
* "*Sc. American*," xlii. 390.
Electricity, *Planté* . . . . "*Telegraphic Jour.*," vi. 32.
Sand blast, *Tilghman* . . * "*Sc. Amer.*," xxxvii. 120
Etching . . . . "*Sc. Amer. Sup.*," 103, 702.
Fluor spar in, *Hegemann* . . "*Technologiste*," xxxviii. 214.

Furnace: crystal glass,
French, Figs. 2546, 2547,
Belgian, Figs. 2537–2539,
Bohemian . . Fig. 2515,
Laboulaye's "*Dictionnaire*," tome iii., cap. "*Verre.*"

Greek, Ancient . . . . . "*Sc. American*," xxxv. 80.
Hardened . . . . "*Sc. American Sup.*," 1480.
De la Bastie and *Siemens* . "*Sc. American*," xxxvii. 177.
"*Man. & Builder*," xii. 38.
Holder for lamps, *Breeden*, Br. * "*Sc. American*," xli. 18.
Irisated, paper by *Lockert* . . "*Technologiste*," xl. 68, 117.
Irisation, *Frémy & Clémandot*. "*Technologiste*," xxxviii. 373.
Lined iron pipe . . . . . . * "*Man. & Builder*," viii. 162.
Making, *Schott* . . . . . . "*Sc. Amer. Sup.*," 1008.
Making, curiosities of . . . * "*Sc. American*," xxxvi. 146.
At Centennial . . . . * "*Sc. American*," xxxv. 303.
Melting Oven, *Greeley* . . . "*Sc. American Sup.*," 1838.
Millstone . . . . "*Eng. & Min. Jour.*," xxvii. 297.
"*Min. & Sc. Press*," xxxvi. 387.
"*Sc. American Sup.*," 1940.
Mousseline, paper by *Lockert* . "*Technologiste*," xl. 51.
Printing on, *Wells* . . . . . * "*Sc. American Sup.*," 749.
Railway sleepers, *Wood*, Br. . * "*Engineering*," xxviii. 272.
"*Eng. & Min. J.*," xxviii. 225.
"*Iron Age*," xxiv., Sept. 11, p. 7.
Scissors for cutting, *Martin* . "*Technologiste*," xxxviii. 217.
Silvering . . . . "*Sc. American*," xxxiv. 262.
Soluble, paper by *Lockert* . . "*Technologiste*," xl. 28.
Spinning . . . . "*Sc. American*," xliii. 385.
Staining . . . . "*Am. Manufact.*," April 23, 1880, p. 6.
Tempered . . . . * "*Sc. American*," xxxvi. 18.
Paper by *Bourrée* . . . . "*Engineering*," xxii. 299.
Siemens process . . . . "*Van Nostr. Mag*," xiv. 512.
Léger . . . . "*Technologiste*," xlvi. 68.
Bourrée. . . . . "*Technologiste*," xxxvii. 182, 194.
Toughened . . . . "*Sc. Amer.*," xxxviii. 119.
Wood, Br . . . . . . * "*Engineering*," xxviii. 272.
Tube making . . . . . . "*Sc. American*," xli. 361.
Type . . . . "*Man. & Builder*," xii. 145.
Vase, "Barberini," ("Portland") * "*Sc. American*," xli. 311.
Weaving . . . . "*Sc. American*," xliii. 385.
Wool, Glass, Austria . . . "*Iron Age*," xix., Feb. 22, p. 3.
Works, Sunderland, Br. . . * "*Sc. American Sup.*," 1570.
Writing on . . . . "*Builder and Woodworker*," xvi. 33.

Colné's report on glass at Paris, 1878, is in vol. iii. of "*Paris Exposition Reports*," p. 311, *et seq.* It includes notices of—

WRITERS ON GLASS.

C Plinius Secundus, History, lib. xxxvi., ch. xxvii.
Tacitus. History, lib. v.
Strabo. Geography, lib. xvi.
Josephus. Jewish Wars, lib. ii., ch. x.
Galen, Plutarch, Seneca, Vitruvius, Vopiscus.
Eraclius, XI. or XII. cent., "*De artibus et coloribus Romanorum.*"
Theophilus, XII. or XIII. cent., "*Diversarium artium Schedula.*"
Agricola, XVI. cent., "*De re metallica.*"
Garzoni. 1587, "*La Piazza Universale di tutti le professione del Mundo,*" describes beads and fancy articles in murano style
Neri of Florence, 1612, "*Traité de l'Art de la Verrerie,*" describes mixtures for white and colored glass; choice and preparation of metallic oxides and fluxes.
Handicquer de Blancourt, 1697. "*L'Art de la Verrerie.*"
Henri de Valois. "*Traité de l'origine du Verre*" (MS) (Mentioned in "*Les Memoires de l'Academie des Inscriptiones*)."
Buonarotto, 1716, in his work on his discoveries in the catacombs of Rome, mentions the old legends of the art, cites Aristophanes as the first author to write on glass-making; and Democritus as having melted flints to form artificial gems.
Middleton, 1745, published on the history of glass.
Hamberger, "*Historia Vitri.*"
Leviel, "*Art of Painting on Glass,*" 1774, cites history, and speculates on the antiquity of the art.
Glass-making became a scientific art XIX. century.
Loysel of St. Gobain.
Bastenaire d'Audenart. "*Art of Vitrification.*"
Sir J. Gardiner Wilkinson, "*Manners and Customs of Ancient Egyptians,*" 1836, describes ancient Egyptian glass objects, going back to B. C. 2000. See notices of the same * page 972, "*Mech. Dict.*"

Later Works on Glass, or Containing Articles on Glass:

Dumas, "*Chemistry Applied to Arts.*"
Muspratt, "*Chemistry.*"
Peligot, "*Lessons on Glass.*"
Bontemps' Works.
Lobmeyr's Works.

Also the following authors:

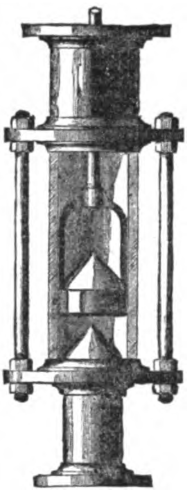
R. E. Raspe.
Beneton de Perrin, Jean.
David Michaelis.
Fougeroux de Boudaroy.
Chevalier de Jaucourt.
Alliot.
Bosc-Dantie.
Porter.
Apsley Pellatt.
Dominique Bussolin.
J. Labarte.
F. de Lasteyrie.
Winston
H. de Fontenay & Bulliot.
Anicherat.

Consult the following:—

"*Art of Glass,*" trans. Blancourt, 1699.
"*Curiosities of Glass-making.*" Pellatt. London, 1849.
"*Guide du Verrier.*" Bontemps. Paris, 1868.
"*Chemistry of Porcelain, Glass, and Pottery.*" Shaw. London, 1837.
"*Manufacture of Crown & Sheet Glass.*" Chance. London, 1856.
"*L'Art de la Verrerie.*" Peligot. Paris, 1862.
"*Les Grandes Usines de France.*" Turgan. Paris, 1862–1870.
"*Les Manufactures des Glaces,*" etc. Cochin. Paris, 1865.
"*Action of Sunlight on Glass,*" "*American Journal.*" Gaffield. New Haven, 1867.
"*La Verrerie.*" Sauzay. Paris, 1868.
"*Rapports du Jury, Paris Exposition,*" 1867, vol. cxi. Paris, 1868.
"*Report of United States Commissioners, Paris Exposition,*" 1878. Blake & Colné. Washington, 1880.
Various articles, pp. 971–984, "*Mech. Dict.*"

Glass Bar'rel Pump. A pump made by Appleby, and used in breweries for raising hot wort, in gas works for ammoniacal liquor, in tan-yards for tan liquor, in drainage works or farms for sewage, in paper-mills for paper pulp and bleach, and in chemical works for strong acids, etc.

Fig. 1201.



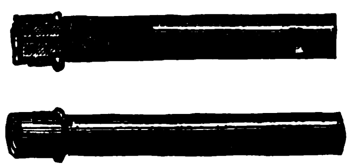
Glass Barrel Pump.

To suit the various circumstances under which it has to work, the mountings of the pump are made either of cast iron, lead, or gun metal, whichever may be best suited to the liquor to be dealt with. The glass working-barrel is accurately bored and highly polished. The mountings are arranged with flanges for coupling up to the suction and delivery pipes, and are held together by wrought-iron screwed bolts or stretchers, with double nuts at each end. The valves are solid india rubber, with lips which open and close. When it is intended to pump hot liquids it will be necessary to place the pump below the liquor, otherwise the steam evolved will prevent the creation of a vacuum in the cylinder. For thin liquids the pumps may be run at a high speed, but for dealing with thick fluids it is advisable to adopt a low speed.

Glass-blow'ers' Pump. A device for injecting air into a glass globe or cylinder while being formed; a substitute for the breath and the power of the lungs.

It was invented by *Robinet*, of Baccarat, and is shown in Fig. 1202. It consists of a small cylinder of sheet brass, closable at one end, in the interior of which is a steel spring;

Fig. 1202.



Glass-blowers' Pump.

at the lower end is a wooden piston, with an opening faced with leather, and held by a bayonet-joint thimble. The mouth of the *ponty*, the pump being held vertical, is placed in contact with the piston, the air contained in the cylinder is by a sudden blow injected through the ponty into the piece of glass being fabricated, and expands therein by the heat of the glass.

Glass-blow'ers' Tools. (*Glass.*) Ponty (blow-pipe), pinchers, shears, calipers, marver (iron plate), bench, and a few other primitive tools.

Glass tools, nickel plated, *Clémandot*, "*Man. & B.*," viii. 258.

Glass Carv'ing. A mode of ornamenting glass by etching and chiseling. The most remarkable instance is the "Portland," otherwise known as the "Barberini," vase. Long supposed to be an onyx, then considered ceramic.

A modern remarkable success in the same line is the "Dennis Vase," by Webb & Sons, shown nearly complete, at the Paris Exposition of 1878.

See "*Report on Paris Exposition*," 1878, vol. iii., pp. 237, 274.

"The body of this vase is of a very dark blue and coated outside with opal glass. The subject chosen by the artist, Mr. Northwood, is the Triumph of Galatea and Aurora. The cover represents a winged horse, not yet finished. The two handles represent horses' heads, one of which is finished. The subjects shown upon the sides, the base, and foot, are ornamented with leaves in opal. The immense difficulty of producing such an article will be understood when it is considered that all the designs in relief have to be carved and chiseled out of the white outside coating; the artist is required to produce a semi-translucid effect, showing the blue glass through the opal, carving out this glass and making it thin enough to show the blue through and yet retain perfect and correct relief forms. This beautiful effect was reproduced in several parts of the vase. The blowing of the vase itself must have been a difficult piece of workmanship, since the horse on the cover and the horse-head handles must have been so put on as to enable the artist to carve correct subjects and introduce the semi-transparent tints I have alluded to. This glass carving is necessarily a very slow work; the vase is not yet finished, some parts being polished and others yet in the rough state. The artist has already devoted two years to the vase, and it is estimated it will be worth $15,000 when finished. It is simply a '*tour de force*.'" —*Colné* (1878).

Glass Ce-ment'. See Recipes, CEMENT, p. 182, *supra*.

Glass Cut'ting. (*Glass.*) There are four kinds of wheels used in cutting or engraving glass: —

1. Cast or wrought-iron wheel.
2. Stone wheel of close grain.
3. A wooden wheel.
4. Cork wheel.

The iron wheel, being mounted in a frame, is rotated, and over it is a drip hopper containing sand and water, which run on to the glass object being cut. The sand cuts away the glass roughly.

The glass is then applied to the stone wheel, which removes the asperities caused by the roughness of the previous process.

Next the glass is applied to the wheel of poplar or willow wood, treated with wet pumice-stone powder. This removes scratches.

The polish is given by the cork-wheel, with *tin putty* (p. 1836), or *colcothar* (p. 593), "*Mech. Dict.*"

A simple way of cutting glass is to crack it with a very fine needle-like gas flame Start the crack with a file, and then apply the flame, which may be produced through a minute perforation in a glass connected with some rubber piping so as to allow of the flame being conveniently carried from point to point. The crack will run before the flame in any desired direction.

Glass Dec'o-ra'ting.

Carving.	Incrusting.
Coloring.	Painting.
Cutting.	Platinizing.
Enameling.	Silvering.
Gilding.	Etc.

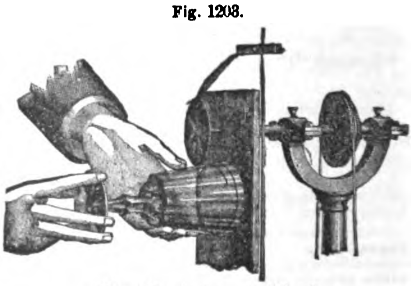
See list under GLASS, p. 400, *supra*; also pp. 975, 976, "*Mech. Dict.*"

See also *Laboulaye's* "*Dictionnaire des Arts*," etc., article "*Verre*," vol. iii., ed. 1877.

Glass En-grav'ing. The Figs. 1203, 1204, show the lathe and manner of using in lining and lettering glass ware, respectively.

As to the former, a wooden gage is placed behind the cut-

Fig. 1203.

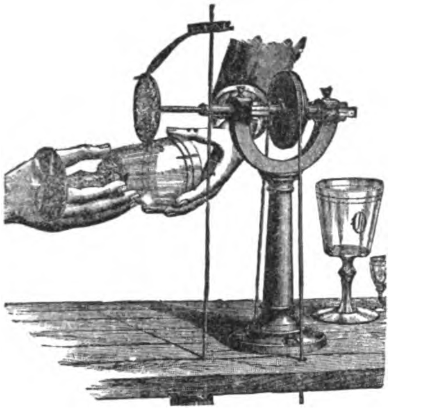


Glass Engraving. (Lining.)

ting wheel to regulate the distance of the line from the edge of the vessel. A little washed flour emery, mixed with olive oil, is applied to the periphery of the wheel, the latter being revolved at a moderate speed. By pressing the goblet against the gage, and at the same time holding it lightly against the wheel and turning it slowly, a line will be formed around it. The wheel is occasionally retouched with emery and oil.

In lettering and ornamenting, the design is first drawn with a pen or brush, charged with a mixture of gum-water

Fig 1204.



Glass Engraving. (*Lettering.*)

and whiting; the lines are then followed by the appropriate wheel charged with emery flour and oil. Small wheels are used for small work and for short curved lines, while the larger wheels will be used in making large curves and straight lines. The engraved work may be polished with leaden wheels, applying pumice-stone and oil.

"The surface of a plate of glass or crystal having been covered with a concentrated solution of nitrate of potash, and a horizontal platinum wire, connected with one of the poles of an electric battery, being placed in the liquid along the edges of the glass, any design may be easily drawn on the glass by touching it with the point at the other end of the platinum wire. The wire forming the 'pencil' is insulated, the tip alone remaining uncovered, and by simply using the wire as an ordinary pencil and tracing imaginary lines on the surface of the glass, the design is permanently reproduced and distinctly engraved thereon. Flat surfaces may be easily treated in this manner, but the difficulty of keeping convex surfaces covered with the nitrate of potash is likely to prove an obstacle to the general adoption of the system. By means of a specially constructed bath, however, it may be possible to overcome the difficulty" — *Planté.*

Engr. by electricity, *Planté* . "*Telegraphic Journal*," vi. 32.
Sand-blast, *Tilghman* . . * "*Scientific Am.*," xxxvii. 120
And depolishing, *Matthewson* "*Technologiste*," xli. 7.

Glass Etch'ing. A ground, or invisible alcohol varnish is laid on glass on which designs or scales may be drawn by means of points: —

Alcohol . . .	100
Mastic . . .	7
Sandarac . .	8

Terquem, "*Journal de Physique.*"

An elaborate article on grounds transferring and etching was reproduced from "*Dingler's Polytechnic Journal*" in the "*Scientific American Supplement*," p. 103.

The fluoric acid process is described in *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," cap. "*Verre*," tome ii., ed. 1877.

Glass Eye.

The workman is provided with a number of thin glass rods, of the colors required Heating the end of one of them by means of a blow-pipe, he gathers from it sufficient for his purpose, on the end of a wire. This first gathering is generally of white or colorless glass, to form the white of the eye. He then takes the rod required to form the iris, and gathers from it on the white, and lastly, a little spot from a black rod is added to form the pupil. During the process the bulb on the end of the wire is rotated in the flame of the blow-pipe and occasionally pressed against a smooth surface to obtain perfect evenness of outline.

Glass Floor'ing. Glass tiles

Flags or slabs of rough-cast glass are manufactured in pieces 6′ broad, 1$\frac{1}{2}$″ thick, 11″ long, and weigh 165 lbs. per square meter; the upper surface is generally molded in diamonds. Pavements of glass are made in the same style as the slabs, with the upper surface molded in diamonds, but are much thicker, and are intended for slabs for carriage-ways. They are made of cubes of about 6″ × 6$\frac{1}{2}$″, and weigh each 19.80 lbs. Rough slabs are also made of 6.56′ × 2.65′, varying in thickness from 9-16″ to 1$\frac{1}{4}$″; weight, from 213 to 492 lbs.

Glass Fur'nace. The use of Siemens' furnace in glass furnaces has proved a great success. The principles of the furnace are described under GAS-GENERATING FURNACE and REGENERATOR FURNACE.

Fig. 1205 shows the application to glass-making. *A* is the furnace, on the siege of which the pots *B B* are placed. *C* are the openings through which the contents of the pots are reached. Under the furnace floor are disposed 4 regenerators, of which but one, *D*, shows in the longitudinal section These, as is explained under the heads cited above, are used in pairs alternately: (1) heated by the gases passing from the furnace to the chimney, and (2) serving to heat the inflammable gases from the gas producer, and the incoming air, which mingle just before reaching the pot furnace *A*.

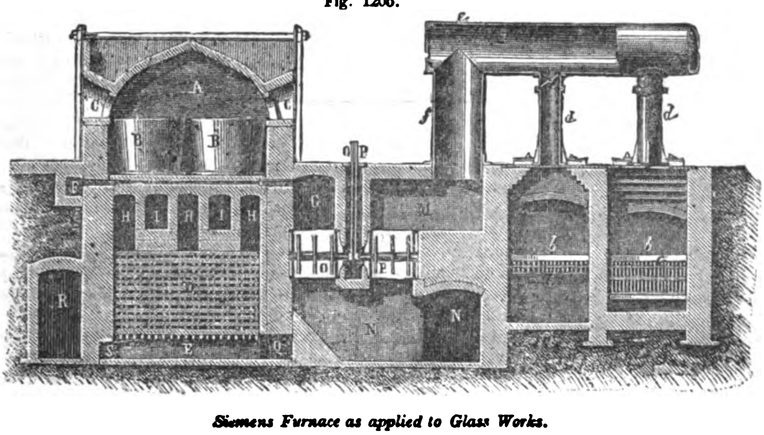
The vaulted roof of the regenerator is the floor of the pot furnace, and is traversed by the longitudinal flues *H I H I*, which communicate on one part by conduit *F* with the open air, and in the other with the flue *G*. Speaking as to any one of the four regenerator chambers, that shown at *D*, for instance, when it is to be *heated* the waste gases from furnace *A* discharge into *H H* and pour downward through the cellular brick structure *D*, through the grated floor into *E*, and thence by *N N* to the chimney; when the regenerator has been sufficiently heated, the valves *O P* are moved and the conditions are changed; the heated gases in *M* coming from the gas producer descend into *E* and pass up through the heated regenerator, to be united with air entering at *G* and passing through a similarly heated regenerator, the two being ignited at their point of junction and filling the furnace *A* with flame.

As one pair of regenerators become heated and the other cooled, the valves which transpose the course of the currents are changed by the motion of a lever, and the functions of the regenerators are changed, and so on alternately.

b b are the grates of the gas-producing furnaces; *d d*, the pipes of ascension for the gases; *e f*, flues communicating with chamber *M*, whence the gases are emitted to one or the other regenerator, as the case may be. See GAS-GENERATING FURNACE.

In the works of Lloyd & Summerfield, Birmingham, England, the application of the Siemens furnace to glass-works was first made, with the result of changing the consumption of fuel from 35 tons of superior coal, to 16 tons of inferior coal, per week.

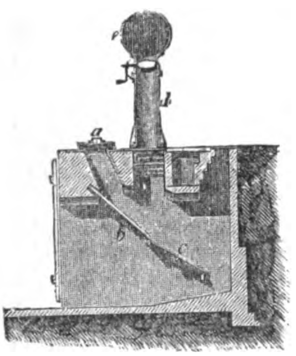
Fig. 1205.



Siemens Furnace as applied to Glass Works.

Fig. 1205 is a vertical section through one furnace in a line at right angles to the view given in Fig. 1206.

Fig. 1206.



Siemens Regenerator. Glass Furnace.

"The Siemens furnaces have been used quite extensively in metallurgy with great success; in this country we find but three glass-houses using them, viz., Burgin & Sons, of Philadelphia, the Lenox Plate Glass Company, and the Crystal City Plate Glass Works. In Europe we find quite a number of firms using them; in England, five plate-glass works, twelve window and bottle houses, and one flint house; in France, seven plate works, ten window and bottle works, and nine flint factories; in Germany, three plate works, eight window and bottle houses, and twelve flint works; in Belgium, four plate works, one window house, and one flint factory. These furnaces have also been introduced in Russia, Portugal, Hungary, and Austria." — *Colné.*

The Boëtius gas furnace, without the regenerating principle, has been introduced among European manufacturers. It is much simpler in construction than the Siemens. The gas generator is somewhat similar to that of Siemens, but the gases, instead of passing through regenerators, are conducted directly to the furnace with a sufficient quantity of air, and there ignited. The air, by passing through passages under the bottom of the furnace, serves to cool the bench, and thereby receives a certain degree of heat extracted from the hot bricks. The furnaces do not cost as much to construct as a regenerating furnace, they are easy of management, and the heat can be readily regulated.

The Ponsard furnace is also used in glass works, and has been described elsewhere. See GAS-GENERATING FURNACE, Figs. 1158-1162, pp. 385-387, *infra*.

In it the heat escaping from the fire-chamber, after having done its work, is conducted to a regenerator under the furnace, made somewhat in the same style as the Siemens. Instead, however, of one of the regenerators receiving the gas from the generator and the other the air to be mixed in the furnace, and having four regenerating chambers, the Ponsard system uses but one chamber. This regenerating chamber is made up of a number of passages adjoining one another, one series of which receives the hot gases after combustion, and the other receiving the air to be heated by the absorption of heat from the adjoining hot canals. This system is, therefore, continuous, and simpler than the Siemens.

The Siemens compartment furnace is a substitute for the bench with pots, the furnace being a tank divided into three compartments by means of transverse floating bridges. In the first compartment the batch is melted, in the second compartment it is refined, while the third compartment is the receptacle for the thoroughly purified glass, from which it is worked out *continuously*.

"The principal advantages resulting from the use of the continuous melting furnace are:—

"1. An increased power of production, as the full melting heat may be employed without interruption, whilst, with the old method of melting, nearly one half of the time is lost by cooling and settling the metal, the working out of the same, and the re-heating of the furnace.

"2. An economy in working, as only one half the number of men are required for the melting operations.

"3. A greater durability of the tank or furnace, owing to the uniform temperature to which it is subjected.

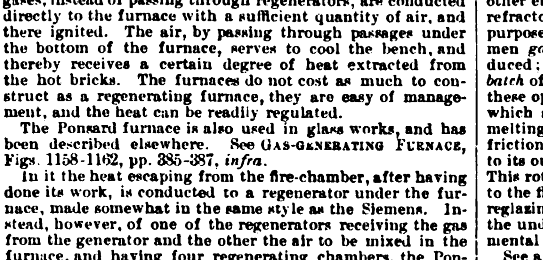
"4. A much greater regularity of working, and more uniform quality of the product than in other furnaces.

"5. For the manufacture of window glass, the compartment may be so arranged that the blowers can work without interfering with the gatherers: this does away with the separate blowing furnace now in use.

"The reason of the greater durability of the tank is not only due to the uniform temperature maintained, but also to the circumstance that the batch is filled in, in such quantities as not to come into contact with either the sides or the bottom of the tank, which consequently are not suddenly cooled or eaten away by the mixture; also to the fact that each compartment of the tank is subjected only to the requisite amount of heat necessary for the purposes carried on therein.

"The difference in the specific weight of the glass at the different stages of melting is used for keeping the metal separate in the several compartments, and the operation of charging the melting compartment with raw material causes the necessary onward pressure." — *Siemens*

Fig. 1207.



Tank Furnace.

Atterbury's tank furnace is shown in Fig. 1207. The tank is shaped like an oval dish, and the arch has the same form; in order to expose a large surface of the glass, relatively to the quantity, and secure a favorable reverberatory form to the arch. The division enables different colored glasses to be worked from the heat and furnace.

Duryee's glass furnace is a revolving cylinder with a blowpipe flame fed with petroleum and steam jet.

Franke's glass furnace is a revolving cylinder having perforated ends for the entrance of the flame from any desired form of fuel chamber, and for its exit to the chimney at the other end. The jacket is lined throughout with a lining of refractory fire-clay, and has openings on its sides for the purpose of access to the glass, and through which the workmen *gather* the glass for the different articles to be produced; another opening is provided, through which the *batch* of materials of which glass is made is introduced. All these openings are provided with doors lined with clay, and which are bolted shut during the *melt* or period when the melting is being done. The cylinder is mounted on anti-friction rollers, and is rotated on its axis by a rack secured to its outside surface and a pinion driven by steam power. This rotation causes the entire mass to be uniformly exposed to the flame traversing the cylinder, also causes the constant reglazing of the sides and ends of the furnace, and prevents the undesirable action of the *gall*, which has proved so detrimental to stationary tank furnaces.

See also *Colné's* "*Report on Glass at the Paris Exposition*," 1878, vol. iii., 352 *et seq.* Also —

Siemens	* "*Scientific American Supplement*,"	2176, * 3966.
Greeley	* "*Scientific American Supplement*,"	1838.

Crystal glass furnace, French and Belgian, Bohemian, *Laboulaye's* "*Dictionnaire des Arts*," etc., cap. "*Verre*," tome iii., ed. 1877.

Glass, Hardened. See GLASS, TEMPERED.

Glass'ing. (*Leather.*) Smoothing and polishing a side of leather by means of a plate glass slicker or glassing jack.

Glass'ing Jack. (*Leather.*) A machine in which is fitted a plate glass slicker for polishing and smoothing leather.

Glass Mill'stone. Blocks of glass of from 6″ to 12″ wide are cast in a shape similar to the panes of the French buhrs, but more regular and uniform. They are united with cement in the same way, and dressed and furrow-cut with picks, pointed hammers, and diamond-dressing machines.

"*Engineering and Mining Journal*" . .	xxvii. 297.
"*Mining and Scientific Press*" . . .	xxxvi. 387.
"*Scientific American Supplement*" . .	1940.

Glass Press. The subject of the principles and practice involved in the making of glass objects by pressure in molds is carefully and lucidly treated by M. Colné in his Report on Glass at the Paris Exposition of 1878, vol. iii., pp. 378 *et seq.* The various requirements of special forms and complicated structures are there given *in extenso.*

Glass Ring. (*Microscope.*) A circle of glass for forming a cell in which a thick object is mounted.

Glass Silk. A product obtained by winding fine threads of glass in fusion on rapidly rotating and heated cylinders.

In the microscope the threads are as fine as those of silk or the fibrillæ of cotton. They break more easily than the latter, but are excessively supple. From the inalterability of the substance, it is very well suited for filtering acid or alkaline solutions, even concentrated, and various other substances, such as nitrate of silver, albumen, collodion, Fehling's liquor, etc. It affords great rapidity of flow, with good filtration. It is preferable to amianthus, which from the arrangement of its parallel fibers cannot be formed into a flexible ball, and which lets fragments pass that float in the liquid. For analysis it is very advantageous, allowing of a ready determination of insoluble matters deposited; also, by calcination and fusion of the glass may be found the volatile principles fixed in the passage of the liquid, unmixed with empyreumatic products.

Glass is capable of extremely fine filiation either by the winding process, cited above, or by means of a blast, in which latter case it assumes a flocculent quality. See MINERAL WOOL.

Glass Sil'ver-ing. Silvered plate glass is produced by causing a slight coating of mercury to adhere to the glass. To obtain this result mercury must be retained by a metallic medium; it is, therefore, amalgamated with tin. Mercury has been chosen owing to its power of reflecting light very brightly.

The process has been described on pp. 982, 983, "*Mech. Dict.*" See also pp. 2184, 2185, *Ibid.*

A solution of silver has been largely substituted for the mercury amalgam. The Pettitjean process is as follows: —

"The operation is very similar to silvering with mercury. The table, instead of being a stone, is a hollow sheet iron table, made quite smooth on its upper surface, and containing inside water capable of being heated by means of steam, to bring the temperature to 95°-104°. Preparatory to silvering the glass it should be thoroughly cleaned. The table being ready, a piece of oil-cloth is spread over it, and upon this is laid a piece of cotton cloth. The plates are now put singly upon these cloths, and the following solutions are poured over them: —

"*Liquor* No. 1. Dissolve in a liter of water 100 grams of nitrate of silver; add 62 grams of liquid ammonia of 0.880 density; filter and dilute with 16 times its volume of water. Then pour in this liquor 7.5 grams of tartaric acid dissolved in about 39 grams of water.

"*Liquor* No. 2. This liquor is precisely the same as the other, with the exception that the quantity of tartaric acid is doubled, say 15 grams.

"First pour liquor No. 1 upon the plates, as much as will remain upon the surface without running over. The heat of the table is now increased gradually to 95°-104° Fah., and in about thirty minutes the glass is covered over with a metallic coating. The table is now inclined and the plates washed with water, which carries off the surplus silver. The table is again raised, and liquor No. 2 is now poured over; in about a quarter of an hour another coat is deposited, which covers the glass completely. The plates are again washed; then they are carried to a slightly heated room, where they are gradually dried.

"This operation, as will be seen, is quite simple, and is generally performed by women. The silver carried off in washing and that contained in the cloths is recovered again. Since glass silvered by this process is liable to be altered when exposed to the air, and the coating may become easily detached if not covered over with a protecting coat of paint, the silver pellicle is covered with an alcoholic copal varnish, put on with a brush, and when this is dry a coat of red-lead paint is put on.

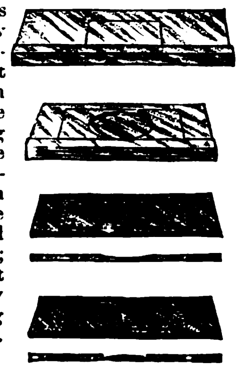
"Plates silvered by this means have more brilliancy than with mercury, but as there is a slight tinge of yellow given to objects reflected by these mirrors, they were at first objected to. This objection has passed away, however, to a great extent, and the yellow reflection has been obviated by giving a slight coloration to the glass. The new silver process costs about 36 cents per square meter. Inasmuch as such works as the St. Gobain have adopted it, and as the terrible disorders caused by mercury may be thus avoided, there should be no hesitation in adopting this new process everywhere." — *Colné.*

Glass Slip. (*Microscope.*) For mounting objects: usually 3′ × 1″ in size, made of crown or plate. See Fig. 1208.

Glass Stage. (*Microscope.*) A platform in the microscope, used instead of brass on account of cleanliness.

Glass, Tem'pered. Siemens' process consists in heating, then suddenly cooling the glass to be hardened and tempered; but when the articles are such as are usually molded, the hardening and tempering are accomplished at the same time as the pressing — that is, the molten glass is run into suitable molds, and while still highly heated, is squeezed; the molds having the effect of giving the necessary cooling without resorting to the liquid bath of M. Bastie.

Fig. 1208.



Glass Slips.

a. Glass slip with ledge.
b. Glass slip with hollow ledge and lip.
c. Glass slip with hollow.
d. Weber's slip with convex cell.

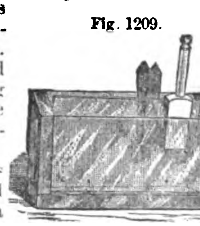
The material employed for these molds depends on the nature and thickness of the glass. In ordinary practice, however, it is found that cast-iron molds maintained at a temperature of about 212° Fah., and earthenware molds kept quite cool, yield very satisfactory results. The liquid glass may be conveyed direct to the molds, or may be taken from the melting furnace on the blower's pipe, and shaped in the mold, but it is preferable to heat the articles after shaping, before pressing and cooling them.

Siemens	"*Van Nostrand's Mag.*," xiv. 572.
	* "*Scientific American*," xxxvi. 18.
	"*Eng. and Mining Jour.*," xxiii. 206.
Paper by *Bourrée* .	"*Engineering*," xxii. 299.
	"*Scientific American Sup.*," 1480.
Comp. of *De la Bastie & Siemens*	"*Scientific American*," xxxvii. 177.
	"*Manufacturer and Builder*," xii. 38.
	"*Scientific American*," xxxviii. 119.
For railway sleepers,	"*Engineering*,"
	"*Eng. and Mining Jour.*," xxviii. 225.
Wood, Br. . . .	* "*Engineering*," xxviii 272.
	"*Iron Age*," xxiv., Sept. 11, p. 7.

Glass Tile. A roofing plate made of glass pressed in imitation of the clay article. The French glass tiles are molded in such a shape that they can be laid alongside of one another, making tight-fitting joints without cement or mortar; 13 tiles cover a square meter; each tile weighs about 5½ pounds.

Glass Trough. (*Microscope.*) A means for keeping aquatic objects in a film of their natural fluid for observation. A division plate and wedge admit of forcing them to one side of the trough so as to be convenient for observation.

Fig. 1209.



Glass Trough.

Glass Type. Glass cast into type form and toughened by the De la Bastie process. Said to have remarkable wearing quality and to be unaffected by acid, inks, and colors. *Montcarmont & Dumas*, of Paris.

"*Manufacturer & Builder*" . . . . xii. 145.

Glau-com'e-ter. An instrument for measuring the density of *must*. The degrees of the glaucometer show the density of the (grape) must, deducting 1 in 12 for foreign matter.

Glaze. For earthenware: —

Silicate of soda	100
Powdered quartz	15
Meudon chalk	25

With an addition of borax 10 when it is desired to be more fusible.
Copper for green color.
Manganese for brown. *Constantine.*
Rendle, Br. . . . . "*Engineering*," xxii. 9.
"*Scientific American*," xxxv. 353.

Glazed Me'ter. (*Gas.*) One with glazed front and top in order to expose the working of the apparatus; showing the motion of the diaphragm and valves, also the gearing and registering index. Intended for exhibition to persons unacquainted with the working of meters, in order to demonstrate the fairness and correctness of the indications of measurement.

Gla'zing Bar'rel. (*Powder Making.*) A revolving barrel in which powder is glazed with graphite. A barrel holds 400 pounds and makes 40 revolutions per minute, an addition of 0.5 oz. of graphite being made for each 100 lbs of powder. 40 minutes is required for each charge.

See "*Ordnance Report*," 1879, Appendix I., p. 108.
"*Engineering*" . . . . * xxv. 138.

Globe. 1. Sphere representing the earth, or the celestial objects.

A skeleton globe with inflated fabric made with gores was shown at the Paris Exposition, 1878. The skeleton is of jointed meridional sections stiffened with zonal rings and revolving on a vertical axis. *Enrico*, Italy.

Artificial, *Browne* . . . . * "*Scientific Amer. Sup.*," 1'1.
Fr. Nat. Library, *Estrées* . * "*Scientific Amer. Sup.*," 48.
Lyons Museum, A. D. 1708 . "*Sc. American*," xxxix. 209.
Time, *Jouvet* . . . . . * "*Sc. American*," xlii. 22.
"*Technologiste*," xxxiv. 319.

2. A spherical glass for a lamp or burner.

"It is not generally known what a very large proportion of light is obstructed by the glass globes or moons so frequently used over gas flames. From experiments, all made with a light equal to fifteen standard candles, I find the following results: —

	Illuminating Power.	Percentage of Light lost.
Naked flame	15.00	–
Clear glass globe	12.80	14.65
Ground glass globe	11.40	24.00
Opal globe	9.00	40.00
Another opal globe	8.16	45.60
Another opal globe	8.00	46.70
Another opal globe	6.64	55.90
Another opal globe	8.00	46.70
Another opal globe	7.48	50.10

The advantage arising from the use of these moons is that they diffuse and soften the glare of the naked light, which is sometimes oppressive to the eyes. Of the opal globes the dead white semi-opaque one should be avoided. A very good form of globe is that with a wide opening at the bottom, which allows a considerable amount of light to be reflected downwards from the white surface of the inside of the globe." — *Pattison.*

Gas-globe holder, *Lovett*, Br. . * "*Engineer*," xlv. 419.
Globes. Effect of on gas-light . "*Sc. American*," xl. 160.

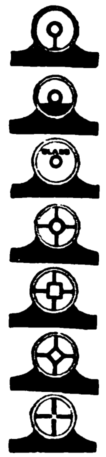
Globe Oil Cup. A lubricator attached to a piece of machinery and having a globular oil chamber. See Fig. 3011, p. 1361, "*Mech. Dict.*"

Globe Sight. (*Rifle.*) *a.* A circular sight; when spherical and upon the muzzle, also called a *bead* sight, or *pin-ball* sight.

b. When *open*, it is also called an *open bead* sight. See BEAD SIGHT, *supra*. The illustrations in Fig. 1210 are open globe sights of various constructions.

Globe Valve. One, the chamber of which is spherical. Such may have a poppet or ball valve and may be for steam, water, gas, air, or other liquid or fluid. The name concerns the shape.

Fig. 1210.



Globe Sights.

A *globe cross valve* is one at the rectangular intersection of two pipes.

A *globe safety valve* is one with a spherical chamber.

And so on, of a globe back-pressure valve, globe check-valve, etc.

A screwed glove valve is one whose valve is worked by a screw; a flanged globe valve one whose connections are by *flange joints* and not by *bell joints*.

Jenkins' globe valve, shown in Fig. 1211, has a valve with an annular packing which is forced down upon the circular seat by the screw. Screw, cap, and valve are removable without disturbing the pipe.

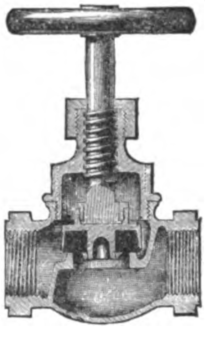
See also GLOBE VALVE, Fig. 2256, p. 988, "*Mech. Dict.*"

Frink's globe valve is shown in Fig. 1212. *A* represents the shell. *B* and *C*, the valve stem and screw. *D*, the valve seat. *E*, the elastic packing of the disk. *F* is a clamping plate, which holds the packing in. *G* is a nut, which holds clamping plate to end of stem. *H* is the disk.

Glos'sing Iron. See FLUTING IRON.

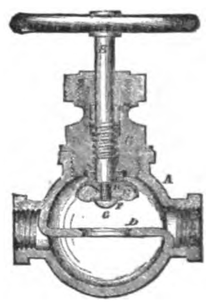
Glove Ma'king. The glove sewing machine of H. P. Hendrickson, Copenhagen, Denmark, shown

Fig. 1211.



Globe Valve.

Fig. 1212.



Globe Valve.

at the Centennial Exhibition, has a tubular arm inclined somewhat from a perpendicular, and about ⅞″ in diameter, and at its upper end a cylindrical shuttle 5-16″ in diameter and ⅝″ long. The shuttle is driven from a pin at the upper end of a rotary reciprocating shaft, twisted at its shank and embraced by a yoke, the reciprocations of which operate the rod after the manner of the looper-rod in the Grover & Baker machine. A flat cloth-support is placed about the upper end of this post, for use in flat work. The needle-bar, operated by a heart-cam and crank, is placed at an angle of from 30° to 40° from a perpendicular. The presser-foot, serrated at bottom, has four motions imparted to it, thereby converting the presser into a four-motioned top-feed.

The glove sewing machine of F. Sandoz, of Paris, was shown at the French Exposition of 1878.

At the Philadelphia Exhibition was also shown the glove and mitten cutting blocks and presses of Newton & Titus, of Gloversville, N. Y.

Glove making . . . . . * "*Sc. American*," xxxvii. 104.
Glove working, *Townsend* . * "*Sc. American*," xxxix. 98.
Glove, Decorticating, *Sabate* * "*Sc. American*," xxxvi. 182.

Glue. Refer to: —

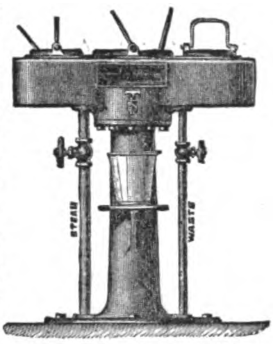
Glue making . . . . . "*Iron Age*," xxi., Jan 24, p. 19.

Glue making	. . . . .	"*Scientific Amer.*," xxxviii. 168.
Glue-heater.		
Richardson, Eng.	. . *	"*Scientific Amer.*," xxxvii 38.
Glue pot, *Comins*	. . . *	"*Scientific Amer.*," xxxvii. 168.
To prevent glue cracking		"*Scientific Amer.*," xxxiv. 353.
Liquid glue	. . . . .	"*Scientific Amer.*," xxxiv. 352.

Glue Heat'er. A glue boiler.

In the figure, the walls of the steam chamber are double throughout, so that the pots do not come in contact with the steam or water. The steam chamber is also cast in one piece, preventing leakage of steam or water, there being but one joint, and that a plain flange which can be made perfectly tight.

Fig. 1213.



Glue Heater.

The glue pots, three in number, rest on turned flanges which are air-tight, to prevent the escape of heat. The center pot holds one gallon, and the two at the ends one-third gallon each.

Each heater is provided with a water pot, also with steam and waste-cocks, so attached by nipples to the steam chamber, that the connecting pipes may pass down through the base, as shown in the engraving, or in any direction from the heater — *Richards*.

Glue Wa'ter Core. A dry sand core in which common glue dissolved in water has been used for giving adhesiveness and strength to the core when dried. For this core a sand containing no loam at all may be used.

Glu'ten Test'er. See ALEUROMETER.

Glu'tine. A preparation by Dr. Bering for stiffening and rendering glossy, calicoes, wall paper, etc.

Freshly precipitated caseine is well washed, dried at 212°, and reduced to a moderately fine powder. This is levigated with a 59 per cent. solution of sodium tungstate. The mass becomes very thick as soon as the solution is added. It is now placed in a boiler and fully liquefied by heat. If it be too dry, a sufficient quantity of water is added. When it has acquired a completely homogeneous consistence, a little carbolic acid or salicylic acid is added to prevent its putrefaction. On cooling, the mass becomes nearly solid.

This preparation, when not completely hardened, is very soluble in water and very adhesive. It also adheres on metal, and may, therefore, be used for labeling tin cans, also bottles and jars. When entirely dry it resists for some time the action of water, but is soluble in glycerine. A mucilage formed by a solution of glutine in water and a small proportion of glycerine forms an excellent flexible varnish for wall paper.

Dissolved in glycerine alone a tough clear mass is formed, which, spread on paper and passed through a solution of alum, acquires the firmness of good batter.

On account of the large quantity of wolframic acid contained in it, it may receive all different tints and colors by the addition of the decoctions of various dyewoods. If, for instance, cotton or linen, soaked in a solution of glutine and dried, is passed through a decoction of logwood, it is dyed violet.

By soaking cottons or linens in glutine solutions, drying, and passing them through solutions of the mineral acids or salts of the same, they are dyed in various colors, resisting the action of soap and water and even that of alkalies. — *Chemiker Zeitung.*

Glyc'er-ine Ce-ment'. For metals and packing joints: glycerine and litharge; made of any consistence to suit. It withstands a temperature of 275° C. Is useful for galvano-plastic purposes, as it reproduces a surface with delicacy and accuracy.

Glycerine	"*Scientific American*," xxxv. 249.
Uses of (solutions, etc.)	"*Scientific American*," xxxvi. 69.
Uses of glycerine . .	"*Scientific American Sup.*," 1813.
Cement	"*Scientific American Sup.*," 2597.

Gnaw'ing For'ceps. (*Surgical.*) Forceps used in osteotomy for biting away portions of necrosed bone, or removing sharp projecting portions. *Ronguer.*

Gold.

Leaf-making	. . . . .	"*Scientific American Sup.*," 4023.
		"*Iron Age*," xviii., Sep. 28, p. 6.
Process, *Plattner*, Cal.	. *	"*Engineering*," xxiv. 119
Transparent	. . . . .	"*Scientific Amer.*," xxxvi. 385.
Volatilized	. . . . .	"*Scientific Amer.*," xxxv. 154.
Washing at Yesso, Japan		"*Scientific American Sup.*," 222.

Gold Al-loy'. An alloy resembling gold. Sometimes the composition has the color and specific gravity of the genuine metal.

Meiffren's. — 800 parts of copper, 28 of platinum, and 20 of tungstic acid are melted in a crucible under a flux, and the melted mass poured out into alkaline water, so as to granulate it. It is then melted together with 170 parts of gold. It resembles 750-1000 fine.

Another. — Pure copper, 100 parts; zinc, or preferably tin, 17 parts; magnesia, 6 parts; sal-ammoniac, 3 6 parts; quicklime, 1.8 parts; tartar of commerce, 9 parts, are mixed as follows: The copper is first melted, then magnesia, sal-ammoniac, lime and tartar are added separately and by degrees, in form of powder. The whole is next briskly stirred for about half an hour so as to mix thoroughly, after which the zinc is added in small grains by throwing it on the surface and stirring it till it is entirely fused; on this being done, the crucible is then covered and the fusion maintained for about 35 minutes, after which the surface is skimmed and the alloy is ready for casting. This alloy has a fine grain, is malleable, and takes a splendid polish. It does not corrode readily. *Schmitte's.*

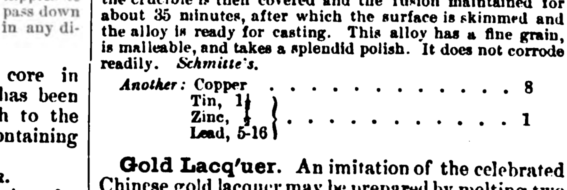
Another: Copper	. . . .	8
Tin, 1½		
Zinc, ½	. . . .	1
Lead, 5-16		

Gold Lacq'uer. An imitation of the celebrated Chinese gold lacquer may be prepared by melting two parts of shellac and one of copal, so as to form a perfectly fluid mixture, and then adding two parts of hot boiled oil. The vessel is then removed from the fire, and ten parts of oil of turpentine gradually added. To improve the color an addition is made of a solution in turpentine of gum gamboge for yellow, and gum dragon for red. These are to be mixed in sufficient quantity to give the desired shade. The Chinese apparently use tinfoil to form a ground upon which lacquer varnish is laid.

Gold Pow'der. Put into an earthenware mortar some gold leaf, with a little honey or thick gum-water, and grind the mixture till the gold is reduced to extremely minute particles; when this is done, a little warm water will wash out the honey or gum, leaving the gold behind in powder.

Gon-do'la Car. (*Railway.*) A car with a

Fig 1214.



Four-wheeled Gondola Car.

platform body, having low side-boards secured by stanchions; or, more seldom, hinged.

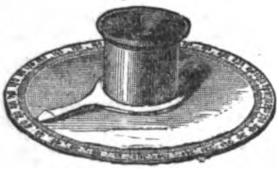
Pennsylvania Railway . . * "*Engineering*," xxvi. 430, 439.

Gong. Champion and Yapp have given precise accounts of the Chinese mode of manufacture.

Manufacture of, *Yapp*	.	"*Van Nostr. Mag.*," xvii 206.
		"*Scientific Amer. Sup.*," 1349.
		"*Iron Age*," xx., Aug. 23, p. 7.

Go'ni-om'e-ter. An instrument fitted to the eye-piece of the microscope; used for determining by means of a double-image prism the angles of crystals.

Fig. 1215.

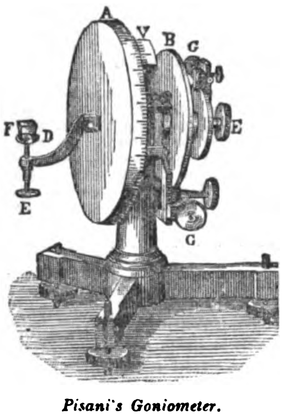


Leeson's Goniometer.

The goniometer of M. Pisani, for measuring the dihedral angles of crystals, is shown in Fig. 1216.

It consists of a circle *A*, divided into degrees and half degrees, and having a vernier, *V*, marked to minutes. The circle is turned by the disk *B*. A second disk moves the axis carrying the piece *D* independently of the circle. This piece is movable normally to the plane of the circle, and supports the platform on which the crystal is placed. *G* and *G'* are adjusting screws for the parts already mentioned.

Fig. 1216.



Pisani's Goniometer.

In order to measure an angle the crystal is secured by wax on the platform in such a position that the ridge of the dihedral angle passes through the axis of the crystal. This position is approximately obtained by movements of the stem *F E*. The goniometer is then placed on a table at some 15' distant from a candle fixed to the wall. After having determined by the plumb line the foot of the perpendicular passing through the luminous point, two points of view are obtained which are in the same vertical plane. The plane of the circle is then adjusted to the plane of these points. By turning the disk *C* the observer rotates the crystal until he notes on one face the reflected image of the flame. Then continuing to move the crystal he notes whether this reflected image coincides with the lower point of sight regarded directly. If this coincidence does not occur, if the luminous point appears to the left or right of the point at the lower end of the plumb line, it is made to coincide by the screw *E*. The coincidence being thus obtained for one face, the other face is adjusted, and when the two images on each face respectively coincide it remains only to measure the angle.

The circle is placed at zero, and by means of disk *C* the circle is turned until the coincidence of the two points of sight is obtained on the face on the same side as the observer. The eye is kept fixed, and the circle is turned by the large disk *B* until coincidence is obtained with the second face. The angle through which the circle is turned is the supplement of the dihedral angle, and it remains only to substract the measurement now from 180° to obtain the required result. See also Fig. 2267, p. 996, "*Mech. Dict.*"

* "*Manufacturer and Builder*" . . . . . . ix. 109.
* "*Scientific American Supplement*" . . . . 477, 704.

Goose'neck. A bent pipe coupling, having a joint at one end so as to be revolvable. Used on fire-engines and sprinkler pumps especially.

Gor'get. (*Surgical.*) A cutting instrument operating by a thrust, and used in making the incision in the prostate gland in lithotomy.

Bush's, Fig. 149 *f*.
Dowell's, Fig. 149.
Hooked gorget, Fig. 152.
Blunt gorget, Fig 139.
Part III., *Tiemann's "Armamentarium Chirurgicum."*

Gor'ing Cloth. (*Nautical.*) That part of the skirts of a sail cut on the bias, where the sail widens towards the clews.

Gorse Cut'ter. An instrument of the nature of a chaff cutter, but heavier, used in Europe to mash and chop the gorse or furze (*Ulex Europeus*), which is so common on the uplands and moors. It is a substitute for hay, and a good green food in winter.

Masticator, *McKenzie*, Br. . * "*Engineering*," xxviii. 446.
Mill, *McKenzie & McBude*, Br. * "*Engineer*," xlix. 109.

Gouge. 1. (*Surgical.*) A curve-edge chisel, used in removing portions of bone by a thrust movement, or by blows of a mallet.

Figs. 84, 85, Part I. ; 90, Part II., *Tiemann's "Armamentarium Chirurgicum."*

2. (*Dentistry.*) A tool for excavating carious teeth.

Goug'ing For'ceps. (*Surgical.*) A bone-gnawing forceps. *Rongeur.*

The beaks of the forceps have a gouge shape.

Gov'er-nor. A device to regulate the speed of an engine or machine.

Steam Engine Governor, p. 997, *et seq.* "*Mech. Dict.*"

Gas. See GAS GOVERNOR, *supra*.

Water-wheel. Fig. 7126, p. 2646, "*Mech. Dict.*"

The *Condé* automatic safety stop-governor is shown in Fig. 1217, Plate XVIII. The valve has a number of ports giving a large sum of opening with a small motion of the valve.

The steam chamber *A* is fitted with a valve, *B*, composed of rings, stayed together by vertical ribs cast on its inside. The spaces between these rings form ports, through which the steam passes from corresponding ports made in the chamber. The valve is *double-acting*, governing on the downward stroke, and cutting off entirely on the upper stroke when the balls drop to their lowest point.

A sleeve and hand-wheel, *C*, are fitted to the upper part of the frame *D* by a screw connection. This sleeve supports the head *G*, which passes down through it to the driving gear, and is raised or lowered through the screw, thus changing the position of the valve in the chamber, increasing or diminishing the speed of the engine at will. Within the head *G* is fitted the cam gearing for transmitting the motion of the balls to the valve. This gearing increases the travel of the valve in proportion as the balls approach a horizontal line.

H is a throttle, with angular connection for attaching steam pipe without elbows. The valve and seat are of brass, and are removable. The valve rod has its traversing screw outside from the packing box, and passes through the outer end of the gland, which acts as the nut. This arrangement prevents steam acting on the thread, and allows a refitting of the valve in its place, simply by removing the gland.

The valve seat is set into the throttle with a taper joint, so as to be removed for repairs, without taking the throttle apart from the steam pipe.

The *Judson* governor is shown in Fig. 1218, Plate XVIII. The illustration shows the governor, governor valve, and stop-valve combined ; the speeder for altering speeds, Sawyer's lever and automatic stop-motion.

In the *Tremper* variable cut-off and governor, shown in Figs. 1219, 1220, 1221, Plate XVIII., the governor is employed not to open and close a valve directly, but merely to determine the point of time at which the cut-off valve shall be closed. This duty requires but little effort on the part of the governor, and its action can therefore be made very sensitive. The cut-off valve is moved by direct attachment to the engine, and is opened and closed at each half-stroke. The time of its opening is fixed and invariable, but its closing is determined by the governor, and varies with the duty to be performed. When the proper amount has passed the valve, the flow of steam into the cylinder is abruptly cut off by the sudden dropping and closing of the cut-off valve, and the volume admitted expands in the cylinder as the piston recedes, the pressure constantly diminishing until the exhaust port is opened and steam released.

Figs. 1219, 1221 are respectively perspective and sectional views of the cut-off governor, and Fig. 1220 is an enlarged view of some of the important parts. In this illustration *G* is the lower end of the governor ball stem, fastened to the wedge *W*; *L L* are the lifters; *C*, the bell crank ; *H*, the cork holder ; *R*, the ring of rubber or cork, upon which the beater *B* falls, after the steel plates *P* of the lifters are disengaged from those of the beater, by the wedge *W*; *V* is the valve stem, to the upper end of which the beater is attached, and to the lower end the cut-off valve. The movement of the beater is, therefore, identical with that of the valve. The rock-rod imparts a rocking movement to the bell-crank which moves the lifters upward and downward alternately, a given distance. The hardened steel plates, fitted into the lifters, project so far as to engage with corresponding plates in the beater. When the cone is raised by the governor balls to its full height, one of the lifters will carry the beater

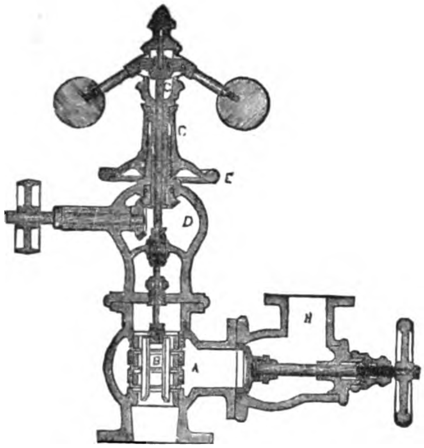


FIG. 1217. *Condé Engine Governor.*

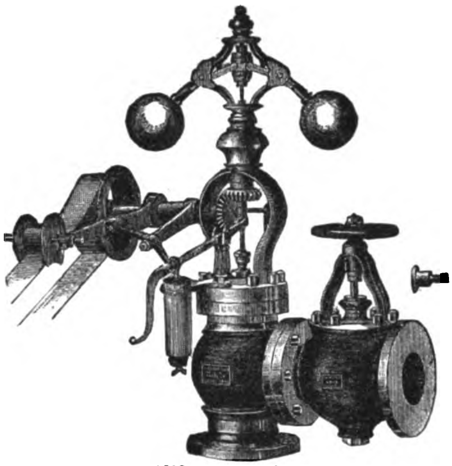


FIG. 1218. *Judson Governor.*

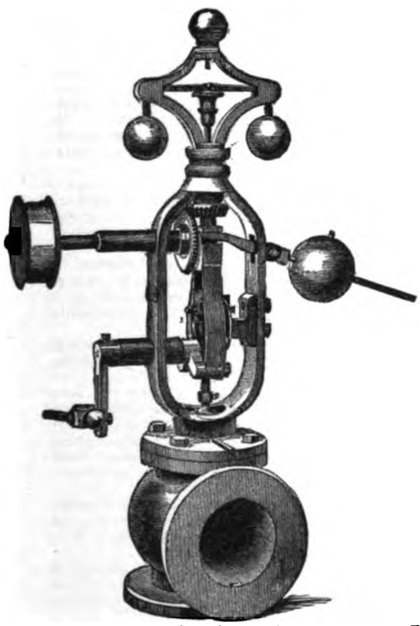


FIG. 1219. (*Perspective.*)

FIG. 1220. (*Portion enlarged.*)
Tremper Variable-Cut-off Governor.

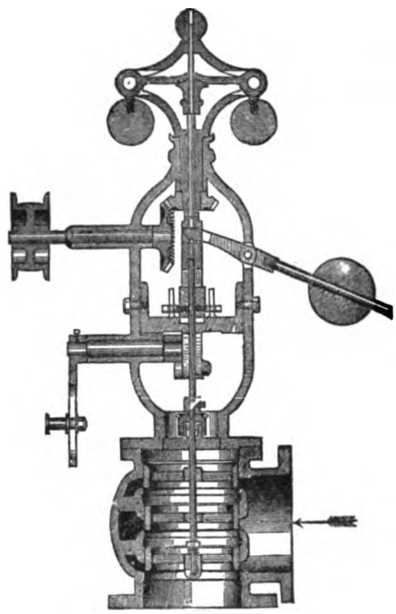


FIG. 1221. (*Vertical Section.*)

FIG. 1222. *Waters Governor.*

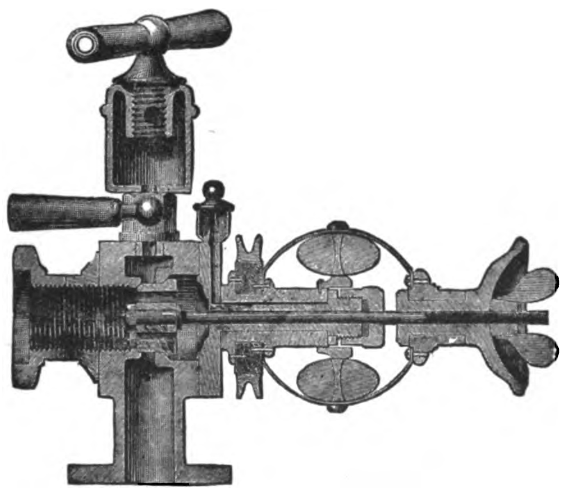


FIG. 1223. *Bourne High Speed Governor.*

 See pages 408, 409.

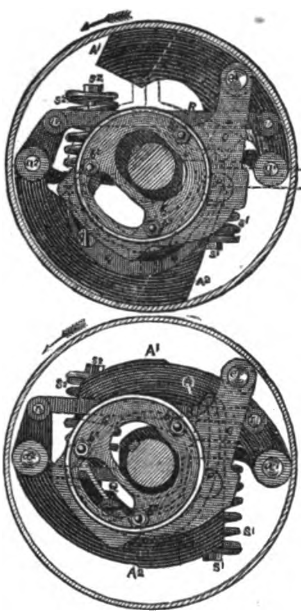


FIG. 1225. *Hartnell's Engine Governor.*

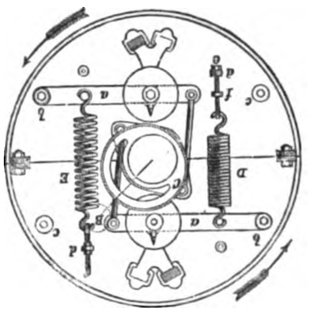


FIG. 1224. " *Buckeye* " *Engine Governor.*

FIG. 1228. *Allen Governor.* (*Vertical Section.*)

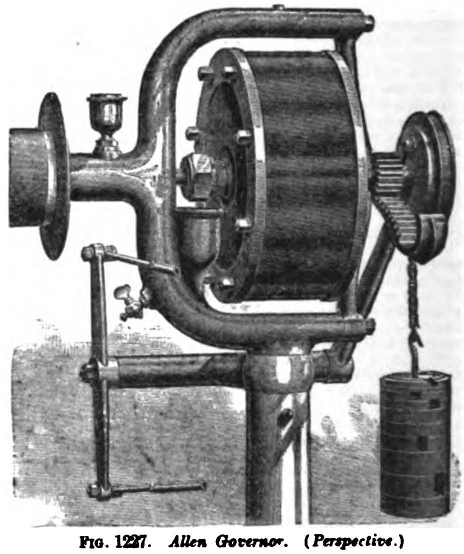


FIG. 1227. *Allen Governor.* (*Perspective.*)

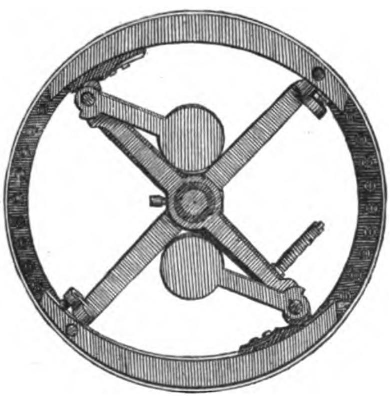


FIG. 1230. *Heebner's Horse-power Governor.*

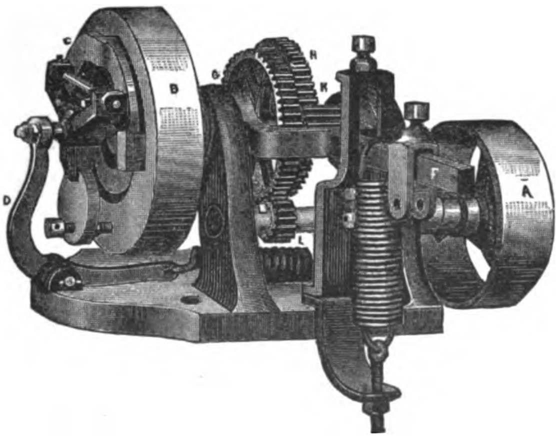


FIG. 1229. *Runqvist's Oscillating Governor.*

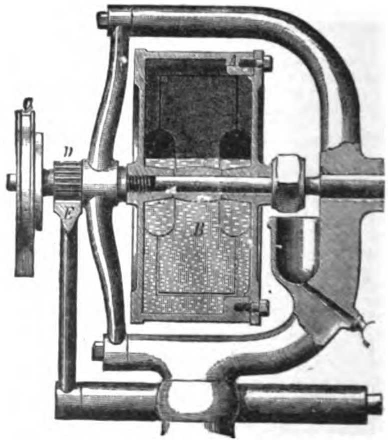


FIG. 1226. *Allen Governor.* (*Vertical Section.*)

upward, opening the cut-off valve; and as the steel plates are not, under these circumstances, disengaged by the wedges, but remain in contact, the valve remains open until it is closed by the lifter in its downward movement. It is then reopened by the lifter on the opposite side, which represents the return-stroke of the piston. When this condition exists, the engine is said to be "*carrying full stroke.*" The steam is not being cut off, but is freely admitted to both ends of the cylinder, and the full power of the engine is being developed. If a less amount of steam is sufficient to maintain the speed of the engine, the wedge *W* is moved downward by the operation of the governor balls and the lifter, sliding outward as it moves upward, is disengaged from the beater, and the valve is allowed to drop instantly into its seat, cutting off the passage of the steam into the cylinder.

The duty of the governor, therefore, is only to determine the position of the wedge *W*, the power required to move the valve being derived directly from the engine itself, operating through the lifter.

The engine governor of *Waters* is shown in Fig. 1222, Plate XVIII. The action of springs is supplemented to that of balls.

The balls are attached to the ends of curved springs, and supported from the ends of bell-crank arms which are pivoted to the revolving sleeve of the governor. In the axis of the sleeve is the upward extension of the valve-stem, and tappets on the inner part of the bell-crank work in the groove of a collar on the valve-stem, so that when the balls fly out by access of speed the tappets force down the stem, and so operate the throttle-valve in the chamber. One end of each of the springs is bolted to the sleeve and the other end connected to a suspended ball, the whole arrangement of balls, springs, and sleeve revolving around the stem. The end of the valve-stem is extended through the top of the composition collar and furnished with a handle with which to turn it and a check-nut to hold it in place. Screwing this stem down causes the engine to run slower, screwing it up causes it to run faster.

Fig 1223, Plate XVIII., shows the *Bourne* high-speed governor (Br.) The whole is made of polished brass. The spindle carries two bent springs, at the center of which two brass weights are situated, and the spindle, springs, and weights are rotated by a small pulley driven by a cord from the shaft. The spindle carries a double-beat valve which is closed or opened by the centrifugal action of the weights or the centripetal action of the springs. The latter is a constant quantity, but is overcome more or less by the centrifugal force as the speed of the engine varies, thus regulating the admission of the steam. The double-beat valve acts also as a stop-valve, its position being governed by the hand-wheel at the end of the spindle, while the periphery screw prevents this wheel from moving from the position at which it is set. On the top of the governor there is a grease cup, by which oil or grease is continuously fed in with the steam. The thumb-screw at the end serves to regulate the speed of the engine, or to stop and start the latter. The governor takes up but little room, and is an improvement on the somewhat similar arrangement long used by Mr. Bourne.

The variable cut-off governor of the "Buckeye" engine is shown at Fig. 1224, Plate XIX.

The cut-off mechanism consists of a light cut-off valve, working on the inner face of the main valve, the stem passing out through the hollow steel stem of the main valve, and being driven from a loose eccentric on the shaft with a special motion derived from the compound rock shaft. This loose eccentric is controlled by the governor, Fig. 1224, which is a shell fast upon the shaft and revolving with it. In this shell are pivoted two weighted levers, the outer ends of which are linked to the flange on the elongated sleeve of the loose eccentric The centrifugal force developed in the weights throws them outward, and two steel coil springs furnish the centripetal force. The system being coupled is independent of gravity, and the speed determines the position of the weighted arms, which, in turn, determine the angular advance of the eccentric and the consequent point of cut-off, the range of which is from zero to nearly three quarters of the stroke

Fig 1225 shows a *Hartnell's* governor (Br), in which an arrangement similar to that shown in Fig. 1224 is adopted. The entire governor is carried by a disk keyed to the crank shaft The purpose is to regulate the admission of steam to the engine cylinder without in any way throttling it, altering the stroke of the eccentric without altering the lead of the slide valve.

The figures show the weights extended and collapsed, respectively.

A^1 and A^2 are the weights, a^1, a^2, the pins on which they swing *R* the link connecting the weights with each other at r^1 and r^2 *E* is the eccentric, having a slotted eye, through which the crank shaft passes; it is fastened to the carrier, *C*, by the bolts b^1, b^2, b^3, and swings from the center e^1 *Q* is the quadrant fastened by the screw *q* to the weight A^2, the arm of this quadrant slides through a swivel pivot *P*, on the eccentric carrier *C*. S^1, S^2, are the springs which control the expansion of the weights, s^1, s^2, the adjusting screws for the springs.

On the engine being put in motion the centrifugal force tends to drive the weights, A^1, A^2, outwards, but they are prevented from flying out too readily by the restraining force of the spiral springs, S^1, S^2. The quadrant *Q* is so fixed upon the weight A^2 as to form an angle inclined to its path of motion, by sliding through the swiveled pivot *P*, and acts as an incline to shift the eccentric, which it does in correspondence with the movement it derives from the governor weights as they fly out or come in, giving more or less eccentricity to the eccentric, and consequently more or less stroke to the slide valve, and steam to the cylinder.

The construction of the *Allen* governor, Figs. 1226–1228, Plate XIX., is as follows: —

Within a corrugated cylinder, which has small projecting ribs on its interior periphery, and which is partially filled with oil, a paddle-wheel is caused to revolve by a spindle passing through one end of the cylinder, driven by a belt communicating with the fly-wheel shaft. The tendency of the revolving paddle-wheel is to cause the cylinder to move in the same direction. On the opposite side to the revolving spindle is a trunnion or short spindle fixed to the cylinder, attached to which is a wheel carrying a set of movable weights suspended by a chain, the speed of the engine being regulated by the number of weights. Attached to the wheel and keyed on the end of the short spindle is a pinion revolving with the cylinder, and working in a toothed sector, the arm of which, being fixed on the spindle of the throttle-valve, opens or closes it as the oil cylinder moves with the paddle, according to the variation of load thrown on the engine. When used with variable cut-off engine, the arm is attached direct to the cut-off.

Fig. 1229 shows the engine governor by *Runqvist*, of Sweden. Its principle is to develop a pressure produced by frictional resistance depending upon the velocity.

To the rapidly revolving main spindle of the governor is rigidly attached a bracket which carries on one side a set screw, and on the other a segment of an iron ring, *C*, in which are mounted three blocks of hard wood. This segment is so attached to the bracket that the faces of the three wooden blocks can readily adjust themselves to form one plane with the point of the set screw, however the latter may be adjusted This plane is not at right angles to the revolving spindle, but is more or less inclined

A heavy ring, *B*, is so attached to the body of the governor by a universal joint that it cannot revolve, but can freely oscillate. This ring is adjusted closely against the wood-blocks and set-screw mentioned before; and the latter forming a plane inclined to the spindle, rotation must transmit an oscillating movement to the ring *B*. This oscillation brings into play the inertia of the mass of the ring, reacting against the wood blocks, and producing, by friction, a resistance against the rotation of the shaft, evidently increasing with the speed.

The governor is driven from the engine by the pulley *A*, whence the motion is transmitted by the pinion *L* to the wheel *G*, which revolves loose on the main spindle of the governor. This wheel gears into a pinion fastened to a spindle, to which the wheel *H* is keyed; and this wheel finally transmits the motion to the main spindle by the pinion *K*. The lever *F* is forked at its fulcrum, that is formed by the main spindle, and it is extended beyond this fulcrum, carrying the spindle of the wheel *H*. From this it will be seen that the combination of wheels forms a differential gear; and here is where the resistance offered against the rotation of the main spindle meets its opponent — the tension of a vertical spiral spring — that will be elongated more or less according to the speed The lever *F* carries on its front end an adjustable saddle, to which the valve rod can be attached.

Fig 1230 is Heebner's speed regulator, for railway horse-powers

The rim or circle is fastened to the power behind the belt wheel, and leaves the shaft exactly in the center. The hub with its attached arms, weighted balls, and friction blocks, has a stud with small coiled brass spring secured by a thumb-screw at the end to regulate the amount of speed. As the speed increases the balls are thrown out by centrifugal force, and press the friction blocks against the rim, thus acting as a brake; but as soon as machinery is applied, and takes the power, the balls fall back and relieve the braking.

2. (*Gas.*) *a.* An instrument or apparatus to regulate the flow of gas. See Gas Governor; Gas Regulator.

b. An attachment to a gas exhauster which causes the pressure in the main to determine the speed of the engine running the exhauster. See Gas Exhauster Governor.

Refer to: *Allen* . . . . * "*Iron Age*," xvii., June 15, p 1.
* "*Polytechnic Review*," ii. 82.
* "*Min. & Sc. Pr.*," xxxviii. 81.
* "*Manuf. & Builder*," xii. 129.

Allen . . . . * "*Sc. American*," xxxiv. 385.
* "*Am. Manuf.*," Aug. 13, 1880, p. 18.
Audrade, Fr. . . . . . . * "*Engineering*," xxiv. 443.
* "*Sc. American Sup.*," 1824.
Throttle, *Bagnall*, Br. . . * "*Engineering*," xxviii. 5.
Batchelor, Br. . . . . * "*Engineer*," xlvi. 241.
Chase . . . . * "*Sc. American*," xxxix. 85.
" Buckeye engine " . . * "*Sc. American*," xxxviii. 310.
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High speed, *Bourne*, Br. . * "*Sc. American Sup.*," 1806.
* "*Engineer*," xliv. 395.
Cosine, *Buss*, Ger. . . * "*Engineer*," xliii. 58.
Clark . . . . * "*Sc. American*," xxxv. 70.
Air compressor, *Clayton* . * "*Iron Age*," xxii., Sept. 19, 1.
Electric, *Hill* . . . . . * "*Teleg. Journal*," iv. 325.
Marine, *Jenkins & Lee* . . * "*Sc. American Sup.*," 4137.
Matteson . . . . * "*American Miller*," viii. 38.
* "*American Miller*," vii. 65.
Marks . . . . * "*Sc. American Sup.*," 440.
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Marine } *Durham*, Br. * "*Engineering*," xxv. 131.
Hydro-steam } * "*Engineer*," xlvi 190.
Marine, *Fowle* . . . . . * "*Sc. American*," xxxviii. 88.
Cosine, *Plambeck & Darkin* * "*Engineering*," xxiii. 99.
Penney . . . . * "*Engineering*," xxv. 229.
Porter . . . . * "*Thurston's Vienna Report*," ii. 32–34.
Marine, *Rankine* . . . . * "*Sc. American Sup.*," 2162.
Rigby . . . . * "*Min. & Sc. Pr.*," xxxvi. 385
Shire . . . . * "*Manuf. and Builder*," viii. 6
Equilibrium, *Shanks*, Br. . * "*Engineering*," xxviii. 28.
Tabor . . . . * "*Sc. American*," xxxvii. 150.
Trary . . . . * "*Engineer*," xlviii. 431.
True . . . . * "*Sc. American*," xxxv. 354.
Varying speed, *Wallis & Steevens*, Br.
* "*Engineering*," xxix. 822.
Waters . . . . * "*Iron Age*," xviii., Sept. 21, 1.
* "*Sc. American*," xxxix. 339.
Westinghouse . . . . * "*Am. Man.*," May 2, 1879, 9.
* "*Engineer*," xlvi. 248.
Ring, *Wile*, Br. . . . . . * "*Engineer*," xlvi. 423.

See also MARINE GOVERNOR; TACHOMETER.

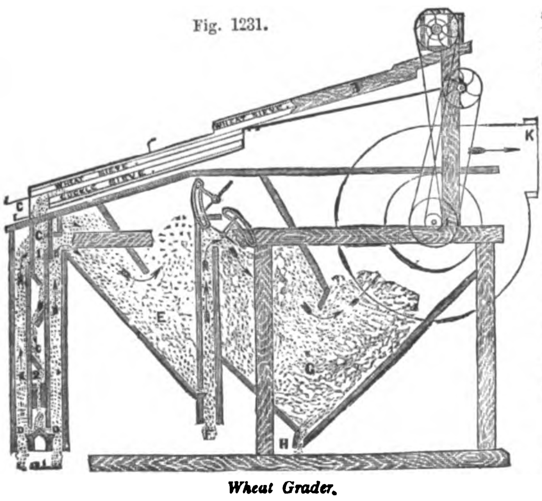
Gra'der. 1. (*Railway.*) A temporary track is laid, and from a platform and caboose car on this track a double plow is rigged out to throw up a track. — *Harden.*

2. An earth scraper.

3. (*Milling.*) A machine for separating grain into lots of varying qualities. Barnard & Lea's wheat grader acts by the combination of sieves and suction blast.

The wheat is received on a broad inclined sieve, *B*, and thence to a second or cockle sieve, and passes to the separating trunk *C*, where it meets the up-blast of air which enters at *D'*. The force of the blast is regulated to perform the separation required: the heavier grain falls at *D'*, second-grade grain is carried up and deposited in *E*, whence it reaches a second separating trunk *F* with up-blast of air, and parts with the screenings, which falls into *G* while the dust goes to the fan and is blown out. See also GRAIN SEPARATOR.

Fig. 1231.

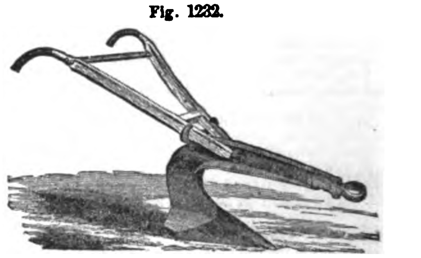


Wheat Grader.

Gra'di-ent'or. A form of surveyor's compass especially adapted for leveling and grading.

Gra'ding Plow. A heavy and strong plow used in road-making and road-working; plowing up the neighboring sod or soil to be removed by the scraper.

Fig. 1232.



Grading Plow.

Gra'ding Scra'per. An earth scraper. See SCRAPER.

Grad'u-a'ted Spring. (*Railway.*) A round-bar single-coil spiral-spring, with two conical india-rubber springs on the inside, one attached to the spring-seat and the other to the spring cap. When the spiral spring is extended, there is some space between the two rubber springs. The weight is first supported by the spiral spring until this is compressed far enough to bring the two rubber springs in contact, when they support part of the load. — *Forney.*

Grad'u-a'ting Sight. (*Fire-arms.*) One graduated for distance, wind, etc. See VERNIER SCALE SIGHT, for the former; WIND GAGE SIGHT, for the latter.

Graf'i-to. (*Fine Arts.*) Italian *Sgraffito*. A style of picture in which a thin light ground is cut, chipped, or scraped away to expose a dark under surface. See Fig. 1233.

It is principally used in artistic ceramics, *pateræ*, etc. See Prof. Blake's Report, " Paris Exposition Reports," 1878, vol. iii., for numerous examples, in which the designs are incised in a thin layer or covering of white slip over a dark red-colored coarse clay body.

In grafito, the figure is outlined by a sharp steel point, and then for the background and shadows the slip covering scraped away to give various depths of color. The design is thus left upon the surface in flat relief, being a mere film not much thicker than a card. The whole surface is then enameled with a fusible hard glaze which incorporates itself with the body and slip, and gives a mellow softness and finish to the work.

Graft'er. A fine-toothed, pointed, narrow-bladed hand saw, used in sawing off limbs and stocks for the insertion of grafts.

Grafting tool. . . * "*Scientific American*," xl. 212.

Graft'ing Scis'sors. (*Surgical.*) A skin grafting scissors, for cutting off and holding a piece of skin. Fig. 87, Part V., *Tiemann's " Armam. Chirurgicum."*

Grain Car. (*Railway.*) A box car, with light door, used for conveying grain in bulk.

Grain Clean'er. A device to remove imperfect or blasted berries, chaff, weed seeds, dirt, dust, or other trash from grain.

The grain separator does as much, but also sorts the grain into qualities. As the cleaning and sorting belong to the separator the subject is there considered. See GRAIN SEPARATOR; GRAIN SCOURER; SMUT MILL; BRUSHING MACHINE, etc.

Commercial wheat is rarely pure. Besides dust, sand, sticks, clods, chaff, and straw, there are numerous seeds, etc., which must be separated from the wheat before grinding. Such are several varieties of wild onions, vetches, peas, parsley, beans, radishes, mustard, chess, oats, grass-seed, cockle; besides blasted kernels of wheat, rust, ergot (smut).

Shriveled or blasted berries are in milling resolved into bran, and the flour discolored and rendered less nutritious. Some foreign seeds impart unpleasant taste, some are unwholesome, others discolor the flour.

Many mechanical devices are used to separate the offal from the pure grain; acting by gravity, meshes of varying size, rolling over a surface, exposed to a blast, a percussive impulse, pockets of varying size and shape, etc. See GRAIN SCREEN; GRAIN SEPARATOR; SMUT MILL. Also list under GRAIN, etc.

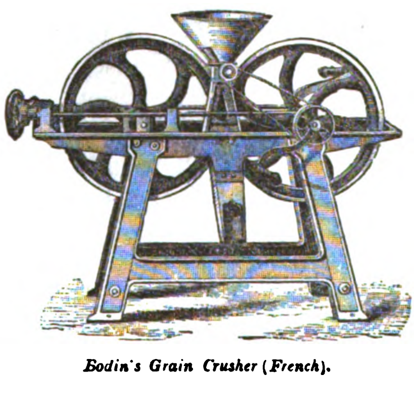
Fig. 1233.

Grafito Tile by Solon.

Grain Clean'ing and Grind'ing. See under the following heads: —

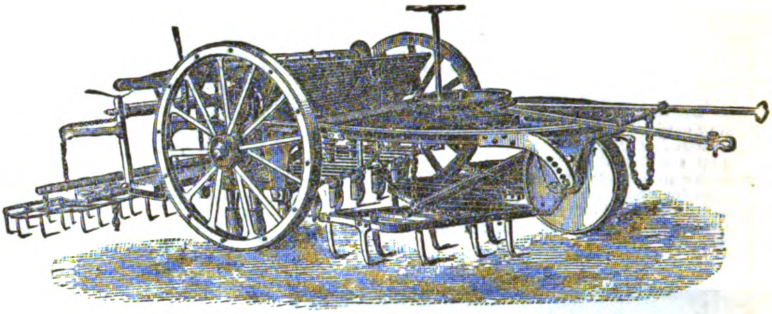
Army mill.
Aspirator.
Back-lash spring.
Bag holder.
Bail.
Barrel bolt.
Bolt cleaner.
Bolt feeder.
Bolting cloth cleaner.
Bolting mill-stone.
Bone mill.
Bosom staff.
Bran baler.
Bran duster.
Bran packer.
Bray plank.
Bridge pot.
Brush-finishing machine.
Brushing machine.
Buckwheat huller.
Buckwheat shucker.
Buhr.
Buhr dresser.
Buhr driver.
Buhr rubber.
Chop separator.
Corn cleaner.
Corundum tool.
Cracking machine.
Creeper.
Cylinder grinding machine.
Cylinder mill.
Damsel.
Decorticator.
Degerminator.
Disintegrator.
Driver.
Dust collector.
Elevator.
Elevator boot.
Exhaust purifier.
Facing machine.
Facing tool.
Flour bolt.
Flour bolting chest.
Flouring mill.
Flour packer.
Furrow-dressing machine.
Furrow-gage staff.
Furrow rubber.
Furrowing machine.
Grader.
Grain cleaner.
Grain damper.
Grain dryer.
Grain mill.
Grain scourer.
Grain screen.
Grain separator.
Grain sifter.
Grain smutter.
Grain sorter.
Grain steamer.
Grain toller.
Grain washer.
Granulating process
Grinding mill.
Grist mill.
Grits-grading machine.
Grits mill.
Grits purifier.
High grinding.
High milling.
Hominy mill.
Horse gears.
Hurst.
Husk frame.
Kibbling mill.
Leveling screw.
Lighter staff.
Low milling.
Maize mill.
Malt crusher.
Meal cooler.
Middlings.
Middlings grinder.
Middlings mill.
Middlings purifier.
Middlings softening machine.
Mill bush.
Mill driver.
Mill feeder.
Milling.
Milling process.
Mill pick.
Mill spindle.
Millstone.
Millstone alarm.
Millstone bush.
Millstone crane.
Millstone curb.
Millstone dresser.
Millstone driver.
Millstone exhaust.
Millstone facing machine.
Millstone feed.
Millstone hoist.
Millstone leveler.
Millstone lift.
Millstone spindle.
Millstone ventilator.
Mixing machine.
Molarimeter.
New process milling.
Oatmeal machine.
Oat mill.
Oil bush spindle.
Pearling.
Pointing.
Portable mill
Process milling.
Proof staff.
Purifier.
Red staff.
Riddle sorter.
Roller mill.
Sack filler.
Sack lifter.
Sack packer.
Sack truck.
Scalping.
Scourer.
Sectional mill.
Semolina machine.
Semolina separator.
Semolina sifter.
Separator.
Shoe.
Sifter.
Sifting machine.
Smut machine.
Smut mill.
Smutter.
Stone clearer.
Stone separator.
Toller.
Tolling machine.
Tomkin post.
Tram pot.
Tram staff.
Unbranning machine
Vertical mill.
Vertical-stone mill.
Wheat brush.
Wheat cracker.
Wheat damper.
Wheat grader.
Wheat heater.
Wheat magnets.
Wheat scourer.
Wheat separator.
Wheat steamer.
Winnowing machine.
Yoke lever.

Fig. 1234.



Bodin's Grain Crusher (French).

Fig. 1236.



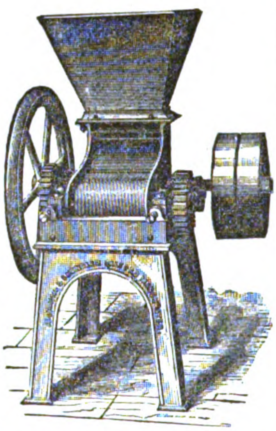
Fowler's Combined Drill and Harrow (Steam Culture.)

Grain Crush'-er. A machine for mashing grain for feed, in order to render it more easily digested. It is largely used in Britain and in France, especially with beans; oats are, however, roughly broken or ground in many cases.

The bean crusher is known as a *kibbler* in England; the grain crusher as a *concasseur* or an *aplatisseur* in France.

Fig. 1234 shows the *aplatisseur* of Bodin, of Rennes. The grain issues from the hopper in quantities regulated by the feed-wheel, and falls between the flat surfaces of the two large rollers (0.70 meter diameter), one of which is driven by hand or pulley, while the other is moved by contact. A set-screw regulates the distance between the two rollers, and a spring permits them to separate should a stone or foreign body intrude between them.

Fig. 1235.



Grain Crusher. (*British.*)

The work by hand is 22 gallons per hour.

The grain crusher of Richmond & Chandler, of Salford, England, is shown in Fig. 1235. The rollers are ridged so as to make it a rough grinding operation. It is used for beans, peas, oats, barley, maize, flax-seed, or malt.

The "set" of the rollers is regulated by means of two thumb-screws in front of the machine, so that the grain may be crushed to the required degree of fineness. The feed of the grain to the rollers, according to the force applied to the machine, is determined by a small regulating wheel.

Machines for crushing oil-cake for cattle and sheep feed are very commonly used in Europe. See Fig. 498, page 152, *supra.*

Grain cutter (feed), *Pini*, Ger * "*Engineer*," xlvi. 434.
Wilhelm, Austria . . . . * "*Engineer*," xlvi. 434.
Crusher, *Von Horde*, Austria * "*Sc. Am. Sup.*," 938, 2755.

Grain Cut'ter. A machine for breaking grain for feed. See Grain Crusher.

"*Scientific American Supplement*," * 2755.

Grain Damp'-er. An apparatus or attachment to dampen grain before grinding. It is done by wetting or steaming. See Wheat Steamer.

Grain Door. (*Railway.*) A close-fitting inside half-door for the doorway of a grain car.

Grain Dress'er. A machine for cleaning and dressing grain before grinding.

See Grain Separator; Grain Scourer; Bushing Machine, etc. See list under Grain Cleaning and Grinding.

Vangelder . . . . * "*Scientific American Sup.*," 1620

Grain Drill. A machine for sowing grain in rows. See Wheat Drill, Figs. 7163–7168, pp. 2761–2763, "*Mech. Dict.*"

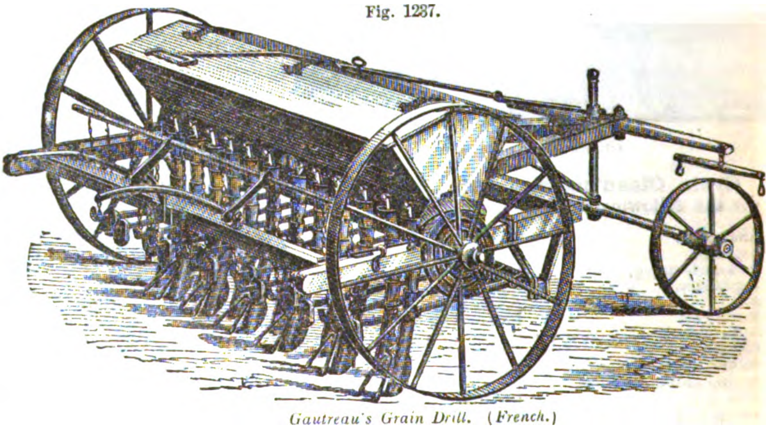
The combined drill and harrow, Fig. 1236, is one of the implements of the British steam culture.

It has a light cultivator or heavy harrow in front of the seeding colters, and a light covering-harrow following the same. The seed-drill itself, even of the largest width, requires but so small a fraction of the power of the engines, that it has been combined with the harrows. The drill has a width of 9'. In turning around, the heavy harrows are lifted by the power of the engine, and the whole implement moves at once on to new ground. The automatic lifting and turning action is described in connection with the turning cultivator, Fig. 739, p. 234, *supra.* See also "*Paris Exposition Reports*" (1878), v 87.

The Gautreau drill (Fr.), Fig. 1237, has a fore carriage (*avant-train*), which is controlled by the workmen at the rear of the machine, and serves to guide the drill. The steering-lever is seen trailing backward and resting on the top of the seed-box. In the English drills this duty is frequently allotted to a man in advance of the hopper-box, walking between it and the fore carriage.

The European shovels, for the English and French agree in this, are nearly vertical, trailing a little backward in fact, and are forced into the soil by means of a weighted lever of the second order attached to each. One or more cast-iron weights are placed on the end of the lever, according to the hardness of the ground, and the result is no small addition to the weight of the machine, and would be needless were the shovels made *hooking* so as to draw into the soil, the

Fig. 1237.



Gautreau's Grain Drill. (*French.*)

point ranging forward in the manner of the ordinary plow, which keeps itself in the ground by virtue of the mode of presentation of its point.

Smyth's telescopic drill-tube (Br.) shown in Fig. 1238, is a substitute for the caoutchouc tube, which is not so popular in Europe as it deserves to be.

Fig. 1238.

Telescopic Drill Tube.

It consists of three parts, slipping easily one within the other. The material is sheet-iron, and the conductor proper may be said to consist of two tubes, b^1 b^2, discharging into a spheroidal cup, *c*, which rests on the bar *d*, and discharges behind the share which opens the furrow. The tube b^3 suspended by chains *g g*, is merely an envelope to prevent the entry of rain, clods, or wind into the tube, to clog it or disturb the fall of the grain from the spout *a*.

See also CORN DRILL, Fig. 691, p. 222, *supra;* GRAIN DRILL, 5 figures, pp. 1002–1004, "*Mech. Dict.*," and WHEAT DRILL, pp. 2761, 2763, *Ibid.*

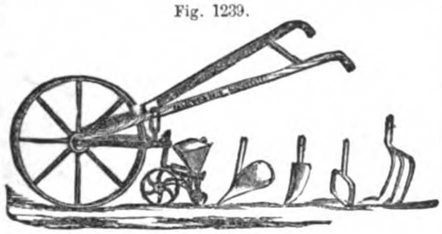
The English garden plow and drill, Fig. 1239, consists of one light steel shovel, for marking out rows to plant, or for loosening up the ground after the plants are up. Also a drilling attachment; a small steel plow for hilling up the rows; a cutter for exterminating weeds, and a rake for pulverizing the ground. The tools being optionally attached to the stock.

Dr. Knight's report on Class 76 at the Paris Exposition of 1878, contains notices and views of the following:

See "*Paris Exposition* (1878) *Reports*," vol. v., pp. 103–119.

Grain drill	*Gautreau*, France.
Grain drill	*Smyth*, England.
Kuhn's grain drill, "Farmer's Friend"	United States.
Shiftable feed-movement of grain-drill	France.
American change wheel arrangement . .	United States.
Telescopic seed-tube	*Smyth*, England.

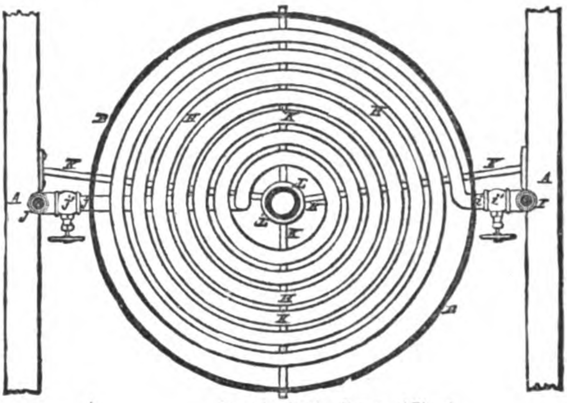
Fig. 1239.



English Garden Plow and Drill.

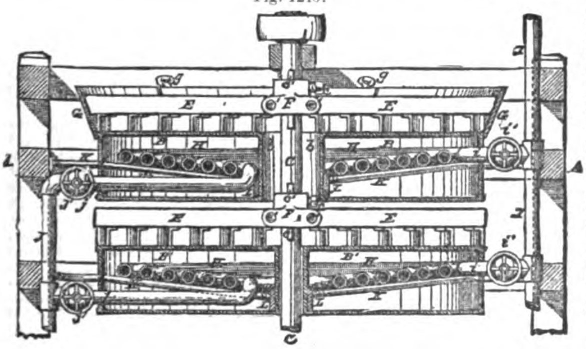
Turnip and beet seed drill . . .	*Corbett & Peale*, England.
Grain and seed drill	*Guilleux*, France.
Broadcast seeder	*Smyth*, England.
Seed sower	*Rasmussen*, Denmark.
Broadcast seeding barrow . . .	*Hunt & Tawell*, England.
Broadcasting plate	France.
Broadcast seeder	*Pernollet*, France.
Combined drill and fertilizer . .	"Farmer's Friend," U. S.
Fertilizer sower	*Josse*, France.
Combined beet seed and fertilizer drill . .	*Smyth*, England.
Beet seed planter	England.
Cup feed	England.
Brush-wheel feed	England.
Provençal plow-drill	*Magnan*, France.
Rayonneur or marker	*Bodin*, France.
Seed planter	France.
Seed planter	France.
Hand seed-drill	France.
Garrett, Br.	* "*Engineer*," xlvii 467.

Fig. 1241.



Roper's Grain Dryer. (*Plan.*)

Fig. 1240.



Roper's Grain Dryer. (*Vertical Section.*)

Grain Dry'er. An apparatus or machine for artificially drying damp or heated grain.

Figs. 1240, 1241 show Roper's apparatus. *A* is the frame of the dryer, supporting the drying-pans *B B'*, through the center of which passes the driving-shaft *C*, carrying the rakes *E*, the teeth of which are so inclined as to carry the grain inward and outward on alternate pans. The grain is carried inward on one pan and discharged through a central opening, *b*, and is carried outward in the next pan of the series and discharged over the edge into the pan beneath.

H is a coil of steam-pipe, one of such coils being provided for each of the pans.

The grain or other material is supplied to the upper pan near its periphery, and carried inward to the central discharge, where it drops on to the pan *B'* beneath, on which it is carried outward and drops from the periphery of the pan on to the flaring edge *G*, and top of the pan beneath.

On the estate of Baron Horsky, in Bohemia, is a granary, provided with an elevator for the purpose of carrying the grain to the uppermost of a series of perforated floors or shelves, by means of which the grain can be made to fall in numerous slender streams through successive air spaces to the hopper at the bottom, from which the grain is again carried in the buckets of the elevator to be discharged on the upper shelf, and so made to go round and round until the desired dryness is attained.

Coignet's apparatus is designed to dry grain and seeds without destroying the life of the germ. For this purpose the articles to be dried are placed upon perforated stages and traversed by a current of air from above, downwards, heated to the proper temperature, from 104° to 122° Fah., which he finds best to answer his purposes. A still higher temperature (namely, from 300° to 310°), applied in the same apparatus, enables him to dry certain animal matters, intended as manures, without causing the loss of their nitrogenous material; but, as such a temperature of dry air would be apt to cause combustion, he replaces this by superheated steam.

There are many typical forms of grain dryers: fan, pans, screens, chutes, traveling aprons, etc. See several instances, pp. 1004, 1005, "*Mech. Dict.*"

Steam, *Cutler*.	* "*American Miller*," vi. 93; x. 161.
Stacey .	* "*Scientific American Sup.*," 240.
Standing	* "*American Miller*," iv. 106.
Wallace .	* "*American Miller*," iv. 6.

Grain El'e-va'tor. An apparatus for lifting or transferring grain. See ELEVATOR.

"The pneumatic grain elevator of Renhaye consists of a centrifugal ventilator, the suction pipe of which is carried to a receiver placed upon the level to which the grain is to be carried. From the same receiver the supply pipe runs to the place from where the grain is to be lifted. Between the openings of the suction and the supply pipe of the receiver is an inclined plane, which throws the grain downward. A screen prevents the grain from entering the suction pipe, through which only the dust is carried off. A piston regulator at the lower end of the supply pipe acts in such a manner upon an adjustable nozzle that the proper proportion between the amounts of air and grain admitted is automatically maintained. The principle upon which this pneumatic elevator acts is that when solid particles in movement in a pipe are mixed with air, a semi-fluid is formed in which the pressures vary in accordance to the laws governing ordinary fluids." — "*Revue Industrielle.*"

Rennie, Br. . . . . * "*Engineer*," xlix. 28.

Grain Fan. See FANNING MILL; WINNOWING MACHINE.

Grain'ing. (*Leather.*) Giving to leather a granular appearance on the grain side by either the graining board or pebbling machine. The term originally meant raising the natural grain or marking of the leather on the hair side; but now is also applied to making artificial markings in imitation of morocco, hog-skin, etc.

Grain'ing Board. (*Leather.*) A rectangular piece of wood, the upper surface a plane; the lower one is convex, and fluted with parallel grooves, which run perpendicular to its length. The grooves are coarse or fine, as occasion requires.

Grain Meas'u-rer. See GRAIN REGISTER; GRAIN SCALE.

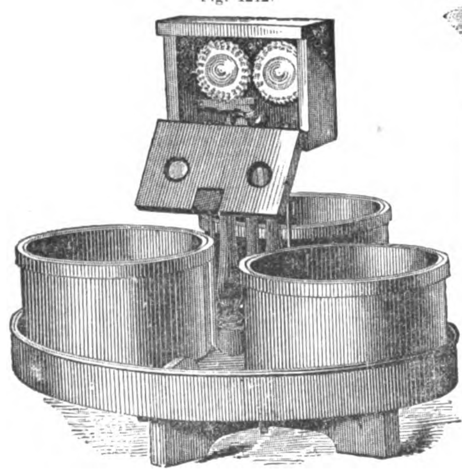
Grain Mill. See GRINDING MILL.

See also CYLINDER MILL; DECORTICATOR; GRAIN CRUSHER; CORN MILL; FLOUR MILL; MILLING, and list under GRAIN, "*Mech. Dict.*," *et supra.*

Grain Reg'is-ter. An apparatus to keep count of half-bushels moved away from the delivery spout of a threshing machine.

The half-bushels are moved consecutively under the spout, and as an empty one replaces the full one removed the register tallies one. The count is kept by the usual system of wheel, as in the gas meter. The shutter of the tally chamber is shown down, but the count may be observed through the windows of the closed shutter.

Fig. 1242.



Grain Register for Threshers.

Grains. An eel spear. One is shown with five prongs. Fig. 1243.

Grain Scale. A machine for weighing grain in commercial quantities and keeping tally of drafts.

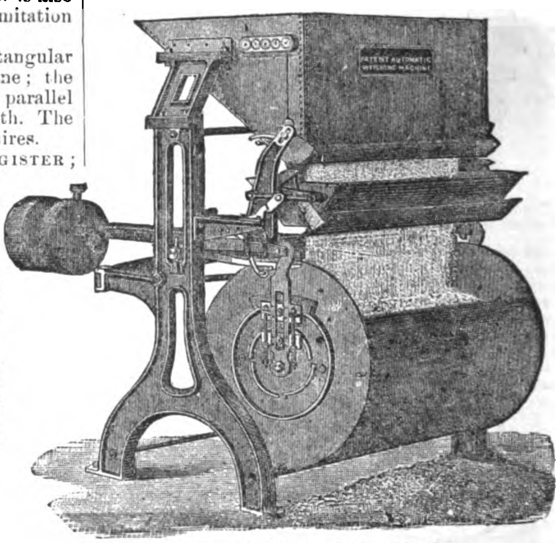
Fig. 1243.

Grains.

The machine shown in Fig. 1244 is by Baxter, of London. It is placed under a chute or spout, which delivers the grain with regularity.

Having determined the quantity that shall be registered at each tip of the cylinder, and adjusted the weight accordingly, the operation of weighing may commence. The grain being led into the hopper, descends into the compartment beneath, until the quantity nearly equivalent to the weight indicated on the steelyard has fallen; the diminishing valve then reduces the stream of falling material to such an extent that its momentum is not sufficient to influence the beam; the actual weighing here commences, and as soon as a correct balance is attained the cut-off instantly stops the supply to the cylinder; at the same moment the cylinder is released; it then turns and discharges its load. Being lightened, it rises, presenting the next compartment to be filled, opens the cut-off (letting out the grain collected therein), and the diminishing valve actuates the index, and the operation is repeated.

Fig. 1244.



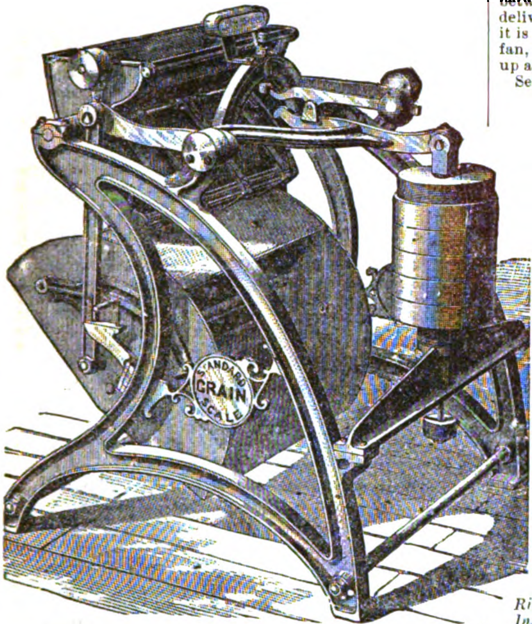
Baxter's Grain-weighing Machine.

The "Standard" grain-weighing machine is shown in Fig. 1245.

It consists of a balance beam, from one end of which, upon knife-edge pivots, is suspended a tilting grain-bucket. The bucket is divided into two equal compartments, and is held in position to receive grain by means of gravitating latches, pivoted to the suspenders which hang upon the knife-edge bearings and sustain the bucket. From the opposite end of the beam is suspended the balancing weight. The balancing weights are so arranged that the lower or main weight, in conjunction with the small weight on the supplemental beam, exactly balances the empty bucket, and the grain weight balances the weight of the grain to be taken in the bucket at each dump. Immediately above the grain bucket is placed the spout, which is gradually tapered to the mouth at the lower end, through which the grain is delivered into the bucket. Mounted upon the side of the spout are two long, narrow plates, the larger of which is known as the main, and the smaller as the supplemental cut-off, which are operated by means of fixed clutches upon the shaft.

When the grain-bucket is at the highest point of its travel, both the cut-off and the drip-plates are entirely withdrawn from under the mouth of the spout, and the grain flows freely into the bucket. When so much grain as is represented by the difference between the supplemental weight and the grain weight is taken into the bucket, the bucket and forward end of the beam descends a short distance, until the supplemental weight rests upon the beam, when the

Fig. 1245.



"Standard" Grain Scale.

bucket lacking grain to the extent of the supplemental weight is checked in its downward movement, and pauses until the requisite quantity to complete the load has been taken. The main cut-off plate is now closed, leaving open only a narrow slit, through which passes the final quantity of grain, necessary to complete the load. The bucket then descends until the latches holding it in position are released by check-pieces on the frame of the machine, when it turns on its shaft, discharges the weighed load of grain, and returns to repeat this operation as long as grain is supplied to the scale. The discharge of the grain from one compartment of the bucket presents the opposite compartment for the reception of grain as it rises under the spout.

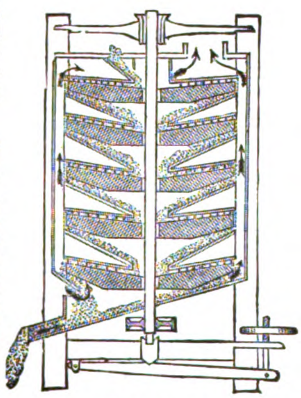
Compare: —

Meter, *Barnard*	* "*Scientific American*," xliii. 259.
Scale, *Cherry*	* "*Scientific Amer.*," xxxvii. 66.
Weighing machine, automatic, *Kaiser*, Austria .	* "*Engineer*," l. 404.
Weighing and measuring mach., Austria . . .	* "*Engineer*," l. 458 (Fig. 48).
"Standard"	* "*Iron Age*," xxv., April 15, p. 1.
Sampler, *Gent*	* "*Scientific Amer.*," xxxvi. 227.

Grain Scour'-er. A machine for removing the fuzz from, and polishing the berry. Used for wheat, rye, and buckwheat.

The grain follows a circuitous passage; falling down a funnel to the center, it is caught upon the rough sandstone disk and thrown out centrifugally, to repeat the action again and again till it reaches the bottom and the discharge spout. The blast which carries off the fuzz ascends through the machine, passing in a contrary direction to the grain.

Fig. 1246.

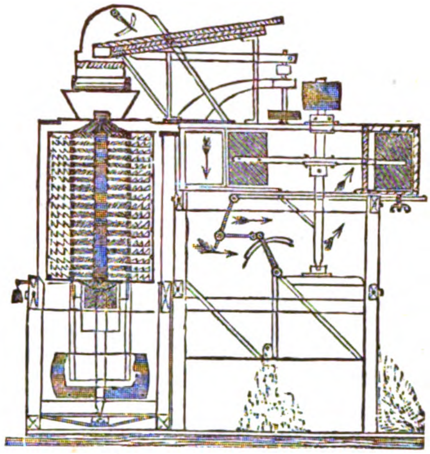


M'Neil's Grain Scourer.

In Ingraham's machine, Fig. 1247, the wheat descends between the brush cylinder and the rough concave, and is delivered with all the fuzz and offal into the chamber, where it is exposed to the current of air passing to the aspiration fan, and is sorted into two grades while the dust is carried up and blown out.

See also BRUSHING MACHINE, p. 141, *supra*.

Fig. 1247.



Ingraham's Grain Scourer.

Richardson	* "*American Miller*," vi. 22.
Ingraham "Excelsior."	* "*American Miller*," vi. 22.
Throop	* "*American Miller*," viii. 454.
Knox	* "*American Miller*," viii. 223.
Trimmer	* "*American Miller*," viii. 321.

Grain Sep'a-ra'tor. 1. The more common form of machine for ridding grain of chaff, husks, dirt, and dust is still the fanning-mill or winnowing machine, but late years have introduced a number of more speedy and excellent methods. The French especially have attained a degree of accuracy in sorting grades of grain, different grains, and grain from offal and dirt. Both in Britain and in France the farmer's implements for cleaning grain are in great variety. In milling implements our variety is the greater.

These machines may be summarized as acting by

a. *Blast.*	*d.* *Adjustable cylindrical sieve.*
b. *Aspiration.*	*e.* *Perforated and dented plates.*
c. *Graduated sieve.*	*f.* *Percussion.*
	g. *Projection.*

a. (*Blast.*) See FANNING MILL, p. 825, "*Mech. Dict.*" WINNOWING MACHINE, p. 2787. *Ibid.*

b. (*Aspiration.*) See ASPIRATING WINNOWING MACHINE, Fig. 119, p. 51, *supra*. Also, GRADER, Fig 1231, p. 410, *Ibid.*

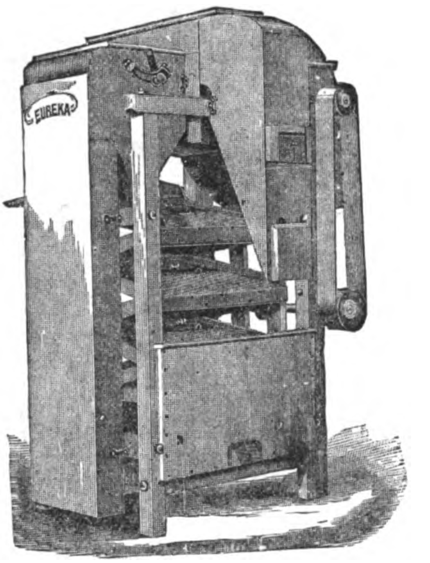
The "Eureka" separator, Fig. 1248, acts in large degree upon the aspirator principle, although it embraces many other features, shaking screens, etc. It has zig-zag arrangement of screens, combined with a lateral shake movement, and is intended to rid wheat of oats and other impurities.

The wheat is first fed into a suction separator, which removes the dust and light impurities, the dust passing to the fan, while the chess (cheat) and such other seeds as are of some value for food are discharged separately. The wheat then falls on to a shaking screen and distributor, which throws off straws, heads, sticks, etc., and distributes the grain evenly the entire length of the upper screen. It then passes over a series of screens which rid it of oats. It then passes to a cockle-screen which also rids it of sand and small seeds, and thence passes to a separating leg, where the operation is completed.

c. (*Graduated Sieve.*) An instance of this is afforded in Fig. 1249 of Plate XX., which represents the grain cleaner and separator of Boby, Bury St. Edmund's, England.

The machine has a wooden frame and a long inclined

Fig. 1248.



"Eureka" Separator.

sieve, which receives at its upper end the grain from a hopper. The grain issues in a thin sheet from the hopper, and first falls upon a separator, which arrests stones and large trash, allowing the grain to pass down and be discharged in a sheet as wide as the inclined sieve beneath. This sieve receives a longitudinal agitation by means of a pitman from a crank on the horizontal axis, which is revolved by hand-crank or belt, as the case may be.

The longitudinal wires of the shaking sieve are carefully stretched, and are spaced so as to retain plump grains and allow broken or thin grains to pass, and the meshes are kept open by thin blades, which also rectify the positions of the passing grains and bring them into parallelism with the wires along which they pass in their descent from the stone-separator to their point of ultimate discharge.

The machine is particularly intended for the cleaning and sorting of barley for malting, and the necessity of a perfect action in this respect is set forth in the statement following:

1. It is essential that, in advance of the payment of the impost duty (internal revenue or excise tax) on the steeped malt, the entire mass must be rid of matters which produce deficient quantities of saccharine extract.

2. It is necessary to separate all light grains before making the malt, for otherwise they will become too damp or saturated in the time necessary for the sufficient steeping of the good grain.

3. The thin or light grains must be absolutely separated from the full-sized grains before making the malt, for otherwise the thin grains pass unbroken between the rollers in the process of crushing the plump grains.

The operating surface of the Boby sieve is stated to have six times the area of the usual rotary sieve, and, the grain being spread over so great a surface, each light grain is sifted out in passing from the hopper to the discharge; in the rotary sieve the acting surface is only at the lower side, estimated as only embracing, at any one time, one-ninth of the peripheral.

d. (*Adjustable Cylindrical Sieve.*) A peculiar character of sieve, of cylindrical form, and capable of having the meshes made of any desired interval, within certain limits. The machine of Penney & Co., of Lincoln, England, is shown in three Figs., 1250, 1251, 1252, of Plate XX.

It is made of various sizes and prices, and there are also special constructions for certain purposes, such as the cleaning and grading of malt, the cleaning of peas and beans, etc. The latter-mentioned articles require such a very different range of adjustability that the machines cannot be economically made to suit the wide ranges of work.

The machine can be adapted for all species and qualities of grains (within profitable limits, as stated) by means of varying the distance between the wires.

The cylindrical screen may be said to consist of one continuous wire laid spirally around the longitudinal bars which form the skeleton of the screen. One of the heads is adjustable longitudinally of the axis of rotation, slipping thereon, and as it is drawn toward the extremity, the spaces between the laps of wire become larger, and, conversely, the intervals are diminished as the heads are approached by the reverse adjustment. Spiral springs mounted upon the exterior rods, as in Fig. 1251 (*ressorts extérieurs*), or within the cylindrical screen, as in Fig. 1252 (*ressorts intérieurs*), keep the screen extended longitudinally.

The different kinds of brushes used for cleaning the meshes of the screen are shown in Figs. 1251, 1252.

Regularity of passage through the length of the screen is secured by a spiral flange or rib projecting inward from the cylindrical surface, which tumbles the grain along until it pushes it out at the end. Dry and broken grain is retarded, while damp grain is expedited in its passage, the rate being thus made uniform, though the condition of the grain may vary.

The machine shown in Fig. 1250 is composed of two parts, of which the second and lower has screen openings of greater interval than the first part. It is intended for grain which contains stones, ordure of vermin, or other matters larger than the wheat or the grain to which the machine is for the time adjusted. The stones and other large matters pass clear through the screen and into a spout, which ejects them at the side; the good grain passes over the meshes of the first part of the cylinder and is divested of the small and broken grains which pass the meshes; it then itself falls between the meshes of the second portion of the cylinder, and is discharged by a spout at the end, while the stones pass on, and so to the side spout as stated.

e. (*Perforated and Dented Plates.*) The riddle-sorter of Pernollet, Paris, shown in Fig. 1253, Plate XX., is made in several forms, some adapted for the ordinary uses of the farm in cleaning grain, and others for special service, such as cleaning green peas, beans, lentils, coffee, cacao; for sorting different kinds of barley for brewers, etc.

The machines, in some cases, are specially constructed for a given purpose, but in others the change of the perforated iron plates for others of larger or smaller apertures is sufficient to adapt the machine to the required purpose.

The grain is placed in the hopper, its rate of feed depending upon the slide in the bottom. An oblique spout conducts the grain fairly within the rotating cylinder, whose four compartments, being clothed with punched iron screens of different apertures, sort the different kinds and drop them into boxes beneath. The respective screens have round holes of different sizes, or long holes, to detain or to allow to pass, as the case may be, seeds of varying sizes and shapes

Marot's grain cleaner, shown in section in Fig. 1254, Plate XX., shows a new feature in grain-cleaners, namely, *indented plates*, which form pockets to carry up seeds on the inside of the cylinder and drop them into a tray, which carries away the seed thus segregated from the other contents of the rolling cylinder.

The *indented plates*, of which detached portions are shown in Fig. 1255, Plate XX., are sectional cylindrical jackets, like the perforated covering of the Pernollet machine just described, but instead of holes they have pockets or cups, made by punching or drilling, and form cylinders around the axis of rotation.

As in the case of the Pernollet machine, and others of its class, the enveloping cylinder has perforations in its four sections, of varying sized apertures, according to the special work to which it has to be applied; so in the case of the Marot machine, the indented jacket, with its recesses facing inward, has pockets of such size and shape as to catch and hold special kinds of grain or of seeds which it may be required to abstract from the mixed or foul material fed into the machine.

The new mode of screening compels the long grains to pass through round holes equal in size to their diameter, a result vainly sought until now, and which can be readily understood in looking at the perforated cell, the entrance to which is three times as large as the perforation, being in fact funnel shaped.

It will be well to enter into a detailed statement of the functions of the different parts for the better understanding of the process and operation, and the perfection attained.

The grain-sorter is composed of a dented cylinder inclosed in a wooden frame, which is surmounted by a hopper, *T*, and in prolongation thereof is a double inclined riddle, agitated by connection with a wheel.

The upper riddle, *g*, retains all the impurities and large round grains; the lower riddle, *g'*, allows passage to the rye-

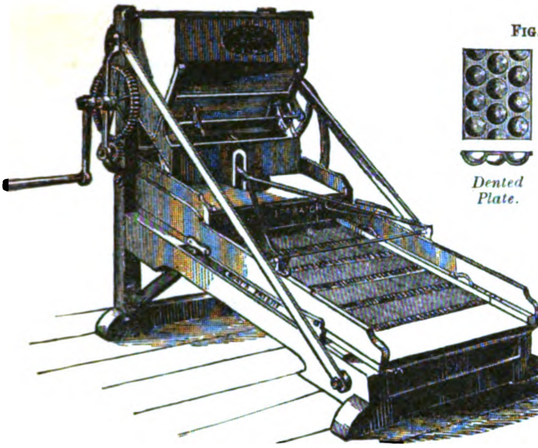
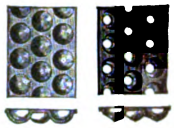


FIG. 1249. ***Grain Cleaner and Separator.***

FIG. 1255.



Dented Plate. *Perforated Plate.*

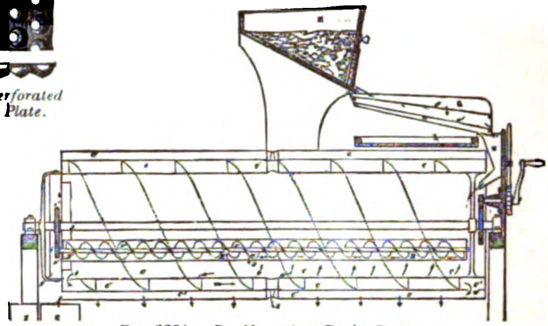


FIG. 1254. ***Double-action Grain Sorter.***

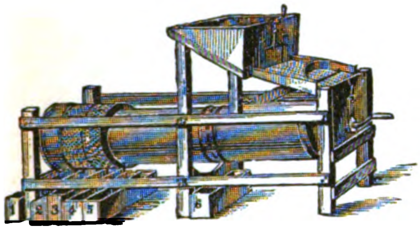


FIG. 1256. ***Barley Sorter for Breweries.***

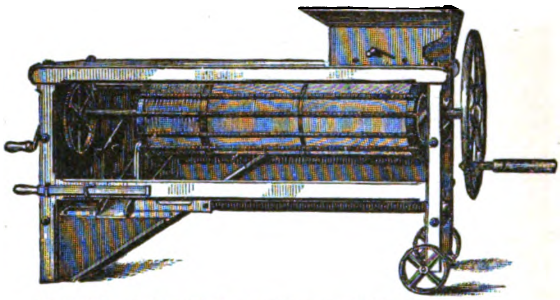


FIG. 1250. *Adjustable Rotary Screen (with Stone Separator).*

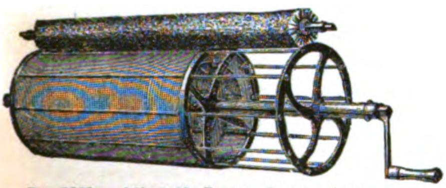


FIG. 1252. *Adjustable Rotary Screen (dismounted).*

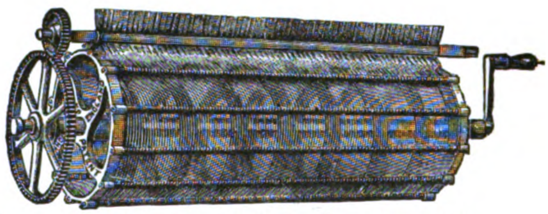


FIG. 1251. *Adjustable Rotary Screen (dismounted).*

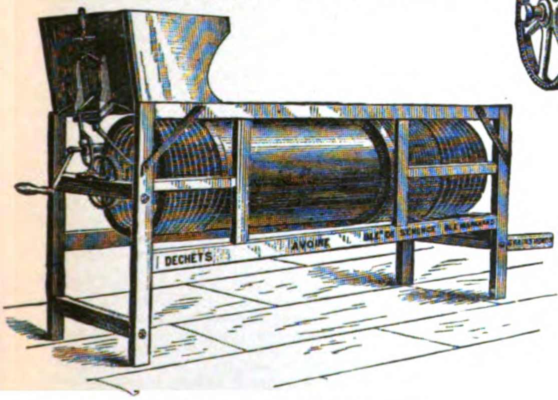


FIG. 1257. *Sifting-sorting Separator.*

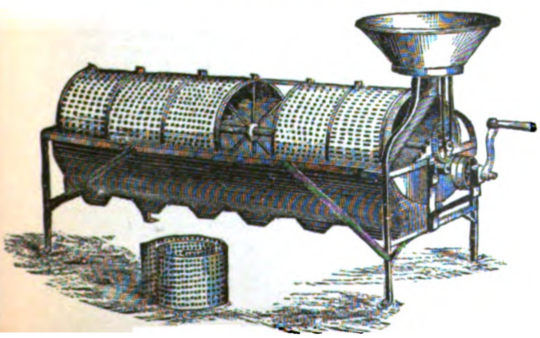


FIG. 1253. ***Riddle Sorter.***

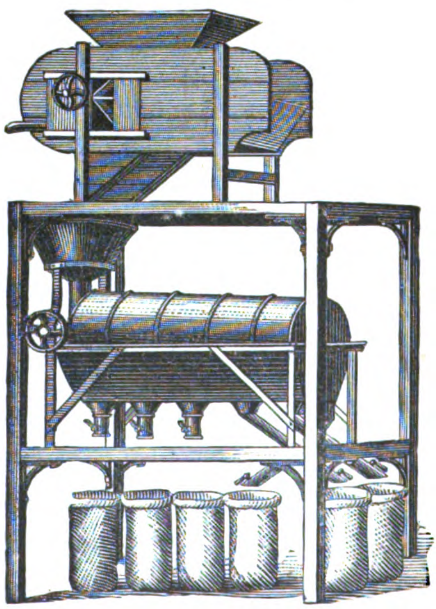


FIG. 1258. ***Cleaning and Separating Machine.***

grass seed, small seeds, and refuse, which fall into a tray, *h*, placed athwart the frame.

The wheat falls off the end of the riddle into a hopper, *E*, and thence into a spout, which conducts it into the interior of the cylinder *C*. In a central position in the cylinder beneath the axis *j* is a trough, *R*, in which is a conveyor, *r*, rotated by a pinion, *i*, from a wheel, *i'*, on the axis *j*.

The first part of the cylinder *C* is studded with indentations (concave interiorly, but not perforated), as shown in the left portion of Fig. 1255, Plate XX., which is a portion of one of the plates.

These depressions are of such diameter that the wheat and round grains may lodge in them, and in the movement of the cylinder their contents are lifted and dropped into the trough *R*, while the barley and oats are prevented, by their length, from lodging in the cups, and, following the slope of the cylinder, are discharged at the opening *o*, at its midlength.

The wheat and round grains, carried up the cups and caught in the trough *R*, are carried along by the conveyor *r*, and fall into the cylinder through an opening, *s*, at a point beyond the discharge, *o*, of the oats and barley. Here they come under the action of the second part of the cylinder, the inner surface of which has depressions of smaller diameter, suitable for carrying up the round grains, such as tares, but rejecting the wheat. The tares, etc., are dropped into the trough *R'*, which is a continuation of *R*, and, being pushed by the conveyor, are forced out at the end and led by a spout (not shown) into the box 1.

The wheat, deprived of oats, barley, and round grains (tares, mustard, rape, etc.), follows the slope of the cylinder to the point *t*, where it falls into the cylinder *C'*. It passes backward along the whole length of the cylinder, pushed by the helicoidal wings which form a conveyor on the periphery of cylinder *C*.

At the point *w*, beneath the place of first entry into the cylinder, the wheat, with some other grains not yet eliminated, falls into cylinder *C''*, which consists of plates both dented and perforated, concavity inward. The grain is caught in the cups and carried up, and, while the diameter of the holes is not sufficient to allow good wheat to pass, the shrunken grains, cheat, rye, rye-grass seed, etc., pass through the openings indicated by the lower row of vertical arrows, and fall upon the floor, while the clean wheat is discharged at the end into box 2.

Another machine is especially constructed for the separation of *crescute* from clover or lucern seed.

Marot's machine for the special use of maltsters and brewers, and shown in Fig. 1256, Plate XX., has substantially the same features in the main, but, in addition, it has three circular riddles at the delivery end of the machine, to separate the barley into three grades according to the diameter of the grains.

The object of the separation is to secure an even germination, as it is found that the different development or condition of the grain causes the sprouting to be more or less rapid; and, consequently, to mix different grades of barley is to obtain an uneven quality of malt, as the plumules and radicles are unevenly developed, indicative of different stages in the resolution of the components of the grain.

The sifting-sorting separator (*cribleur-trieur-diviseur*) of Caramija-Maugé, of Paris, is shown in Fig. 1257, Plate XX. It acts in the same general way as that of Marot, Fig. 1254, previously described, but carries the principle of separation to a fuller extent. It is intended to separate mixed wheat, barley, rye, oats, peas, vetches, cockle, cheat, etc.

The grain in the hopper on the left passes through a gate and by a tube to the interior of the rolling-screen. The first section removes small seeds and waste (*déchets*), and then the dents in the first portion of the cylinder raise the wheat and round grains and drop them into the interior tray, where the spiral blade drives them toward the second section of the cylinder. The long grains, oats and barley, are pushed along in the first section of the cylinder until they reach the exterior holes, at which they issue.

The wheat and round grains being conducted into the second section of the cylinder, as stated above, the round grains are picked up by the dented surface and raised so as to drop into the second interior trough, wherein a spiral works to thrust them out at the end, where they fall into the box shown at the right.

The second section of the cylinder has portions of differing fineness of mesh, sorting the wheat into qualities for seed and for market.

The result of the operation is five grades; reading from the left to the right, they are as follows: Waste, oats and barley, seed wheat, merchantable wheat, round grains.

Fig. 1258, Plate XX., is the separator of Pernollet, of Paris. It consists of a winnowing machine above and a cylindrical screen below, discharging the grades of grain and offal into separate bags.

The cleaning is done above and the separating below, the latter differing in no essential respect from some of those previously described. The machine is also by special adjustment adapted for sorting coffee, the product of the ground cacao, etc.

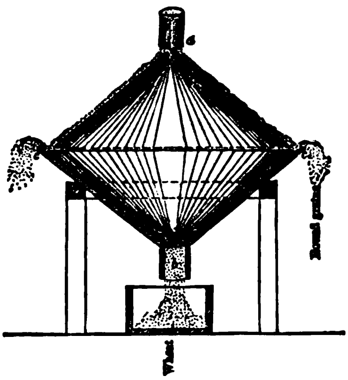
f. (*Percussion.*) This machine seems to be used but little out of France. Several ingenious forms of it are made by Hignette, Paris. It is especially intended to remove clods, and is shown under CLOD CLEARER, Fig. 637, p. 201, *supra*.

The tray has a rocking motion on pivoted legs, at the rate of 115 double strokes per minute. Grain falls from a hopper into the tray, and is bounced from side to side, angular blocks directing it to different discharge apertures.

g. (*Projection.*) A machine used in Austria, for the separation of round seeds from grain, is shown at Fig. 1257, in which advantage has been taken of the spherical form of certain of the foreign seeds to effect their removal.

The wheat, with its mingled mustard-seed, wild pease, and other round grains, is discharged through a tube upon the

Fig. 1259.



Conical Grain Separator.

apex of a varnished wooden cone, the slopes of which are inclined to the perpendicular at an angle of about 55°. The elongated wheat-grains slide to the bottom within a certain time, being retarded by friction. The round grains, however, rolling down the side of the cone, acquire very much greater velocity, and leap across a narrow opening at the base of the cone; while the wheat-grains, moving much more slowly, fall into the opening, and are received into a separate receptacle.

The spout *a* is adjustable. The round grains, striking the slender ledge at the base of the cone, bound or leap across the openings *c c*, while the long grains of wheat, moving at a slower rate, fall through and descend the incline to *b*.

The Vienna steam-mills have an endless apron stretched upon two equally inclined cylinders. The apron has a transverse inclination, and receives the grain at one end in a thin stream. The round grains roll off while the wheat grains travel to the end and are discharged into a box.

The principle of projection is also used in grading products of milling. See MILLING, *infra*.

2. A threshing machine, which see.

Dr. Knight's report on Class 76, Paris Exposition of 1878, gives views and description of the following. See "*Paris Exposition* (1878) *Reports*," vol. v., pp. 187-199.

Aspirating winnower, *Girardin*	France.
Grain-cleaner and separator, *Robert Boby* . .	England.
Adjustable rotary screen, with stone separator, *Penney & Co.*, and others	England.
Riddle sorter. *Pernollet*	France.
Grain sorter. *Marot*	France.
Grain sorter, dented plate	France.
Grain sorter, dented and perforated plate . .	France.
Barley-sorter for breweries	France.
Sifting-sorting-separator, *Caramija-Maugé* .	France.
Stone-clearer, *Hignette*	France.
Aspirating stone-clearer	France.

Refer also to : —

Cleaner, *Johnson* . .	* "*Scientific American*," xxxiv. 262.
Millot	* "*Scientific American Sup.*," 2702.
Richmond	* "*American Miller*," viii. 196.
Seck	* "*American Miller*," vi. 128.
"Triumph," *Slater* .	* "*American Miller*," iii. 183.
Dresser, *Vangelder* .	* "*Scientific American Sup.*," 1620.
Dryer, steam, *Cutler* .	* "*American Miller*," vi. 93, 161.
Stacey	* "*Scientific American Sup.*," 240.
Standing	* "*American Miller*," iv. 106.
Wallace	* "*American Miller*," iv. 5.
Scourer, *Knox* . .	* "*American Miller*," viii. 224.
Ingraham & Beard .	* "*American Miller*," vi. 22.
"Excelsior" . . .	* "*American Miller*," vi. 22.
Richardson	* "*American Miller*," vi. 22.
Throop	* "*American Miller*," viii. 454.
Trimmer . . .	* "*American Miller*," viii. 321.
Screen, *Barnard* . .	* "*American Miller*," iv. 115.
Separator, *Booth* . .	* "*American Miller*," v. 38.
Jewell	* "*American Miller*," iv. 47.
Kurth	* "*American Miller*," viii. 356.
"New Era" . . .	* "*American Miller*," iv. 24.
Taylor	* "*American Miller*," vii. 3.
Sorter and smutter.	
Rose, Switz. . . .	* "*Engineer*," xlvi. 258.
Stone clearer	Fig. 637, page 201, *supra*.

Grain Side. (*Leather.*) The side of a skin or hide from which the hair has been removed.

Grain Sift'er. See GRAIN SCREEN; GRAIN SEPARATOR.

Grain Sort'er. See GRAIN SEPARATOR, p. 415, *et seq.*; GRADER, page 410.

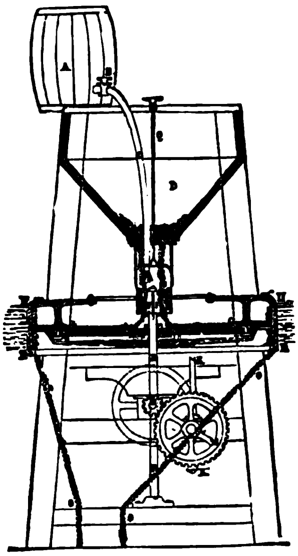
Grain Steam'er. See WHEAT HEATER.

Grain Tol'ler. A device for taking from a grist the miller's portion or toll.

See TOLL COLLECTOR, p. 2587, "*Mech. Dict.*"
* "*Mining and Scientific Press*" . . . . xxxvi. 297.

Grain Wash'er. An apparatus for washing grain previous to grinding.

Fig. 1260.



Grain Washer.

Fig 1260 shows a French apparatus for this purpose. *H H* is a sheet-metal cage revolving on the vertical axis *R*; the latter also carries a spiral brush, *F F*, in the neck of the hopper *D*, down which the wheat and water are passed. Traversing together through the neck the wheat is washed, and both are discharged into the cage *H H*, which, being in rapid motion, rejects the water at its circumference and retains the wheat. The course of water being stopped, the revolution is kept up till the wheat is sufficiently dry, and it is then discharged into the hopper *O O*.

Rebel's system, French also, is an inclined cylinder.

Rose, Switz.
* "*Engineer*," xlvi. 258.

Grain Weigh'ing Ma-chine. See GRAIN SCALE, pp. 414, 415, *supra*.

Gramme Ma-chine'. The dynamo-electric machine of M. Gramme, celebrated in the history of the art. Fig. 893, Plate XI., *supra*.

See . . . . * "*Iron Age*," xxiii., Jan 2, p. 9.
* "*Scientific American Sup.*," 2404.

Grand Feu. (*Ceramics.*) A French term, but frequently used in English treatises, signifying that the articles are baked in very highly heated kilns or muffles.

Gran'ite Ware. 1. (*Ceramics.*) A trade name (*w. g.*, white granite) of a kind of stoneware.

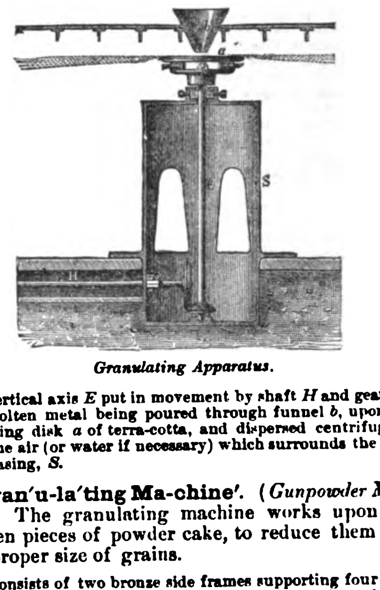
2. An enameled iron ware made by the St. Louis Stamping Company. It has a stone-like enamel of a gray color and remarkably adherent to iron, free from poisonous qualities and very durable.

Gran'u-la'ted Steel. (*Metallurgy.*) Melted pig-iron is run into a cistern of water; the grains put in a crucible with sparry iron ore, which yields oxygen to remove the carbon. The fragments are melted, and cast in ingots. *Uchatius steel.*

Gran'u-la'ting Ap'pa-ra'tus. An apparatus for the granulation of metals is shown in Fig. 1261. The object is to reduce the metal to fine powder or small particles so as to multiply the surfaces and facilitate oxidation, in their attack by acids.

The apparatus shown in Fig. 1261 is used for iron, copper and its alloys with zinc, lead, and tin. It consists essentially

Fig. 1261.



Granulating Apparatus.

of a vertical axis *E* put in movement by shaft *H* and gearing, the molten metal being poured through funnel *b*, upon the revolving disk *a* of terra-cotta, and dispersed centrifugally into the air (or water if necessary) which surrounds the cast-iron casing, *S*.

Gran'u-la'ting Ma-chine'. (*Gunpowder Making.*) The granulating machine works upon the broken pieces of powder cake, to reduce them into the proper size of grains.

It consists of two bronze side frames supporting four pairs of bronze toothed rollers placed on different levels and having their axes parallel and horizontal.

The first set is at the top of the machine, about 20′ from the floor, and the press cake, broken up between them, falls on to an inclined screen which conducts the fragments to a second pair of rollers. A succession of vibratory screens sorts the powder into grades and dust.

In the Petersburg arsenal the powder cake is broken into grains by placing it in sieves which contain a certain number of bronze balls. These sieves are attached to a vibratory frame, crushing the cake, the pieces falling through the bottom of the sieve into drawers beneath. The grains are subsequently dusted, glazed, and assorted. See Fig. 19 accompanying Appendix L, "*Ordnance Report*," 1877.

See also, *Ibid.*, 1879, Appendix I, Plate IV., Fig. 8, and description on pp. 104, 105.

Br., "*Engineering*" . . . . * xxv. 138.

Gran'u-la'ting Pro'cess. (*Milling.*) The system of milling consisting in the repeated cracking of the grain and its fragments between rollers, instead of tearing it to pieces and reducing it to flour and offal between stones. The diagram, Fig. 1262, shows the gradations of the process.

See CYLINDER MILL; ROLLER MILL; MILLING, etc.

Middlings Mill, *Mills* . . . * "*American Miller*," v. 177.
Middlings mill, *Mills* . . . * "*American Miller*," vi. 98; vii. 277.

Fig. 1262.

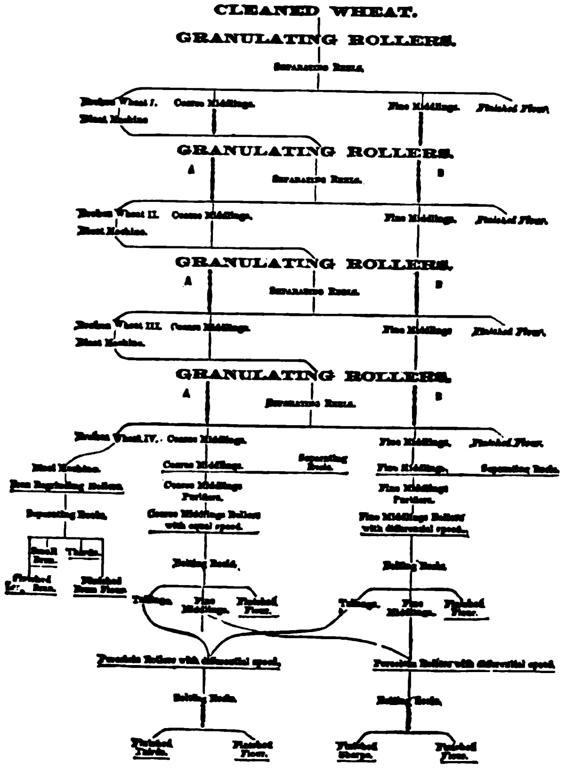


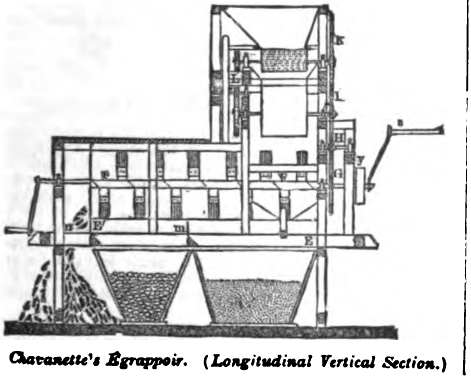
Diagram of Wegmann's Granulating Process.

Gran'u-la'ted Wood Pow'der. The invention of Captain Schultze, of the Prussian army.

Wood is sawed into fine veneers across the grain. These veneers are chipped into small cubes. The acids and soluble substances are removed, and the little cubes are treated with a mixture of 40 parts by weight of nitric acid (of 1.48 to 1.50) and 100 parts sulphuric acid (of 1.85), and set aside to cool. Six parts of wood is added to 100 parts of the acid, stirring constantly for 3 hours. The grains are dried in a centrifugal machine, washed in running water, boiled in a weak solution of carbonate of soda; again washed and dried. The grains are then heated with potash or baryta nitrate, dried at a temperature of 90° to 112° Fah. for 12 hours.

Grape Mill. Figs. 1263, 1264 show Chavanette's (Paris) machine, for crushing, pressing, and de-stalking grapes.

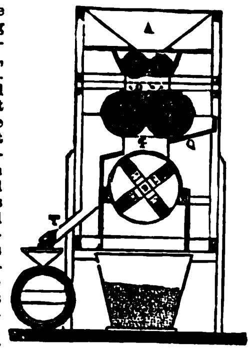
Fig. 1263.



Chavanette's Égrappoir. (*Longitudinal Vertical Section.*)

It is intended to do the whole duty of crushing the grape, expressing the juice, and removing the stalks, skins, and pips. Great stress is laid upon the perfect separation, on the supposition that the effect of fermentation upon the seeds and stalks is injurious to the wine, and the relative quantity of the skins in the fermentation-vat should be under control, as it is the fermenting skin which confers the color upon the wine. The value of the *dégrappage*, however, is disputed. In the *Côte d'Or*, for instance, it is claimed that the *rafle* (stalk of the bunch) contains the ferment, bitartrate of potassa, and tannin in notable quantities, and its presence in the fermenting vat adds quality to the wine and assists in its conservation.

Fig. 1264.

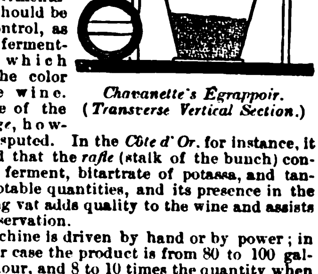


Chavanette's Égrappoir. (*Transverse Vertical Section.*)

The machine is driven by hand or by power; in the former case the product is from 80 to 100 gallons per hour, and 8 to 10 times the quantity when driven by an engine of 1-horse-power.

A is the hopper into which the grapes are thrown. From this they fall between two cylinders, *B B'*, the outer surfaces of which have conical-headed nails, which move in close proximity, but without contact. The cylinders are separated by a distance of 5 to 6 millimeters. The crushed mass falls upon a pair of cylinders covered with sheet caoutchouc, which has a uniform thickness of 7 millimeters. The pips, stalks, and skins are drawn through, but deprived of juice, which passes out through perforated plates, *O*, at the ends of the cylinder-box, and then, by the inclined plate *Q* and spout *T*, is discharged into a funnel and barrel. The pips, skins, and stalks drop into a chute, *P*, and then into a long cylindrical horizontal chamber, in which is a revolving helical brush, *F F'*, which drives the contents against the exterior, the lower part of which is covered with wire cloth, while the upper is of wood or sheet metal. The meshes of the portion from *E* to *m* are of such a size as to let the grape seeds fall through: from *m* to *E'* the skins pass out and the stalks are ejected at the end, *n*, of the cylinder. *G*, *H*, *I*, *K*, *L* are gear-wheels for transmitting motion derived from the crank *Z* or pulley *y*. *V* is the fly-wheel.

Fig 1265.



Grape Crusher.

The crushing of the grape is still performed by the feet in many parts of France. Earnest efforts are making to induce the small proprietors to adopt the *écrase-raisin* or *fouloir*.

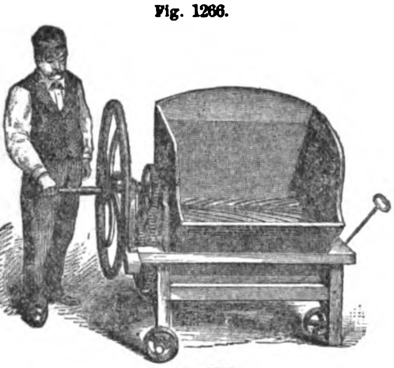
The grape-crusher, Fig. 1265, of Meixmoron de Dombasle, of Nancy, is a light machine, driven by hand, and placed above the vat. It has two wooden rollers, and rods upon them which act as teeth to draw in and crush the grapes which are thrown into the hopper. The keys allow the juxtaposition of the rollers to be regulated. The work performed is 2,000 kilos of grapes per hour.

The American grape-mill is upon the same principle as that shown in Fig. 1265, a pair of rollers; toothed or spiked, to tear and crush.

The grape mill of Mabille Frères, of Amboise, is shown in Fig. 1266. The teeth on the rollers are spiral, and the action is one of tearing as well as cutting. It is the "*usage du Midi*," a great and important grape region.

See Wine Press.

Fig. 1266.



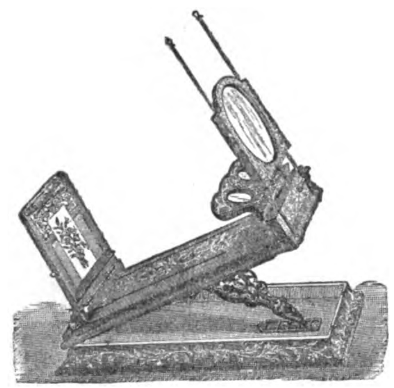
Grape Mill.

Graph'ite Bat'te-ry. (*Electricity.*) 1. A term used in England in reference to a battery, having platinized carbon plates and amalgamated zinc plates in dilute sulphuric acid.

2. A battery in which mineral graphite is used as the negative element. See instance in list under GALVANIC BATTERY.

Graph'o-scope. (*Optics.*) A mounted glass for viewing pictures or photographs. The lens mounting is usually hinged to a frame which forms the picture holder.

Fig. 1267.



Graphoscope.

Graph'o-ste're-o-scope. (*Optics.*) A frame with mounted lens, for viewing stereoscopic pictures.

Grap'nel. 1. A boat's anchor with four claws.

2. A grappling hook, for recovering submerged property.

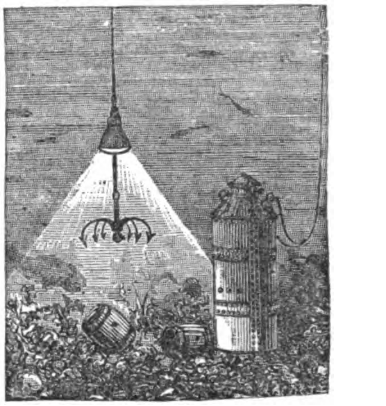
Fig. 1268 shows Toselli's (taupe marine) for directing the search for objects of value at the bottom of the sea. Suspended in the vicinity of the diving-bell is a spring grapple and an electric light with reflector, directing a bright light over a circular area of the bottom. Also used in coral, pearl-oyster, and sponge fishing.

3. A grapple for submarine cables.

The kind of grapnel ordinarily employed in picking up submarine cables for repairs is that known as the *centipede* grapnel. It resembles a compound fish-hook in shape, the stem or shank being set round with several prongs or flukes which catch the cable as the grapnel is dragged across it over the sea bottom. The flukes are rigidly welded to the stem, and one disadvantage in this form of grapnel is its liability to have its flukes broken off if it catches in submarine rocks or other obstructions on the bottom. To prevent the escape of the cable from the claw a fluke has been designed to close upon the cable and prevent its jumping out again.

Jamieson's cable grapnel, shown in Fig. 1269, is self-relieving when it comes in contact with rock or other obstruc-

Fig. 1268.

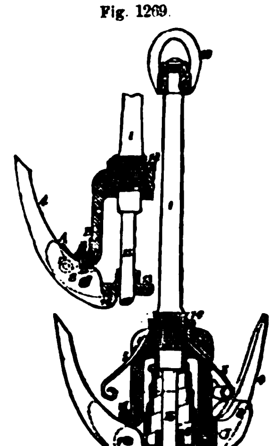


Toselli's (Taupe Marine).

tions on the bottom, and closes on the cable when once encountered.

At the lower end of the grapnel shank, 1, there is fixed a boss, 2, for containing a spring, 6, which exercises a pressure upon the inner ends of the grapnel toes, 4, as the outer portions of the flukes, 8, are called. The toe portion of each fluke is free to move round a center or fulcrum carried by the joint of the fluke, which is rigidly fixed to the boss, so that when the toe encounters a rock or other obstacle of the kind it yields to it, turning round on its fulcrum, 7, and thereby exercising a compression upon the spring until the obstruction is cleared, when the recoil of the spring restores the toe to its former position. When, however, the grapnel meets the cable, the latter, 18, lies in the joint of the fluke, where it is attached to the boss, and it is retained there by a spring, 5, which juts out from the boss and arches over it so as to hold it in.

Fig. 1269.



Submarine Cable Grapnel.

The grapnel operates in the following manner: The toes when engaged by rocks or other obstructions are pressed outward and rotate round their respective fulcra, their inner ends bearing against the movable piston 13 on the reduced portion 15, of the shank, which compresses the spring up the boss; a movement which may continue until the toes move round to the angle shown by dotted lines on the left hand, an angle amply sufficient to relieve the toes from the obstruction. As soon as the toes are released, the piston is forced down again by the reaction of the spring, and, bearing against the toes, restores them to their initial working angle. This angle is fixed for each grapnel by the shoulders 17 on the boss 2 which act as stops between the boss and toes, preventing the latter from bending in toward the shank.

The fragmentary view shows a grapnel with an arrangement of cutting shears for severing a cable or torpedo line. In this figure *A* and *B* are two steel knives or shears mounted on respective fulcra, *C* and *D*, and capable of rotating round them. These knives are ground sharp in their upper edges, on which the cable 18 rests. When a strain is produced on the cable by hauling in the grapnel, these knives shut on each other and shear the cable in two.

The upper shackle 10 is the means of attachment for the grapnel line, and 11 is for the length of chain which is always trailed after a grapnel to keep it from skidding and jumping.

For telegraph cables.	
Jamieson & King . .	* "*Telegraphic Journal*," vi. 483.
	* "*Scientific Amer. Sup.*," 1779.
	* "*Engineering*," xxiv. 431.
Submarine cable.	
Paper by *Jamieson* .	* "*Jour. Soc. Tel. Eng.*," vii. 393.
Lambert	* "*Jour. Soc. Tel. Eng.*," vii. 417.

Grap'ple. 1. A tool with spring jaws which are closed by striking the fish.

United States Patents.

7,709	Warner *et al.*
16,014	E. Horton.
20,343	J. Garl.
144,110	J. W. Knapp.
168,835	M. Jincks.

2. A pair of claws grasping a beam or rafter as a means of suspension of a tackle for hoisting hay in a barn, or merchandise in a warehouse. See Grapple, p. 1011, "*Mech. Dict.*"

Grap'ple Dredg'ing Ma-chine'. A dredge with hinged jaws or claws which inclose or clasp the object.

Grap'ple Hay Fork. That form of fork with hinged jaws which mutually approach to clasp the hay; a form of horse hay-fork. Figs. 2027, 2080, p. 907, "*Mech. Dict.*"

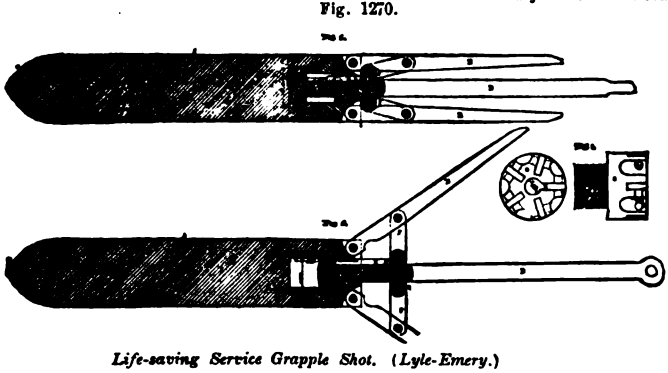
Grap'ple Hook. 1. (*Fishing.*) One with guard to prevent fish from getting loose from the barb. See Fig. 2000, p. 872, "*Mech. Dict.*" Also list of U. S. Patents, 1846–1872; Report of U. S. Fish Commissioners, Part I., 1873.

2. (*Hoisting.*) A pair of hooks to clasp the object to be hoisted. See Bale Hook, Fig. 181, p. 68; and Barrel Hook, Fig. 221, p. 78, *supra;* and *c* Fig. 2302, p. 1011, "*Mech. Dict.*"

3. A grapple attached to a beam as a means of suspension of hoisting tackle, etc. See *a, b, d, e,* Fig. 2302, p. 1011, "*Mech. Dict.*"

Grap'ple Shot. A shot used in the life-saving service on the sea-coast. Being fired across a ship, it catches in the rigging and serves as a means of establishing communication with shore. The flukes lie parallel in the barrel, but spring out when the cable is hauled in.

Fig. 1270.



Life-saving Service Grapple Shot. (*Lyle-Emery.*)

Grap'pling Gear. (*Fishing.*) Used to recover lost trawls. See Grapnel; Grapple.

Grap'pling Hook. (*Surgical.*) An instrument with a pair of claws at each end, used in post-mortems and dissecting to retain an opened flap in position.

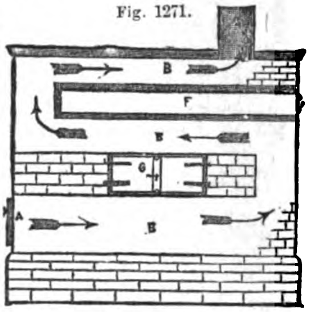
Grap'pling For'ceps. (*Surgical.*) A tweezers with double claws on the end of the prongs. Used in skin-grafting. — *Piffard.*

Grap'pling Tongs. (*Fishing.*) Broad-mouthed tongs for gathering oysters. Oyster tongs.

Grass-burn'ing Stove. A stove for burning prairie grass where coal and wood are scarce.

It is built of brick, stone, or concrete.

Fig. 1271.



Mennonite Stove.

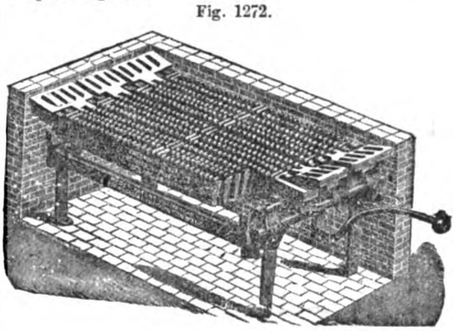
A. Furnace door to fire-box.
B. Draft.
C. Pipe.
F. Chamber with iron shutter (hinged) to let out heat. This chamber has doors on both sides of furnace.
G. Oven or cooking place on kitchen side of furnace.

Grate. 1. An open fire as in the open stove, Fig. 5009, p. 2410, "*Mech. Dict.*"

2. The iron bars containing the fuel in a furnace or fire-box. A collection of grate bars. A grid.

Fig. 1272 shows the Ryder reciprocal grate.

Fig. 1272.



Ryder Reciprocal Grate.

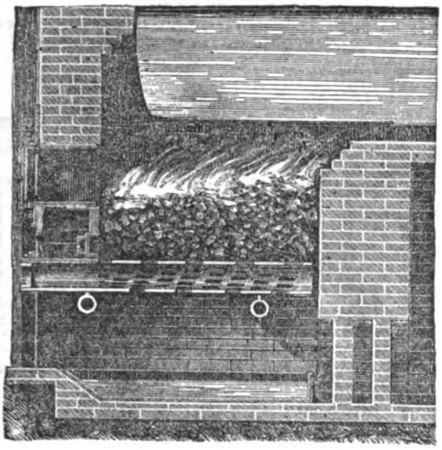
The grate consists of a series of alternate movable and stationary bars. The movable bars are moved backward and forward several inches by a lever in front of the boiler, through the ash-pit door. The movable bars, resting on friction rolls, are raised above the stationary bars a little, and have a corrugated surface for friction, which disturbs the coal, destroys the clinkers, and removes the ashes, thus opening up a uniform draft over the fire surface.

Fig. 1273 shows Schmitz's French furnace, having grate-bars which are hollow to allow passage of air, and turn on their axes to prevent burning out or having clinkers attached to them.

Fig. 1274 shows the Tupper sectional grate for steamboats, locomotives, and furnaces. The sections are laid on truss bars, but not fastened, so that they can expand and contract without strain. The openings in the bars are V-shaped.

Fig. 1275 shows the Hawley-Adams grate. The shaking grate-bars are rocked back and forth by a lever, so as to break up the slag or clinkers which would block them.

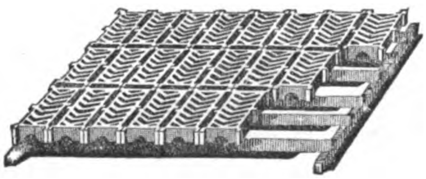
Fig. 1273.



Furnace, with Turning Grate-bars.

Fig. 1276 shows the grate of the "Calorific" cooking-stove. It has a sliding grate which is

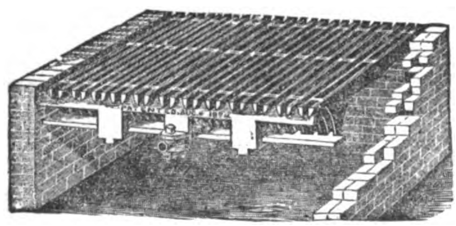
Fig. 1274.



Tupper Grate.

pulled forward to allow the clinkers at the back of the fire to drop out, and the clinkers in front are then picked out.

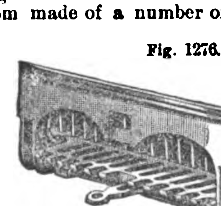
Fig. 1275.



Rocking Grate-bars.

Fig. 1277 is Bissell's radiator shaking grate, the bottom made of a number of parallel bars, which

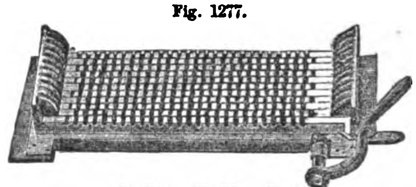
Fig. 1276.



Anti-clinker Stove Grate.

are shaken in concert by means of the handle on the side. Numerous examples are shown under GRATE, GRATE BAR, on pages 1012, 1013, "*Mech. Dict.*"

Fig. 1277.



Radiator Shaking Grate.

Refer to: —

Grates at Centennial, shaking.
Rider, Smith, Adams . "*Iron Age*," xviii., Aug. 3, p. 1.
Denny & Ruth . . . * "*Scientific Amer.*," xxxvii. 390.
Erdmans . . . . . * "*Scientific Amer.*," xxxiv. 22.
Peat-burning, Domestic . * "*Engineer*," xlii., 348.
Revolving . . . . . * "*Iron Age*," xviii., Dec. 28, p. 5.
Rotary, *Denny & Ruth* . * "*Min. & Sc. Press*," xxxvi. 177.
Shaking, *M'Farlane* . . * "*Am. Man.*," Mar. 21, 1879, p. 8.
Water-bar . . . . . * "*Scientific Amer.*," xxxv. 68.
Revolving, *Barber*, Engl. * "*Scientific American Sup.*," 855.
Ten Brink, Switz. . . * "*Engineering*," xxviii. 175.

Gra'ted Door. A door of open slatted-work for cattle cars in warm weather, and for other purposes.

Grate Ring. A ring surrounding the tip-grate of a heating stove.

Grate Sha'ker. The lever for agitating the grate of a heating stove, to drop the ashes.

Grav'el Pow'der. Coarse gunpowder, otherwise known as pebble powder, which see.

Gra'ving Dock. Clark's elevating dock in the repairing basin of Blackwall, River Thames, is a depositing dock; but instead of depositing the vessels on a grid, as in the Clark & Standfield dock at Nicolaieff, on the Black Sea, the vessel is placed on stocks on a large barge, of the nature of a camel. The lifting is by means of two parallel ranges of hydraulic presses, between which the ship is floated to a position over the cradle and camel on which it is to be lifted, and on which it eventually floats, clear of the water, to be repaired.

A general view of the whole apparatus is given in Plate IX., opp. p. 252, *supra*.

Refer also to —

Birkenhead, Br. . . . . * "*Engineer*," xliv. 152.
Green, Blackwall, Br. . * "*Engineering*," xxvi. 110.
Caisson, Poplar, London . * "*Engineer*," xlvii. 392.
Toulon, Fr. . . . . . * "*Engineering*," xxvi. 398, 508.

Grav'i-ty Bat'te-ry. The invention of Calland or Varley, 1854.

A battery in which the different fluids range themselves at different heights in a single jar by virtue of their differing specific gravities.

The zinc element is above in sulphuric acid, and the copper below in sulphate of copper. The crystals of the latter may be covered with a layer of sawdust or sand, to prevent mixing the fluids by accidental agitation; as in —

Minotto's battery, Prescott's "*Electricity*," p. 60.
Siemens-Halske has interposed paper pulp, Prescott, * p. 52.
See also *Meidinger* . . . * Prescott, p. 53.
Daniell . . . . * Prescott, p. 59.
Sir William Thomson . * Prescott, p. 62.
Ubicini . . . . "*Telegraphic Journal*," v. 265.

See also CALLAUD BATTERY; GRAVITY BATTERY, "*Mech. Dict.*"

Grav'i-ty In'di-ca'tor. An invention by M. Lebourg, for experimental verification of the laws of falling bodies.

"A flattened cylindrico-conical weight, guided in its fall, like that of General Morin's apparatus, carries, instead of a style, a vertical tuning-fork, furnished with a short and stiff metallic wire. The weight falls down a rule, graduated on one of its edges, and covered with smoke black. The tuning-fork is set in vibration automatically at the commencement of its fall, and it inscribes on the fixed rule a sinuous line, inspection of which affords an easy demonstration of the laws of the fall of bodies. By mounting on the apparatus several tuning-forks one may compare together their number of vibrations, and even determine the absolute height of the sound produced." — "*Journal de Physique*."

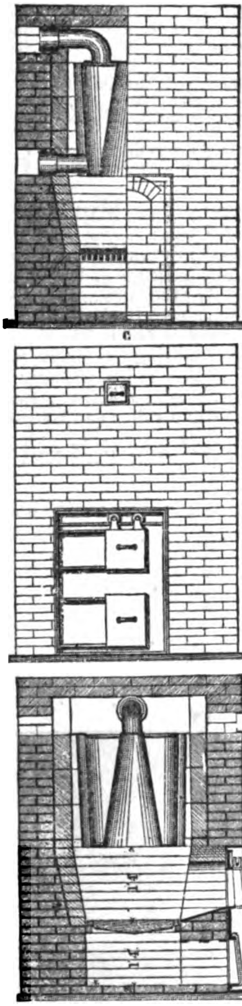
Grease Box. The axle-box of a railway truck.

Grease cup, automatic, Fr. * "*Sc. American*," xxxiv. 230.

Greas'er. A name for oil-cup, lubricator, oiler, etc. See under the various heads.

Grease Trap. A cistern in the course of a sewer. An inlet pipe discharges into the cistern, and the orifice of the outlet is a bent pipe so far beneath the surface as to avoid removal of the floating scum of grease.— *Waring's "Sanitary Drainage."*

Fig. 1278.



Greenhouse Furnace and Boiler.

Green'house Furnace. The boiler for hot water heating apparatus for conservatories is usually a ribbed or corrugated iron, or sectional ring boiler, set in brick-work, and having departure and return pipes in which the water circulates through the greenhouse.

Burbidge & Healy's greenhouse heater is shown in Fig. 1278; three views, a combined half-vertical section, and half-front view; a front view and a transverse vertical section. The bells for the attachment of the pipes are shown on the left in the upper of the three views.

"*Scientific American Sup.*," 2250, 2394.

Green'house Syr'inge. A hand irrigator. See Aquapult; Hand Pump; Irrigator, etc.

Green'house Ven'ti-la'tor. A window-lifting apparatus for the glazed roofs of conservatories.

Green Ware. (*Ceramics.*) Articles just molded or otherwise shaped, before drying and baking.

Gre-nade'. The modern hand-torpedo, used in the British navy, is a compressed ball of gun-cotton, attached to a long cord, by means of which the torpedo is exploded with a force sufficient to shatter a five-ton block of granite when it has been pitched into position.

Gren'a-dine. (*Fabric.*) A French worsted dress-goods, woven with a gauze or open taffeta armure, and having a silk *grège*, organzine or cotton warp and an English combing-wool weft, which is highly twisted and gas-singed.

It is a kind of close barége.

Gre-net' Bat'te-ry. (*Electricity.*) A single-fluid bichromate battery. A bottle-shaped vessel has a stopper from which two carbon plates depend into the liquid. A zinc plate, *Z*, between the carbons *K K*, by means of a rod passing through a central aperture in the stopper, can be immersed at will in the liquid, to set the battery in action.

Fig. 1279.

Grenet Battery.

Niaudet, Amer. transl., * 222.
Trouvé's improvement on Grenet compounds a number of pairs of removable elements. *Niaudet, ut supra*, * 224.

Grid. 1. A grate, grate-bar, or furnace bottom.

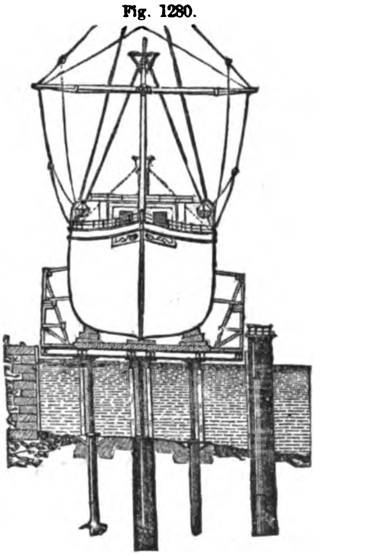
2. A grille or grated opening.

3. (*Hydr. Eng*). A structure of beams — lying in parallel open order they resemble a gridiron — on which a ship rests in building, lifting, or repairing.

Fig. 1280 shows a hydraulic grid of Clark, Standfield, & Co., whose depositing dock is a grid of the largest and most admirable construction, and is shown in Plate IX., Depositing Dock, *supra*.

In using the dock the grid and presses are lowered to the bottom, and the keel of the vessel is brought directly over

Fig. 1280.



Hydraulic Grid.

the center and secured in position by the bilge blocks and side shoring frames, the presses are then worked and the vessel lifted till the grid is above high-water mark. When in this position a number of struts or swinging frames (which were previously held up in a horizontal position under the grid) are liberated and allowed to hang in a vertical position. The grid is now lowered a few inches until the whole of these struts rest on raised bearings cast on the head of the presses, and the whole weight of the vessel and grid rests on them. The rams are now allowed to sink down into the presses, where they remain in fresh water, and are consequently less disposed to rust. The supports are hinged or swung at the top so as to fall accurately into their places, and suitable means are provided for raising and lowering them simultaneously by means of chains and shears. These frames are of considerable breadth, and some of them swing transversely and others longitudinally, so as to obviate any tendency of the grid to move in either direction. There are also, in addition, strong cast-iron columns, with guides, against which the grid slides as it rises and falls. The pumps, pipes, and valves are similar to those used in ordinary hydraulic docks.

See also Hydraulic Hoist, *infra*.

Hydraulic.
Clark & Standfield, Br. . . * "*Engineering*." xxvii. 203.
* "*Scientific Amer.*," xl. 291.

Grille. A panel of metal open-work in a wall.

Grind'er. 1. (*Caoutchouc Manufacture.*) A pair of large iron rolls revolving at a moderate speed, between which the rubber with the sulphur and other substances to be mixed with it are repeatedly passed and ground together until they are thoroughly combined, and form one homogeneous mass of about the consistence of ordinary putty.

2. A machine for sharpening, as a grindstone or emery wheel: which see.

3. A machine for dressing to form, using abrading materials as a substitute for a planer, etc. See Grinding Machine.

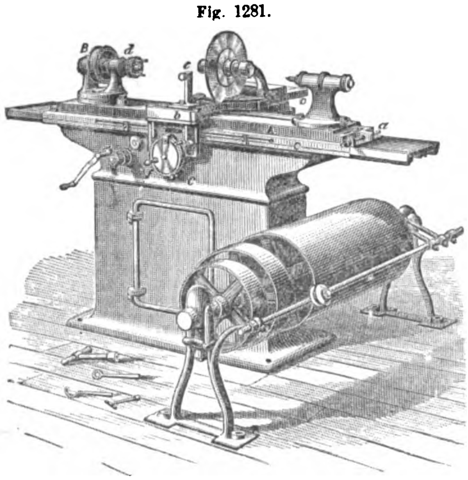
Grind'ing and Pol'ish-ing Tools, etc. See under the following heads: —

Agate burnisher.
Buhr dresser.
Buhr rubber.
Bur.
Burnisher.
Burring engine.
Cabinet file.
Cherry.
Corundum point.
Corundum tool.
Cross file.
Dental file.
Dental grindstone.
Dental polisher.
Double ender.
Emery band.
Emery board.
Emery stick.
Emery stone.
Facing tool.
File.
File-card.
File carrier.
File guard.
File holder.
Finger steel.
Five cant file.
Float.
Furrow rubber.
Furrowing machine.
Knife cleaner.
Knife grinding machine.
Mill-file.
Millstone dresser.
Pillar-file.
Plug-finishing file.
Polisher.
Polishing disk.
Polishing iron.
Porte polisher.
Rasp.
Reaper.
Riffler.
Round iron.
Saw filing clamp.
Saw filing vise.
Scraper.
Scraper plane.
Scratch brush.
Scratcher.
Shave hook.
Six-canted file.
Tripoli.
Tube brush.
Tube cleaner.
Tube scraper.
Veneer scraper.
Wall scraper.

Grind'ing Lap. A grinding machine with a revolving wheel for cutting surfaces. See Lap, p. 1252, "*Mech. Dict.*"

Grind'ing Ma-chine'. A machine adapted for the execution of circular grinding, such as the grinding of hardened plugs, arbors, spindles, reamers, standards, cutters, etc. It will grind straight and tapering, either inside or outside, and is especially useful in grinding out holes in hardened cast-steel boxes and bushings.

Fig. 1281.



Grinding Machine.

Brown & Sharpe's grinding machine. Fig. 1281, operates by a solid emery or corundum wheel. The work can be revolved upon dead centers or otherwise. The grinding wheel can be moved over the work at any angle, by which means any taper can be produced. Wheels from ½" to 12" in diameter can be used either with or without water. The feed-works and slides of the machine are protected from grit and dust. The grinding of taper holes and angular cutters is provided for by graduated arcs. A special chuck is provided, for holding work to have holes ground. An additional movable table, capable of adjustment by a tangent screw and graduated arc, admits of straight and curved taper grinding with the centers of the machine always in line.

Refer to: Ventilators for, Br. * "*Eng'ing*," xxii. 19, 169.
Lathe, *Pratt & Whitney* . . . * "*Engineer*," xlii. 24.
Machine, metal, *Bollmann*, Fr. * "*Sc. Amer.*," xxxvii. 214.
* "*Iron Age*," xxi, May 2, 1
Tools, On grinding, *Rose* . . * "*Sc. Amer.*," xxxvii. 405.
Universal, *Thompson, Sterne & Co.*, Br.
* "*Engineer*," xli. 187.

Grind'ing Mill. The subject is considered under many heads assembled in list under Grain Cleaning and Grinding, p. 411, *supra*.

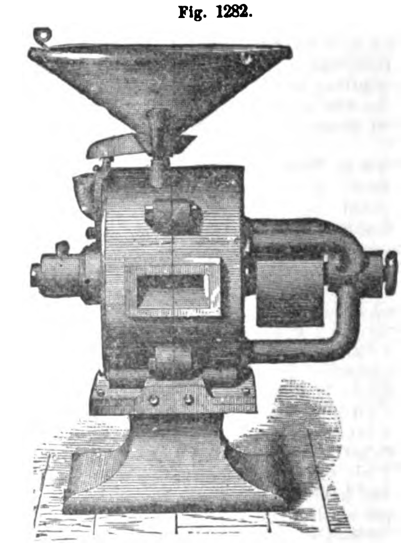
The purposes and construction of machines differ greatly; they are adapted for grain, ore, fertilizers; are made vertical or horizontal; edge rolling (Chilian); grinding on the flat; upper, under, or both stones moving; made of iron, buhr, glass, etc.; are made like cages, working by impact; grind by a tearing action between two surfaces, or a crushing between a roller and concave, or flattening between two rollers, etc. See numerous examples of forms and principles, Plate XXII., "*Mech. Dict.*," opp. p. 1020.

The principal heads under which they will be found are:

Aplatisseur.
Aspirator
Bean mill.
Bone mill.
Cake grinder.
Cement mill.
Concasseur.
Corn mill.
Cylinder mill.
Fertilizer mill.
Granulating mill.
Kibbler.
Ore mill.
Roller mill.

See also list under Mills, *infra*.

Fig. 1282.



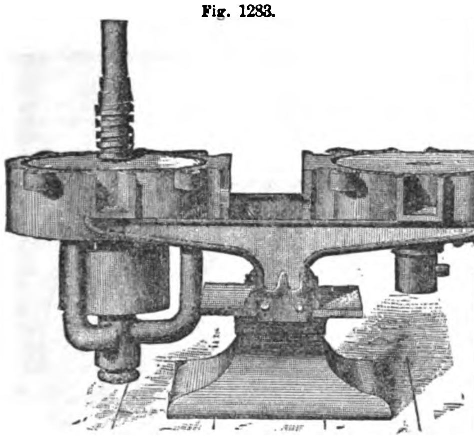
Grinding Mill. (*Elevation.*)

Figs. 1282, 1283, show the Harrison portable mill with a pair of stones, one being a runner.

Fig. 1282 is an end or face view. The case and pedestal are cast in one piece. The heads containing the bed and runners are bolted to the rim of the case.

Fig 1283 shows the pedestal and case, with a dressing-frame bolted on and the buhrs turned out upon it for dressing. The frame is made in two parts, and fastened, one on each side of the case, by tap bolts, and when the dressing is done the frame is removed.

Fig. 1283.



Grinding Mill. (Open for Dress.)

Refer to: —

Bressen & Co., Fr. . * "*Scientific American*," xli. 248.
Buhr . . . . * "*Scientific American*," xl. 178.
Portable, *Clayton & Shuttleworth*, Engl. . . * "*Scientific American*," xli. 70.
* "*Engineer*," xlvii. 423.
Harrison . . . . . * "*Scientific Amer.*," xxxvii. 291, 310, 323.
Munson . . . . . . * "*Scientific American*," xli. 54.
Nicholson . . . . . * "*Engineer*," xlvii. 408.
Obenchain . . . . . * "*American Miller*," vii. 239.
Iron upright, *Phillips* . . * "*Scientific Amer.*," xxxviii. 328.
Ransomes . . . . . * "*Engineer*," xlvi. 403.
Ross . . . . * "*Scientific Amer.*," xxxvii. 339.
Walling . . . . . . * "*Scientific American*," xli. 83.
Upright, *Straub* . . . . * "*Scientific Amer.*," xxxvi. 86.
* "*Scientific American*," xl 34.
For gunpowder, Br. . . * "*Engineering*," xxv. 37.
See also GRAIN MILL.
Both stones running . . * "*Scientific Amer.*," xxxiv. 35.
Corn Mill, *Ransome*, Br. * "*Engineering*," xxvii. 319.
Garlic extractor, *Millot*, Switz. . . * "*Engineer*," xlvi. 255.
Floating mills, *Balaklava* "*American Miller*," vi. 101.

Dr. Knight's report on agricultural machinery at the Paris Exposition of 1878 contains views and descriptions of the following feed mills See "*Paris Exposition* (1878) *Reports*," vol v., pp. 200–205: —

Grain flattener *Bodin*, France.
Grain crusher, *Richmond & Chandler*, England.
Biddell's oats and beans kibbler. *Maldon Iron Works*, England.
Oil-cake breaker. *Corbett & Peale*, England.
Consult: *Hughes' "American Miller and Millwright's Assistant."*
Dixon's "Practical Millwrights' & Engineers' Guide."
Pallett's "Millers', Millwrights' & Engineers' Guide."

Grind'ing Wheels. Grinding wheels are known as stones, laps, glazers, rubbers, etc., according to material, fineness, etc. Including the finer ones which are *polishing* wheels, they are made of stone, emery solidified by cement, wood, leather, paper, lead, rags (cut in disks), brush.

For the materials for arming the surface, see GRINDING AND POLISHING MATERIALS, p. 1017, "*Mech. Dict.*"

Grind'stone.

J. M. Safford's report in "*Centennial Exhibition Reports*," Group I., vol. iii., p. 183, *et seq.*
Grinding wheels, on, *Ross* . * "*Scientific Amer. Sup.*," 540.
Making and uses, *Mitchell* . * "*Iron Age*," xviii, July 6, p. 9; July 20, p 7.
Trough, *Brown & Sharpe* . * "*Sc. American*," xxxviii. 271.

Grind'stone Dres'ser. See TRUEING TOOL, Fig. 6682, p. 2632, "*Mech. Dict.*"

Gris-aille'. (*Fabric.*) A French fancy dress goods woven on a taffeta loom. It has a cotton chappe or fancy warp and an English combing wool weft. Warp is printed or *chiné*.

Gri-sou'me-ter. (Fr. *grisou*, fire-damp.) A fire damp detector invented by M. Coquillon.

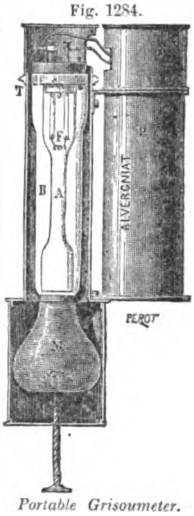
It is based on the property of palladium wire when heated, to burn the last traces of hydrogen contained in any carburet when supplied with sufficient oxygen for its combustion.

The reduction in volume resulting from this combustion is proportionate to the quantity of the protocarburet, so that a properly graduated gage furnishes at once the proportion of gas consumed.

The same principle is found in Coquillon's *Carburometer*.

The portable grisoumeter consists of a central tube, *A*, called the burner, narrowed in the middle and graduated into spaces of equal capacity; the lower end is open, the top closed by an india-rubber stopper carrying two holders for the conducting wires, and the lower branches of which press down the palladium wire. A third opening is left in the stopper to receive a small wooden plug or a glass rod. This first tube is surrounded by a glass sheath or cylinder, *B*, closed at the top by a rubber disk having an orifice which closes by means of a plug. To the lower portion is adapted a diaphragm containing water, which is elevated or depressed by means of a screw, on the principle of the Fortin barometer. Next to this first portion of the instrument is placed a second one, which consists of a Plante's condenser, the poles of which are attached to the two holders of the burner. A lateral screw acting by pressure starts the current and heats the wire at the desired moment. When an analysis is to be made, the inner tubes being full of water, the screw is lowered, so that as the liquid descends it is replaced by the air of the mine. The volume is so adjusted that the levels of both the tube and sheath are on the same horizontal line opposite the zero of the scale.

Fig. 1284.



Portable Grisoumeter.

The burner is now closed while the outer sheath is left open. The electric current is started and the wire heated to redness. The gas is rapidly burned, and after giving time for cooling, the water is seen to rise more or less in accordance with the quantity of gas burned. The two water levels are readjusted by means of the bottom screw to equalize the pressure; and the division of the scale opposite the surface level read off. This instrument gives in one reading the amount of protocarburet in hundredths, but does not apply to quantities of the same exceeding five to six per cent. This would be useless practically, as at this point the miner's lamp is full of fire and he himself in the midst of a detonating compound.

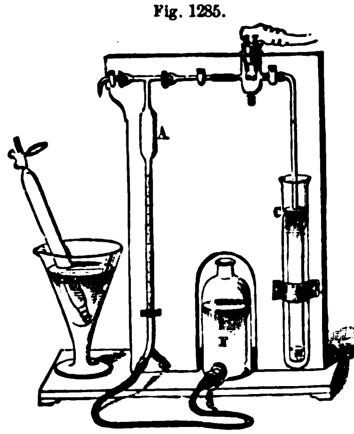
M. Coquillon has since replaced the palladium by platinum.

The principle of the stationary grisoumeter is based on Professor Deville's double flash, and is shown in Fig. 1285. It comprises, first, a vertical glass tube, *A*, or gage, the top of which is branched in T shape, two cocks being adapted to the horizontal branches of the T. The lower portion of this tube is constricted and carries ten divisions, each of which may be subdivided into ten others; it is bent at right angles and attached to a rubber tube fastened to a flask used as an aspirator or blower. The capacity of the tube measured from the cock is 25 cubic centimeters, and the zero of the scale is indicated at the bottom. This is the point that must be reached by the gaseous volume when no protocarburet is contained in the instrument; 10 is marked near the bulge, each division being equal to ½ cubic centimeter. The second portion of the apparatus is the burner *B*, formed by a small thimble-shaped tube closed by a rubber stopper pierced by two holes into which are introduced the holders for the palladium wires.

Laterally are adapted small capillary tubes which by means of rubber tubing allow of an attachment on the one side to the gage, on the other to the following bell glass. This last, *C*, is capped by a capillary tube bent at right angles and surrounded by a glass cylinder or sheath closed at the bottom and filled with water. The whole apparatus, as well as the corks, is in glass, and is mounted on a stout wooden board so as to protect it from accident. A small box containing 10 small tubes filled with water is accessory to the apparatus, these being filled when desired with the air collected in the various levels of the colliery and destined for analysis.

The use of the stationary grisoumeter is very simple. The bell glass surrounded by its cylinder is filled with water to a

Fig. 1285.



Stationary Grisoumeter.

determinate or fixed point: the gage tube is also filled with water. The burner and capillary tubes are left full of air. One of the small tubes from the box is now attached in such a manner that one end plunges into a tumbler full of water while the other or taper end is connected by means of a rubber tube to the anterior end of the gage. One of Mohr's forceps closes this rubber tube at the desired height

In order to introduce 56 centimeters of gas into the gage, the left cock is opened and the forceps pressed by the right hand, while the left hand holds the flask so as to be able to raise or lower it at will. The gas passes from the conico-cylindrical tube into the gage, and must be made to coincide with the zero of the scale as indicated by the water level. This being done, the left cock is closed and the right opened, and at the same time the palladium wire is heated to redness. The gas is made to circulate two or three times over the palladium by the motion given to the flask. After the burner has cooled down, the gas is returned to the gage, and the scale read off. This last is so graduated as to indicate at sight hundredths and thousandths of protocarburet or of bicarburet.

Portative, *Coquillon* . . . . . "*Technologiste*," xl. 435.
Régnard . . . . "*Technologiste*," xxxix. 375.
Lamp, *Mallard et al.* . . . . "*Technologiste*," xli. 348.
Dissipating fire-damp, *Delaurier* "*Technologiste*," xli. 647.
Coquillon . . . . . . * "*Engineering*," xxiv. 317.
* "*Manuf. & Builder*," xi. 158.
* "*Engineer*," xlix. 53.

See also PHANARO-GRISOUMETER, *infra*. FIRE DAMP DETECTOR, *supra*, and references *passim*.

Grist Tol'ler. This machine operates through the periodical presentation of a toll spout with its attendant valve. Each time the spout is presented under the falling grain it takes in a portion which is carried down and out of the machine as toll.

The amount of toll taken is governed by a device in which the position of a wrist in a slotted crank regulates the amount taken.

Grits. (*Milling.*) Cracked fragments of wheat smaller than *groats*. An incident to the HIGH MILLING process, which see. See also GROATS.

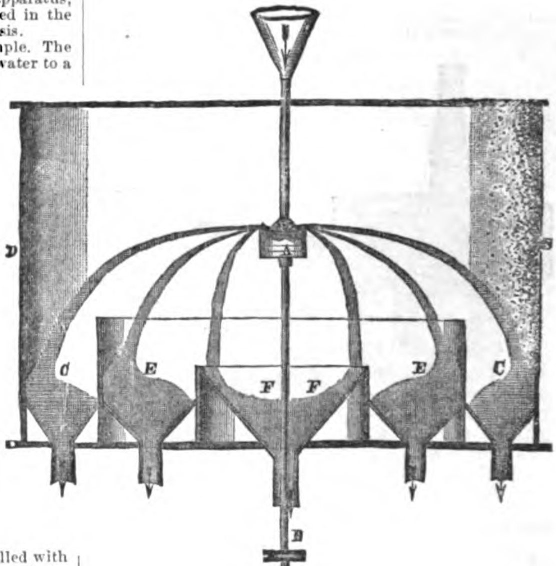
Grits Gra'ding Ma-chine'. (*Milling.*) A centrifugal apparatus for grading grits after the separation of the fine flour by the process of bolting.

The grits passes by a spout to the top of a rapidly revolving wheel, *A*, and is projected centrifugally; the larger particles fly to a greater distance and fall at *C*, while the others reach *E F* respectively, according to relative levity.

Grits Mill. The grits mill with one cylinder is used in the St. Georgen manufactory of St. Gallen.

W is the cylinder with steel shell and *S* the steel concave. It is used for the cracking of wheat and the production of grits, leaving further milling to be done with a run of stones.

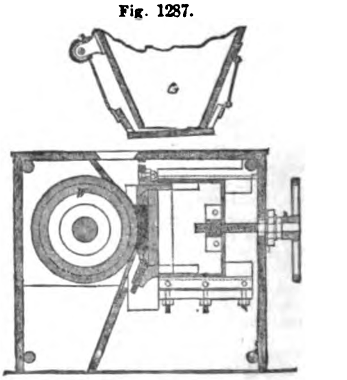
Fig. 1286.



Grits Grading Machine.

Grits Pu'ri-fi'er. A machine for separating bran scales from grits. It is of Austrian origin, the originator being Ignaz Paur, the inventor of

Fig. 1287.



Cylinder Mill of St. Georgen, St. Gallen, Switzerland.

the high-milling process. Paur's and Escher Wys's grits-purifiers are shown by Kick in his report on Group IV. to the Austrian Government, 1873, and in Prof. Horsford's report, "Vienna Bread," Vienna Exposition, 1873, vol. ii., § B.

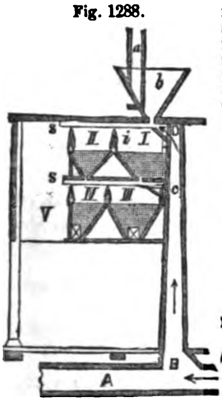
The machine, Fig. 1288, acts by a blast of air upon the materials of different gravity.

The *bran* is a thin flat scale of the wheat shell. The grits are irregular fragments from the interior of the grain, relatively heavier than the bran.

a is a supply tube introducing the mixed bran and grits. *b* is a hopper with a slit at the bottom. At *D* a current of air enters and encounters the falling stream of bran and grits. The grits being heavier fall into division *I*, the bran is carried to *V*, and the intermediates fall into *I I*. A second current of air entering at *c* subjects the matters to a farther separation.

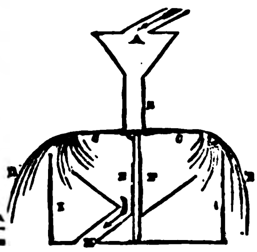
Another form is shown in Fig. 1289, and is used at Pesth. *A* is a hopper receiving the meal; *B* a cylinder fitting the spout from the hopper, and admitting of raising and lowering; *b* is a circular smooth metallic plate revolved by a vertical shaft attached below. The meal as it issues from the foot of the hollow cylinder is carried to the periphery and shot outward into the current of air produced by suction through spout *H*. The rounded grits, having greater weight in proportion to the extent of surface, reach the space *D*; the bran-flakes, having least material to surface, are drawn to *F*; and the fine flour falls between to the receptacle *H*.

Fig. 1288.



Paur's Grits Purifier.

Fig. 1289.



Grits Purifier. (*Pesth.*)

Griz'zly. (*Cal. Hydraulic Mining.*) *Grizzlies* are heavy iron grates which catch the bowlders and through which the gravel is sifted; they are placed at the point where the washings fall into the sluice.

Groats. (*Milling.*) *a.* Bruised or cracked fragments of wheat with bran attached; larger than *grits*. An incident to the process of HIGH MILLING, which see. This is the technical meaning of the word; adopted in the search for specific words to indicate conditions of fineness or quality.

b. Hulled and broken grain, used as an article of food. May be of wheat or oats. This is the domestic meaning of the word *groats* (pr. *grits*).

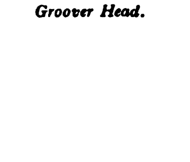
Groom'er. An application of the flexible or jointed revolving shaft to rotate a brush used in the grooming of horses. The flexible shaft is thus used in drilling, by dentists, for sheep shearing, horse clipping, hair cutting and brushing, and horse grooming.

Fig. 1290.

Horse Groomer.

Groov'er Head. A circular cutter used on a wood-planing machine to cut the grooves on one edge of matched boards. The cutters have spurs, and are held in slots by tapered compression bolts.

Fig. 1291.



Groover Head.

Groov'ing Ma-chine'. A form of lathe for making grooved or scroll work, such as table legs, balustrades, etc.

Ground Cock. A basin cock, ground into its seat, as distinguished from *compression* cock.

See Fig. 672, p. 216, *supra.*

Ground'ing Ma-chine'. (*Wall Paper.*) A machine for giving the requisite body to receive the colored pattern.

While passing over a roller the paper is covered with a mixture of clay (that used contains about 18 per cent. of alumina), glue, and water, and if the surface is to be finally polished — or satin finished — a percentage of lard oil is added. After the mixture is applied it is evenly distributed over the paper, first by two reciprocating brushes, then by a rotating brush roller, and lastly by two brushes like the first.

See cut, Fig. 1, p. 226, "*Scientific American,*" vol. xxxvii.

Group Spring. *Railway.* One formed of a number of separate springs in a cluster. See *u*, Fig. 1143, "*Mech. Dict.*"

Grous'er. (*Hydraulic Engineering.*) A heavy iron-pointed oak timber which passes through the hull or down the side of a boat for the purpose of anchoring.

"*Report of Chief of Engineers,*" 1876, vol. ii., Part II., p. 408, and A, Fig. 1.

Grout Wall. One made of béton or similar material.

"Grout (or concrete) as building material, is composed of lime and coarse gravel mixed with water, in the same manner as ordinary mortar, and of about the same consistency.

"A small proportion of cement — say, one tenth — may be mixed with lime, and will add to the strength, durability, and finish of the walls.

"To give solidity, quarry chips can be used by being imbedded in the composition while forming the walls.

"The walls of buildings are formed of this material by making boxes or molds of 2″ plank, of uniform width, placed on edge horizontally, as wide apart as the desired thickness of the walls, and held in place by cleats. Into these boxes or molds thus formed the grout is put, and allowed to remain a sufficient time to harden; when the boxes are removed, and again placed at the top of the layer just formed, and again filled with gravel and stone; and so on until the wall is of the required height.

"If the planks of which the boxes are made are, say, 12″ wide, the grout will harden in about 24 hours sufficiently to allow the boxes to be removed without injury to the wall.

"The gravel used may be mixed with a moderate proportion of sand advantageously.

"The partition walls can be built more cheaply and rapidly of lumber than of gravel; as where inside walls are constructed it is difficult to fit and manage the boxes without injuring the outside walls."

The boxes and method of construction are similar to those used in pisé walls. The difference is only in the material used. — *Report of Lieut. Rogers, U. S. A.*

Grove Bat'te-ry. The nitric acid battery, the invention of Mr. Grove, now Justice Sir W. R. Grove. It eliminates the hydrogen by oxidizing it so as to form water, and so prevents the polarization of the negative plate.

It has the amalgamated zinc in sulphuric acid, and its platinum in nitric acid, with an intervening porous cell.

Prescott, "*Electricity*" . . . . . * 64; *Ganot*, * 686.
De la Rive, London, 1853 . . . . * 44.
Noad, London, 1859 . . . . . . * 276.
de Moncel, Paris, 1856 . . . . . 69.
Shaffner, New York, 1859 . . . . * 97.
Niaudet, American transl. . . . . * 155.
"*English Mechanic*" . . . . . . * xxiii. 77.
Poggendorf's modification, *Niaudet*, American transl. . . . . . . * 155.

Grow'ing Cell. (*Optics.*) Beck's. A plate of glass into which is fitted an annular zinc trough upon the upper surface of which a cover of plate-glass is screwed. On the top of this glass the object to be kept alive is placed, and over it is laid a thin glass cover.

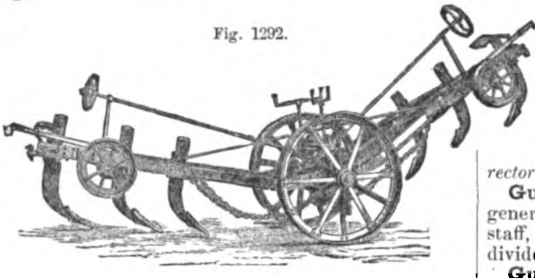
The action of this growing cell is as follows: The trough is filled with water, the plate-glass is screwed down, the thin cover placed upon it. The plate-glass cover has two holes pierced in it, one of which comes under the covering glass, and through which the water will flow by capillary attraction, feeding the object. The other hole is outside and will admit sufficient air to replace that lost by the capillary action under the covering glass.

Grub'ber. An implement for deep cultivation.

An implement for tearing through soils infested with grubs, stumps, stones, and roots. A clearing plow.

The steam grubber, Fig. 1292, is one of the set of steam cultivation implements. It is especially intended for working in stiff clay land, to stir and aërate the subsoil without

Fig. 1292.



Fowler's Steam Grubber.

materially disturbing the surface. For this purpose it is made with 1, 2, or 3 tines, and is worked 2′ deep. It is also used for stirring up the subsoil of old grass lands, and, with 1 or 2 tines, to a depth of as much as 30′′ in removing stones or tree-roots. It is known as a "knifer."

It may be called a renovating or reclaiming implement, and under all circumstances of its use is a powerful assistant in the matter of drainage in strong soils.

Grub'bing Ma-chine'. A special gun-tool. The work has a semi-rotary motion against a fixed tool.

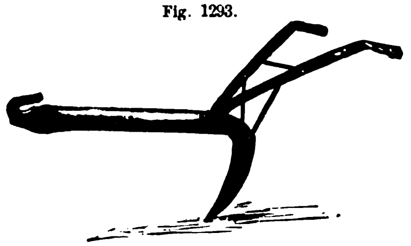
In the special grubbing machine the tool has a motion on a segment of a circle, and an automatic feed. — *Pratt & Whitney.*

Grub Break'er. (*Agric.*) A form of heavy plow used in recently cleared land, and having a strongly braced colter and share for uprooting grubs and breaking roots.

Grub Hoe. An implement something between a hoe and an adze, used in cutting and digging up brush, saplings, etc.

Grub Hook. An implement drawn by a team and used in rolling out stones and tearing out roots, stumps, and logs.

Fig. 1293.



Grub Hook.

Grum'met. (*Nautical.*) See GROMMET, p. 1025, "*Mech. Dict.*"

Guard. A fence, fender, screen, canopy, etc., as the case may be: —

A dash-board, or step-guard in cars.

A fender in grates.

A piece to receive the jar of an opening door.

A screen to keep the heat of a fire from a person, wall, or furniture.

A grating to a window to preserve it from blows.

(*Fire-arms.*) The bow which protects the trigger.

Guard Bolt. A flat-headed screw-bolt, fully counter-sunk, for fastening the guards of mowing machines to the bars.

Guard'ed In'stru-ment. (*Surgical.*) Said of an instrument the point or cutting edge of which is concealed or guarded during introduction, and uncovered when at the place where it is to become effective. As *guarded blunt-hook, guarded bistoury, guarded trephine.*

Bistoury caché expresses the same idea.

Gui'bal Fan. A ventilating wheel on the exhaust principle, receiving the air around its axis and forcing it by wings centrifugally to the exit shaft.

Guide. (*Surgical.*) A stiffening stem, withdrawable, in a soft rubber catheter.

A cannulated stem affording a means of direction to a flexible instrument. A *director.*

Gui'don. The flag of a commander of horse; generally of damask and fringed, 3′ broad on the staff, and lessening towards the bottom, where it is divided into two peaks.

Guil'lo-tine In'stru-ment. (*Surgical.*) An instrument for excising the tonsil or uvula. It has a cutter sliding in guides and a loop to hold the object.

See TONSILOTOME, *e*, Fig. 6525, "*Mech. Dict.*"; UVULATOME, *d*, Fig. 6886, *Ibid.*

Home-made . . . . * "*Scientific American*," xlii. 295.

Gui-tar'. (*Music.*) An instrument played by the hands, having 6 strings tuned in fourths and thirds. The three lower strings are of silk, covered with silver wire; the three upper of catgut. The three former are usually played by the thumb; the three latter, G, B, E, by the fore, middle, and third fingers respectively, the little finger resting on the instrument.

Gum De-pres'sor. A dentist's tool, used in holding the gum down from the tooth in filling cavities close to or under the gum.

Gum Lan'cet. (*Surgical.*) A pocket lancet in shell handle. See *a*, Fig. 2795, p. 1249, "*Mech. Dict.*"

Gum'mer. A tooth for gulleting saws. See SAW GUMMER.

Gum'mer Grind'er. A tool for holding the cutter of a saw gummer while being ground.

Gum Spring. One made of caoutchouc — india rubber.

Gun. See CANNON; RIFLE, etc.

"Duilio," *Armstrong* gun.

Bore	17.72′′.
Shot	2018 lbs.
Maximum charge powder	511 lbs.
Ordinary charge powder	355 lbs.

See CANNON, RIFLE, etc., and various specific heads.

Sporting and whaling guns.	*Gatling* gun.
Blow-gun.	*Armstrong* gun.
Syringe gun.	*Whitworth* gun.

Rifle-barrel in shot-gun bore.
Stevens . . . . . . * "*Scientific American*," xl. 263.
Gun-lock concealed.
"Climax," *Holland* . * "*Scientific American*," xli. 411.
Gun tool, *Barthel* . . . * "*Scientific American*," xl. 131.
Hammerless, *Guener*, Br. * "*Scientific American*," xliii. 274.

Gun Bar'row. The *brouette militaire* of M. Bazin. The butts of two rifles are attached to a pair of small wheels; the barrels form handles; the barrow supports the soldiers' knapsacks and other impedimenta.

Gun'boat.

Gunboats ready for launching, Portsmouth, Eng. * "*Scientific American Sup.*," 2034.
Chinese . . . . . . "*Scientific American Sup.*," 983.
"Delta," China . . . * "*Scientific American Sup.*," 1087.
"Epsilon," China . . * "*Engineer*," xlviii. 144.

Gun Brush. A spiral cylindrical brush with stiff bristles; used for cleaning gun-bores.

Gun Car'riage.

The "*Report of the Chief of Ordnance, U. S. A.*," 1877, Appendix K, contains notices and views of the following: —

Austrian field carriage	Plate IV.
Austrian 3.42'' gun and caisson	Plate V.
English 9-pounder field carriage	Plates VI., VII.
German field carriage	Plate VIII.
Engelhardt's field carriage . .	Plate IX.
Swedish field carriage	Plate X.
Swedish traveling forge . . .	Plate XI.
English field traveling forge . .	Plate XII.
English 7-pdr. mount'n carriage	Plate XIII.
Gruson's 21-pdr. coast carriage .	Plate XIV.
Krupp's 12'' gun and carriage .	Plate XV.
Krupp's 14'' gun and carriage .	Plate XVI.
German naval carriage	Plate XVII.
German turret carriage . . .	Plate XVIII.
Prussian gun-lift	Plates XIX., XX.
Krupp's gun-lift	Plate XXI.
Hydraulic buffer	Plate XXII.
Traversing and running-back gear 11'' gun	Plate XXIII.
English 10'' casemate carriage .	Plate XXIV.
English 10'' casemate carriage (high)	Plate XXV.
English 11'' C. P. carriage . .	Plate XXVI.
English 35-ton carriage . . .	Plates XXVII., XXVIII.
Moncrieff's 7'' depressing car. .	Plate XXIX.
Vavasseur's carriage	Plate XXX.
Hydro-pneumatic ship-carriage .	Plate XXXI.
Swedish 27-cm. gun-carriage .	Plate XXXII.
Austrian siege carriage . . .	Plate XXXIII.
Prussian siege carriage . . .	Plate XXXIV.
Krupp's 21-cm. siege carriage .	Plates XXXV., XXXVI.
Krupp's 15-cm. siege carriage .	Plate XXXVII.
English 40-pdr. siege carriage .	Plates XXXVIII.
Moncrieff's hydro-pneum. siege carriage	Plate XXXIX., XL.
Austrian mortar carriage . . .	Plate XLI.
German mortar carriage . . .	Plate XLII.
Krupp's 28-cm. mortar carriage	Plate XLIII.
Russian mortar carriage . . .	Plate XLIV., XLV.
English sling wagon	Plate XLVI.
Lischine's hospital tent . . .	Plate XLVII.

English "*Armstrong*" 10'' on casemate carriage, same report, Fig 46, Appendix L.

French sea-coast carriage 27 cm. rifled gun, Fig. 67, Appendix L, "*Ordnance Report*," 1877, and p. 544.

American carriage for 8'' rifle. *Ibid.*, Appendix P.

American carriage for 12'' rifle. *Ibid.*, Appendix T.

American carriage for 12'' rifle. *Ibid.*, 1876, p. 96, Pl. III.

American carriage for 9'' converted rifle. *Ibid.*, 1871, Appendix I., p. 134.

Flank-defense carriage for Gatling gun. *Ibid.*, 1879, Appendix I.[5], p 163, and Plates I., II., III.

Moncrieff . . . . . "*Van Nostrand's Mag.*," xv. 375.
Overbank, *Maquay*, Br. * "*Engineer*," xliv. 88.
Gun truck, Penn. Ra'y . * "*Engineering*," xxvi. 492.

Report on depressing gun-carriages, by Board of Ordnance Officers U. S. Army, Washington, 1873. Refers to 58 systems, parts, and accessories, pp. 19, 20. And illustrates —

Service barbette carriage, 15''.
Benton's apparatus for maneuvering guns.
Buffington's counterpoise carriage.
Capt. J. Wall Wilson's device for checking recoil.
Capt. W. R. King's counterpoise carriage.
Capt. W. R. King's depressing carriage.

See also HYDRAULIC COMPRESSOR, *infra.*

Gun'-cot'ton. Cotton rendered explosive by treatment with sulphuric and nitric acids. See p. 1036, "*Mech. Dict.*"

Modes of manufacture and considerations of its stability, in "*Report of the Chief of Ordnance, U. S. A.*," 1877, p. 458, *et seq.* See also *Ibid.*, 1879, Appendix I., pp. 130-132.

On cannon, effect of . . * "*Scientific American Sup.*," 2618.

Punchon's improvements in the manufacture of gun cotton are thus described: —

"The cotton is first thoroughly cleansed by boiling it in an alkaline solution and exposing it to a current of air, and then again boiling it in clean water. After the second boiling it must be again thoroughly dried, first by a centrifugal machine, and afterward by being passed over a current of hot air, the wet meeting the cold current, and as it dries rising to a temperature of about 120° F. The cotton, in charges of one pound each, is then steeped for five minutes in a bath containing three parts of sulphuric acid and one part of nitric acid, after which it is taken out and placed in an iron cylinder, and a perforated piston, about 8'' in diameter, is forced down upon it by hydraulic pressure. The excess of acid pressed out of the cotton passes through the perforations in the disk and is pumped off. The cotton is then placed in glazed earthenware jars, which are covered in order to prevent any heating taking place, the jars being placed in a current of cold water, where they are allowed to remain for 24 hours, after which the cotton is taken out and again thoroughly washed, and while yet damp is passed between rollers until it is reduced to a very fine powder; this process being gone through while the compound is damp, prevents any possibility of its explosion. The powder is then mixed with a certain quantity of sugar, nitric acid, and water, into a pulpy mass, which, after being strained through a fine sieve, is carefully dried in a temperature never exceeding 120° F. The manufacturing process is finally completed by passing it through rollers under very high pressure, by which means it is compressed into a hard substance and rendered almost impervious to damp. The gun-cotton intended for blasting purposes is made into thin cakes, broken and irregular in size, but for rifle cartridges it is made in small pellets, similar in form and size to rape seed." — "*Universal Engineer.*"

Gun Hand'-tools.

Ball seater.	Intrenching spade.
Breech wrench.	Loading plug.
Burgoyne.	Primer.
Capper.	Primer extractor.
Cartridge capper.	Re-capper.
Cartridge loader.	Re-loading tool.
Countersink.	Re-primer.
Extractor.	Uncapping knife.
Gun brush.	

Gun Har-poon'. A harpoon projected by a gun. Used in whaling. See HARPOON.

Gun Lift. A hoisting arrangement for mounting and dismounting cannon.

Ordnance Report, 1877, Plates XIX., XX., gives views of Prussian gun lift.
Plate XXI., Krupp's gun lift.

Gun Ma-chines'.

Barrel boring machine.	Gun stocking machine.
Breaking down machine.	Gun stock lathe.
Bullet machine.	Impression machine.
Bullet-patching machine.	Incorporating mill.
Butt lathe.	Lead wire apparatus.
Cartridge heading machine.	Loading machine.
Cartridge varnishing machine.	Mixing machine.
Charcoal grinding machine.	Pebble-powder machine.
Clamp-milling machine.	Pellet-powder machine.
Coiling machine.	Pistol rifling machine.
Cupping machine.	Powder dusting machine.
Drawing machine.	Powder pressing machine.
Dusting machine.	Priming machine.
Glazing barrel.	Rifling machine.
Granulating machine.	Tapering and crimping machine.

Gun'pow-der. See references: —

"Compensators," *Totten* . . * "*Sc. American*," xxxvi. 305.
Incorporating mill, Br. . . * "*Engineering*," xxv. 37.
Manufacture of, *Hay* . . . * "*Engineering*," xxv. 1, 37, 95.
Mixing machine, Br. . . . * "*Engineering*," xxv. 37.
Modern history of, "*Jour. Soc. of Arts.*" "*Van Nostr. Mag.*," xxi 203.
Pebble-powder machine . . * "*Engineering*," xxv. 236.
Densimeter . . . . . . * "*Engineering*," xxv. 236.
Manuf. "*Revue Industrielle*" "*Van Nostr Mag.*," xvi. 305.
Sifting reel, Br. . . . . . * "*Engineering*," xxv 37.
Breaking-down machine . . * "*Engineering*," xxv. 95.
Charcoal grinding mill, Br. . * "*Engineering*," xxv. 37.
Granulating machine, Br. . * "*Engineering*," xxv. 138.
Dusting reel . . . . . * "*Engineering*," xxv. 138.
Glazing barrel . . . . . "*Engineering*," xxv. 138.
Drying stove . . . . . * "*Engineering*," xxv. 198.
Pellet powder machine . . * "*Engineering*," xxv. 198.
Grinding apparatus, Br. . . * "*Engineering*," xxv. 37.
Work: *Dupont* . . . . . "*Amer. Artizan*," xvii 369
Hydraulic pressure apparatus * "*Engineering*," xxv. 95.

See also list under "EXPLOSIVES."

Systems and modes of manufacture of gunpowder are detailed in Appendix K, "*Report of Chief of Ordnance U. S. A.*, 1877, p. 437, *et seq.*

British	p. 438.	"Krupp's" . .	p. 454.
Russian	p. 445.	French	p. 455.
"Wiener" powder	p. 451.	"Wetteren" . .	p. 457.
German	p. 452.	Austrian . . .	p. 457.

Materials, proportions, processes, machinery, tests, packing, storage, etc., *Crispin & Baylor's* report, "*Ordnance Report*," 1879, * pp. 91–134.

See also report on cannon powders of the following shapes, etc. : —

Hexagonal.	Polyhedral.
Sphero-hexagonal.	English pebble.
Octohedral.	Progressive.

"*Ordnance Report*," 1879, Appendix II., 7, * p. 85, *et seq.*
Ibid., Appendix I., * pp. 122–130.
See also : —
"*Ordnance Manual*," 1861.
"*Handbook on the Manufacture of Powder.*" (British.)
Benton's "*Ordnance and Gunnery.*"
Cooke's "*Naval Ordnance and Gunnery.*"
Marvin's "*Granulation of Powder.*"

Gun'pow-der Pa'per. A substitute for gunpowder. *Powder-paper* consists of paper impregnated with a mixture of potassic chlorate, nitrate, prussiate, and chromate, powdered wood-charcoal, and a little starch. The powder-paper is rolled into the shape of a cartridge of any required length or diameter. It is said that no explosion can take place except by way of contact with fire. Also that the powder paper leaves no greasy residue on the inside of the gun, produces less smoke, gives a less violent recoil, and is less impaired by humidity than gunpowder. With equal charges, by weight, of gunpowder and powder-paper, the penetrating power of the latter is 5-16ths greater than that of the former. — "*Pop. Science Monthly*," x., p. 253.

Gun Stock'ing Ma-chin'e-ry. Includes machines for

Bedding the barrel.	Placing the butt plate.
Bedding the lock.	Turning the stock, etc.
Bedding the guard.	

Gun Stock Lathe. See GUN STOCK, p. 1042, "*Mech. Dict.*," also LATHE, p. 1264, *Ibid.*

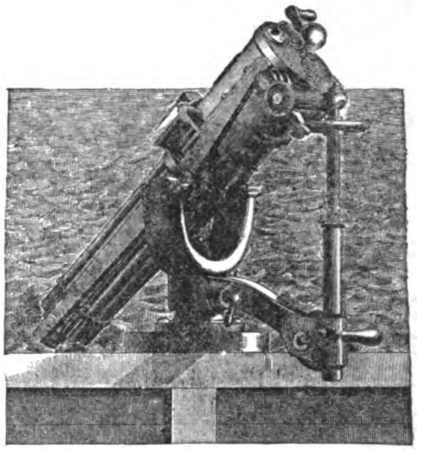
Gun'-tack-le Pur'chase. (*Nautical.*) A form of tackle, also known as a *double purchase*, having two single-sheave blocks. Fig. 6159, "*Mech. Dict.*"

Gun'wale Gun. A light Gatling gun fixed upon the gunwale, and so adjusted that it may be depressed 30°. Fig. 1294. With this power of depression, combined with the swivel-mounting, the weapon may be made to command the whole range of approach of boats for the purpose of boarding.

Gun'wale Winch. (*Fishing.*) A roller with hand crank, mounted on the boat's gunwale, to haul in a fishing line.

Gut Belt'ing. Lathe or machine belting made

Fig. 1294.



"*Gatling*" *Gunwale Gun.*

of cat-gut. Treatise on gut belting, "*Iron Age*," xix., March 15, p. 1.

Gut Hook. A coupling hook and eye for round gut belts.

Gut'ta-per'cha Soft'en-er. (*Dentistry.*) A small pan in water-bath over an alcohol lamp; used in bringing gutta-percha to a molding temperature.

Gutta-percha product, E. Indies "*Scientific Am. Sup.*," 2415.
Provision and uses, *Bolas* . . "*Scientific Am. Sup.*," 4009.

Gut'ter Plane. A molding plane with a semi-cylindrical sole, and a bit of corresponding shape. Used in planing out gutters in stuff for eave-troughs.

Gym-nas'tic Ap'pa-ra'tus. See EXERCISING MACHINE; HEALTH LIFT, etc.

Gyn'æ-co-log'i-cal In'stru-ments. (*Surgical.*) Those for operating in cases peculiar to females. See list under SURGICAL INSTRUMENTS.

Gynæcological table, *Foster*,* "*Med. Record*," May 24, 1879.

Gy'ro-pig'eon. A flying object simulating a pigeon in flight. Used as a flying target in shooting matches. Projected by a spring trap. Fig. 3708, p. 1700, "*Mech. Dict.*"

Gy'ro-scope.

Electro-magnetic apparatus to demonstrate the revolution of the earth. *Du Moncel's* "*Exposé des Applications de l'Electricité*," iv. 176.

Gyroscope, *Deane* . .	* "*Scientific American*," xxxiv. 244.
Fessel	* "*Manuf. & Builder*," ix. 133, 157.
Gruey, Fr. . . .	* "*Scientific American*," xl. 41.
Electrical, *Hopkins* .	* "*Telegraphic Journal*," vi. 276. 331.
	* "*Scientific American*," xxxviii. 335.

H.

Hai-tha'o. A species of gelatine used in giving body to tissues and paper.

It resembles Irish moss, and may be derived either from the *Gehelium corneum*, a seaweed of Java, or from the *Phearia lichenoides*, peculiar to Mauritius. It is treated with hot acetic acid, afterwards with water, and finally with ammonia. The residuum dissolved in boiling water furnishes, on cooling, a jelly which is dried, and forms the commercial article. It was first used for alimentary purposes, and is now used as a size, and also as a substitute for gold-beater's skin. When placed in water it takes up about 500 times its own weight of the fluid. It is only soluble in boiling water, and insoluble in weak or diluted acids, alkaline solutions, and ether, but is attacked by sulphuric and other concentrated acids.

Half Back Saw. A hand-saw having a back stiffened to a distance about half the length of the blade from the handle.

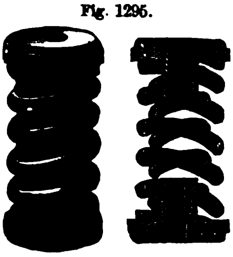
Half Clear. (*Glass.*) Said of glass, a portion of the surface of which has been depolished by any means, such as acid, grinding, etc.

Half-crys'tal Glass. (*Glass.*) A French term for *lime*-glass. *Crystal* answers to the English *flint* glass.

Half-el-lip'tic Spring. A carriage spring composed of one set of plates, like a half ellipse. See Figs. on p. 143, *supra*.

Half Hatch'et. A hatchet with one straight side, all the projection of the bit being on the side toward the hand. A shingling hatchet.

Fig. 1295.



Half-round-bar Spiral Spring.

Half Hose Coup'ling. A coupling having at one end a corrugated tubular portion on which the hose is bound, and at the other a sleeve internally threaded to receive an iron pipe.

Half-round'-bar Spi'ral Spring. (*Railway.*) A coil spring made of half-round steel rod. Fig. 1295 shows it in a double nest form.

Fig. 1296.

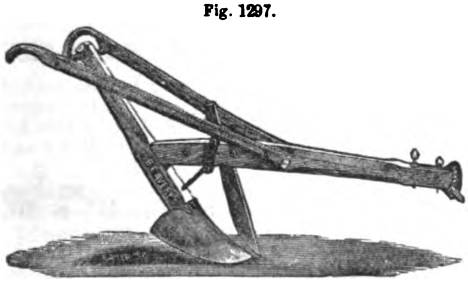
Flanged Half-S Hopper Trap.

Half-round' Spade. (*Whaling.*) Used in cutting the blanket-piece free from the carcass as the lifting tackle and blubber hook draw upon the piece in flaying.

Half-S Hop'per Trap. A sewer trap with a single bend; half the letter S in form. Fig. 1296 shows the form, and also a man-hole with cover.

Half-shov'el Plow. (*Agric.*) A plow intended for rooty land. The blade is of steel, and

Fig. 1297.



Half-shovel Plow.

has one straight side; it is braced by a lay to prevent its being broken or bent. A broad iron plate is attached to the beam, and the colter may be changed from a jumping to a cutting colter.

Half Spring. A spring with but one set of leaves; like a half-elliptic spring, shown at *d*, Fig. 1136, p. 480, *"Mech. Dict.,"* and Figs. 450–452, p. 143, *supra.*

Half Trap. A sinking bend in a sewer pipe, like a half-S, not having the rising portion. See Fig. 1296.

Hame. A curved piece of wood or metal, two of which are fitted to the collar; they have draft eyes to which traces and chains are attached.

The attachments are: —
Hame clip; a metallic link by which the tug is attached.
Hame link; at the lower end of each hame, for the hame strap to pass through.
Hame ring; on the hame, for the rein to pass through.
Hame strap; to couple the hames around the collar.
Hame terret; a rein ring in coach harness.
Hame tug; the forward loop on the trace; attached to the clip.

Ham'mer. (*Stone Working.*) Stone hammers are of various kinds, with faces or edges, plain or notched. Sometimes one end has a point (the *peen*) which is practically a pick, and used in *pointing* ashlars. See STONE DRESSING.

See Bush hammer.	Mallet.
Cavil.	Patent hammer.
Crandall.	Peen hammer.
Double-face hammer.	Pick.
Face hammer.	Stone hammer.
Hand hammer.	Tooth axe.

(*Surgical.*) Used in osteotomy. The percussor used in auscultation is also a hammer or mallet.

See under the following list, which includes also other striking tools, including sledges, mauls, hatchets, axes, and picks: —

Adze.	Mason's hammer.
Axe.	Mattock.
Ballast hammer.	Mill pick.
Ball-peen hammer.	Miner's pick.
Beating hammer.	Nail gun.
Bench hatchet.	Nail hammer.
Blacksmith's sledge.	Napping hammer.
Blocking hammer.	Patent hammer.
Brad driver.	Pavior's hammer.
Brad hammer.	Pavior's rammer.
Bricklayer's hammer.	Peeling axe.
Broad axe.	Peen hammer.
Bull-head axe.	Percussing hammer.
Bung start.	Pick.
Bush hammer.	Pick-axe.
Calking beetle.	Pick hammer.
Calking mallet.	Pick mattock.
Carpet hammer.	Plugging mallet.
Cavil.	Quartering hammer.
Claw hatchet.	Railroad axe.
Coal sledge.	Rammer.
Crandall.	Ring mallet.
Cross peen hammer.	Riveting hammer.
Dental mallet.	Set hammer.
Dog-head.	Sharp-peen hammer.
Double face hammer.	Shingling hatchet.
Drift hammer.	Ship's axe.
Driving hammer.	Sledge.
Electro-magnetic mallet.	Spalling hammer.
Engineer's hammer.	Spike maul.
Face hammer.	Steak hammer.
Farrier's hammer.	Stone axe.
Fireman's axe.	Stone-cutter's hammer.
Flaking hammer.	Stone pick
Flanging hammer.	Straight-peen hammer.
Geological hammer.	Striking sledge.
Half hatchet.	Swaging mallet.
Hammer pick.	Tamping pick.
Hand-drilling hammer.	Tinner's hammer.
Hand hammer.	Tooth axe.
Hatchet.	Top maul.
Hawsing beetle.	Trimming hammer.
Horse-shoe hammer.	Turning hammer.
Knapping hammer.	Turning sledge.
Lathing hatchet.	Welding hammer.
Mallet.	Wood chopper's maul.

Refer to: Cushioned hammer, *Bradley.*
* *"Scientific American Sup.,"* 737.
* *"Engineer,"* xlii. 221.
Helve hammer, Cuyahoga Iron Works.
* *"Amer. Manuf.,"* Dec. 12, 1879, p. 7.
Pneumatic hammer, *Sholl*, Br. * *"Engineer,"* xliii. 369.
Power hammer, *Hasse-Simon*, * *"Engineer,"* xlviii. 412.

Ham'mered Ar'ti-fi'cial Stone. An artificial stone compacted by means of blows.

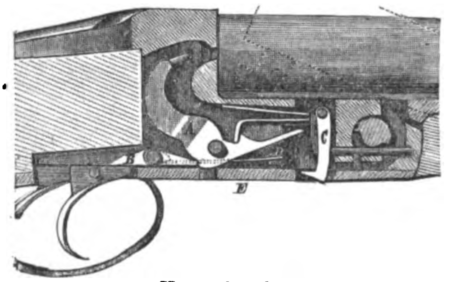
The ingredients and proportions vary with the facilities of the place of manufacture. *Béton*, as made by M. Coignet, is made of sand 5, lime 1, hydraulic lime 0.25, which are mixed with a shovel, water being sparingly used, and the compounded materials violently ground in a tempering mill and rammed in molds. See p. 278, *"Mech. Dict."*

The material to which the name of *hammered artificial stone* has been given is made by the application of the stroke of the steam hammer upon properly mixed proportions of hydraulic and common limes, hydraulic cements, pulverized iron slag, sand, broken stone, marble or granite, clays and minerals, inclosed in properly constructed molds and dies. It is made by proper disposition of the ingredients, to imitate marble, and, by carving the interior faces of the molds, to assume any ornamental configuration.

Ham'mer-less Gun. One without exterior hammer; usually fired by concealed spring-pin. The term may include the needle and bolt guns.

That shown in Fig. 1298 is by Greener, of Birmingham, England. It is shown by longitudinal section. The barrels are hinged to the breech-frame in the usual manner, but in-

Fig. 1298.



Hammerless Gun.

stead of the ordinary gun lock with outside hammers, the tumblers A are made nearly in the form of an elbow lever. These tumblers have their upper ends curved forward, and are provided with a small rounded point, which is arranged to strike through a small hole at the center of the breech piece instead of the ordinary firing pin. The lower front portions of the tumblers A are extended forward in the form of a flat arm, and these arms are curved laterally inward, so that their inner ends nearly meet at the center, each arm terminating with a small rounded projection on its lower side. The tumblers are in a recess which also contains the mainspring. (Referred to in the plural, as the gun is double barreled.)

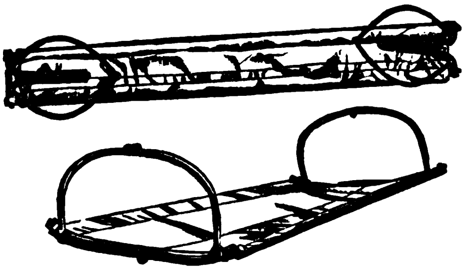
To one of the projections in rear of the joint is pivoted a pendant C, which plays loosely in a vertical slot in the center of the front arm of the breech frame, directly in front of the converging arms of the tumblers. This pendant has a hook-shaped projection which engages under the front ends of the arms of the tumblers, so that when the rear ends of the barrels are raised the hook raises the arms of the tumblers far enough to permit the dogs B to engage in a notch in the tumblers, thus automatically cocking the arm.

To hold the hook C back far enough to engage with the arms of the tumblers, a pin extends through a projection on the under side of the barrels. The triggers operate upon the rear arms of the dogs for firing the arm.

Ham'mer Pick. A stone-mason's tool having a hammer face and pointed peen at the respective ends of the head. A *pick-hammer.*

Ham'mer Strap. An iron strap stapled at its rear end on a wagon tongue, and having an eye at

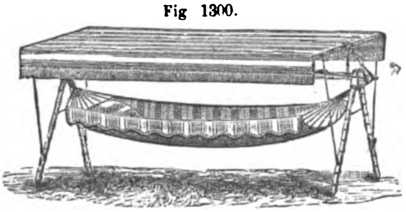
Fig. 1299.



British Navy Hammock.

its forward end which rests on the double tree. The handle of the *hammer*, so called, goes through

Fig 1300.



Lawn, or Tourist's Hammock.

the eye, the double-tree, and the tongue, and bears the strain in pulling.

Ham'mock. A suspended netting for reclining or sleeping.

Fig. 1299 is Stone's (Br.) portable swinging bedstead with canvas sacking. It is capable of being folded up and stowed,

Fig. 1301.

"Ashantee" Hammock.

being especially intended for a customary hammock arrangement on board ships of war.

Fig. 1300 is the Gwynfè (*Leycester*, Br.) self supporting hammock tent which stands by itself independently of ropes, trees, or pegs. The awning can be moved to any position.

Elastic suspension, *d'Ancora*, Italy * "*Sc. Amer. Sup.*," 1682.
Mosquito net frame, *Volle* . . . * "*Sc. Amer.*," xxxviii. 339.

Fig. 1301 shows the "Ashantee" hammock on slinging apparatus.

Ham'mock Clews. (*Nautical.*) The gatherings at the ends of a hammock formed by a *grommet* and *knittles* at each end, and by which it is suspended.

Ham'mock Cloth. (*Nautical.*) Canvas to protect the hammock from wet when stowed in the nettings on deck.

Ham'mock Net. Open-work or netted hammock.

Ham Try'er. A long bodkin for probing a ham, to detect by smelling the condition as to soundness around the bone.

Han'cock In'spi-ra'tor. See INSPIRATOR.

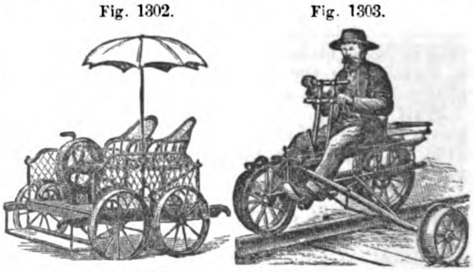
Hand. (*Fire-arm.*) The part of the stock gripped by the hand, and which may be either *straight* or *pistol-gripped.*

Hand Blow'er. A blower or bellows worked by hand. See Figs. 347, 348, pp. 111, 112, *supra.* Also Fig. 3891, p. 1768, "*Mech. Dict.*"; also list under BLACKSMITH'S TOOLS, p. 291, *Ibid.*; and list of AIR APPARATUS, pp. 25, 26, *Ibid.*

Hand Bolt'-cut-ter. A bolt-cutting machine, worked by hand-power. See Fig. 367, p. 117, *supra.*

Hand Car. (*Railway.*) A light car, driven by hand-crank and gearing, operated by those riding

Fig. 1302. Fig. 1303.



Inspection Hand-car. *Three-wheeled Hand-car.*

on the car. See various kinds in *Forney's* "*Car-builders' Dictionary,*" Figs. 43–47. See also INSPECTION CAR.

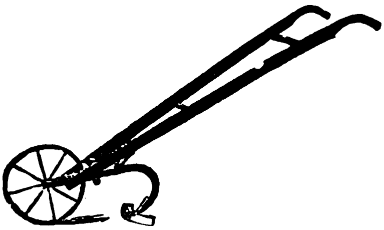
Penn. Railway . . . . * "*Engineering,*" xxv. 44.
Phila. & Reading R. R. . * "*Scientific Amer. Sup.*," 2754.
* "*R. R. Gazette,*" xxiii. 107.
Sheffield . . . . . . * "*R. R. Gazette,*" xxiii. 123.

Hand Clamp. A species of vise for holding parts in apposition while nailing, glueing, or fastening by other means. See Fig. 1310, p. 560, "*Mech. Dict.*" See list of CLAMPS, p. 199, *supra*.

Hand Corn-plant'er. A hand implement forced into the soil and dropping corn into the opening. See Fig. 1470, p. 627, "*Mech. Dict.*," Fig 2383, p. 1057, *Ibid.*

Hand Cul'ti-va'tor. A garden cultivator, which runs with a wheel in front, and carries a

Fig. 1304.



Hand Cultivator.

hoe, the penetration and direction of which are governed by means of the handles.

Hand Drill. 1. A drilling machine or tool run by hand. See instances, Fig. 2374, p. 1055, "*Mech. Dict.*"

Refer to: —

Quick-speed	* "*Engineer*," xliv., 454.
Bellamy	* "*Scientific Amer.*," xxxix. 115.
Wiley & Russell . . .	* "*Iron Age*," xxi., April 11, p. 3.

2. A machine for drilling seed in rows. See HAND SEED-DRILL, *infra*.

Hand-dril'ling Ham'mer. (*Stone.*) One used with the chisel in jumping holes in rock for blasting or splitting by plug and feather. The hammer is of steel, and weighs from 3 to 8 pounds.

Hand Hoist. A lifting apparatus worked by hand, as in some species of winch. Specifically, an arrangement of pulley-blocks known as the *differential*. See Fig. 821, p. 257, *supra*, and Fig. 1647, p. 701, "*Mech. Dict.*"

Hand'-hole Trap. A sewer-trap, made with a hand hole, through which may be reached any obstruction which has caught in the bend. See HALF-S HOPPER TRAP, *supra*.

Hand Joint'er. A small machine for trueing the edges of boards or staves. A *buzz-planer*. See HAND MATCHER.

Han'dle Net. (*Fishing.*) A dip-net stretched on a hoop, with a handle.

Han'dlers. (*Leather.*) The vats in which the hides brought from the beam house are first placed, hanging lengthwise and parallel to each other. The vats have a weak infusion of oak bark. Otherwise known as *stringers*.

Hand Line. (*Fishing.*) A line, hooked and baited, and held in the hand, a *trawl* line, for instance; in contradistinction to a *set* line, or a *fly* line.

The hand-line has one or two hooks baited and sunk near to the bottom, or thrown to any desired distance by means of a weight, and managed from the shore or a boat.

Or, it is drawn rapidly over the surface of the water behind a boat, either with a bait attached or a shining object, such as a spoon.

Han'dling. 1. (*Leather.*) Taking the sides or skins out of the vats into the air, smoothing them out, and piling them on one side to drain, after which they are returned to the *stringers*. Each time they are handled they are returned to a stronger ooze.

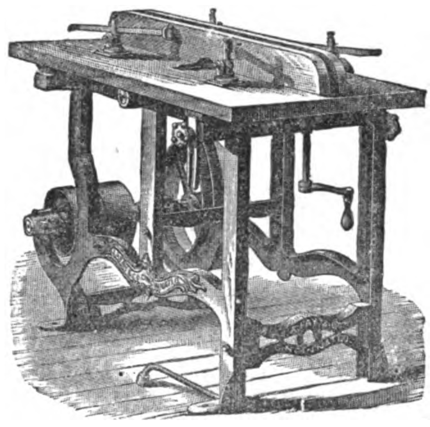
(*Ceramics.*) The operation of putting handles on ware, such as ewers, etc. The handles are molded separately.

Hand Mag'ni-fi'er. (*Optics.*) A series of 3 lenses giving various magnifying powers, whether used separately or in combination, and usually made to carry in the pocket. See LENS HOLDER.

Hand Match'er. A machine for tongueing and grooving short stuff for boxes, furniture, wagon boards, etc.

That shown has two heads, one for tongueing and one for grooving, running on the same arbor below the platen, which is raised or lowered to suit the required depth of work.

Fig. 1305.



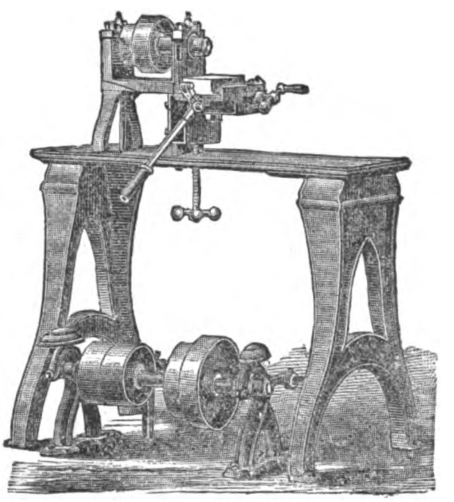
Hand Matcher.

The platen is furnished with movable fence and spring rollers, which are adjustable for different thicknesses of stuff which is passed over the heads edgewise, between the rollers and guides, both edges of the stuff being worked without change in the position of the operator.

Hand Mil'ling Ma-chine'. A machine tool, small of its class, the slide adapted to be run by hand.

Fig. 1306 shows a hand machine which is adapted for taking short milling cuts. The adjustment screw for the table passes down through the bed-plate, and is operated from the

Fig. 1306.



Hand Milling Machine.

under side. The cross-slide is adjusted by a screw that projects in front. The sliding table on which the work is placed is operated by a hand lever, and the motion is gaged by an adjustable stop. The spindle is steel, having gun-metal boxes and a taper-hole to receive the shanks of arbors.

The motion of the cutter is by power, that of the work by hand.

In a somewhat larger machine of this class, by *Kelly, Howell, & Ludwig*, and to which power-feed may be applied, the slide has a tool-post attached for the purpose of cutting up stock, facing nuts, or shaping up work from the solid bar or single pieces to be held in the chuck. The tool-post can be removed from the sliding table, and index centers, milling vise, or any milling fixture put on, required for milling, — taps, reamers, nuts, splining shafts, and any milling suitable to be done on a machine with a screw and level feed The table has a rack-and-pinion feed, operated by a hand-lever attached to the pinion shaft for a quick motion, and a screw feed so attached that either can be used when required; it also has a cross feed for adjustment or butt milling, drilling, etc The body of the machine is a large cupboard base with shelves for tools.

Pratt & Whitney . . * "*Thurston's Vienna Rep.*," ii. 225.

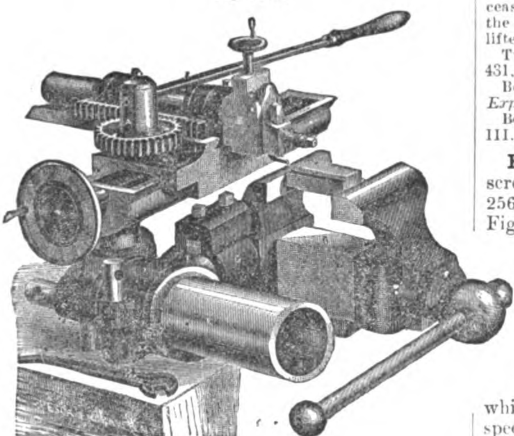
Hand Mor'tis-ing Ma-chine'. A machine in which the force of the blow of the chisel is given by hand. Fig. 3234, p. 1481, "*Mech. Dict.*"

Hand Pla'ner. 1. (*Wood.*) See HAND MATCHER.

2. (*Metal.*) A planing machine, small of its class, and adapted to be worked by hand.

Hall's hand planer is shown in Fig. 1307. The vise is

Fig 1307.



Hand Planer.

made expressly for the planer, which latter is attache by a socket, and has various adjustments to suit the tool to the piece held in the jaws of the vise. The pinion may be set to suit the length and convenience of the stroke. The tool-head swivels on its center, and may be set forward or back by the adjustable joints. The tool has a perpendicular feed of 2¼″. The motion of the lever rotates the pinion, and gives rectilinear motion to the rack which carries the tool-head.

Wood-planer, hand-feed,
Richards, * "*Eng'ing*," xxiii. 274.

Hand Pump. A pump for use in conservatories, washing carriages, etc. Specifically a light implement held in one hand and worked by the other.

See AQUAPULT, Fig. 104, p. 44, *supra*, and HYDRONETTE, *infra*.

The *proof* pump and *gas-drip* pump of the plumber are other instances.

Carr . . . . * "*Manuf. & Builder*," ix. 177.
Holland . . . . . . * "*Iron Age*," xxiii., June 5, p. 1.
"Reliance," Br. . . . * "*Engineer*," xliii. 170.

Hand Rake. (*Agric.*) A term applied to that class of harvesters in which the gavel is removed from the platform by a rake in the hands of a man who rides on the machine. The automatic or self-rake has superseded the hand rake in this country, but not yet in Europe.

Hand Rock Drill. A smaller form of stone drilling machine, differing but little except in size from the Rock drills, pp. 1956–1958, and Diamond drills, p. 697, "*Mech. Dict.*"

Fig. 1308.

Hand Seed Drill.

Hand Seed Drill. A garden tool, for planting seeds in rows.

The seed is deposited in the hopper, and by simply pushing the drill along the ground, the traveling wheel gives a motion to a slide at the bottom of the hopper, and the seed at once falls through a tube situate behind the colter and drops into the soil. The seed ceases to run through, the moment the drill is lifted off the ground.

Two forms of the broad-cast seeder are shown in Figs 430, 431, p. 136, *supra*.

Beet-drill, Figs. 132, 133, 135-137, Knight's Report, "*Paris Exposition Reports*," 1878, v., 118 *et seq*

Beet-drill, Fr., "*Dept. Agric. Sp. Report*," No. 28, Plate III.

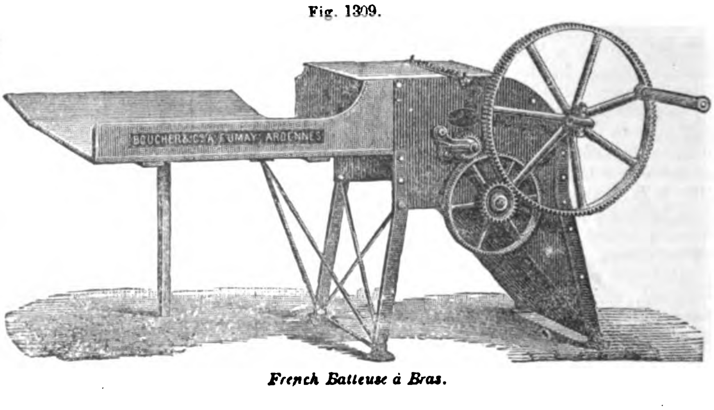
Hand Stock Dies. Cutters for making screws, bolts, and threading pipes. See DIE, p. 256, *supra*; and Fig. 4739, p. 2069, "*Mech. Dict.*;" Fig. 4754, p. 2074, *Ibid.*

Hand'-strap Ap'pa-ra'tus. The dependent lever of the counter shaft gearing, by which the strap is run from the loose to the tight pulley, or *vice versa*. A *belt shifter*.

Hand Thresh'er. A threshing machine driven by hand; formerly common in the United States, and yet numerous in Europe. Fig. 1309 shows an excellent French form in which the machine is overshot, and the requisite speed is given to the beating cylinder by the aid of multiplying wheels.

Hand methods of threshing still survive in many countries; the sled shod with flints, the roller sled, and tramping by cattle are shown on p. 2555, "*Mech. Dict*" The roller is still used in Lombardy. and the *ripple*, in Europe for removing flax seed from the bolls, and in Africa for threshing *dhura*.

Fig. 1309.



French Batteuse à Bras.

Hand Tools. Used in many trades. See under the following heads: —

Adjustable plane.
Adjustable vise.
Adze.
Adze plane.
Angle boring machine.
Angular bench drill.
Angular bit stock.
Anvil vise.
Apple-parer.
Auger.
Auger bit.
Automatic boring tool.
Axe.
Axle setter.
Backing boards.
Back saw.
Bale hook.
Ballast hammer.
Ball-peen hammer.
Ball seater.
Band-saw brazing tool.
Band-saw holder.
Band-saw tongs.
Band setter.
Barley fork.
Barrel busher.
Barrel lifter.
Basin wrench.
Bean slicer.
Beating hammer.
Beef shaver.
Beetle destroyer.
Bench cramp.
Bench drill.
Bench hatchet.
Bench screw.
Bench stop.
Bending tool.
Bent trimmer.
Bevel.
Beveling instrument.
Binder.
Bit.
Bit brace.
Bit-brace die.
Bit-brace tap.
Blacksmith's chisel.
Blacksmith's drill.
Blacksmith's sledge.
Blocking hammer.
Block plane.
Boat hook.
Bodkin.
Bolt cutter.
Border knife.
Boring-bar clamp.
Boring-bar wrench.
Boring tool.
Bosom staff.
Bottoming tap.
Bow-back saw.
Bow-drill stock.
Bow saw.
Box hook.
Box scraper.
Brace.
Brad driver.
Brad hammer.
Bramble scythe.
Brazing tongs.
Bread knife.
Bread slicer.
Breast drill.
Breech wrench.
Bricklayer's hammer.
Brick trowel.
Broad axe.
Broadcast seeder.
Brush jack.
Brush-jack needle.
Buck saw.
Buhr dresser.
Buhr rubber.
Bull-head axe.
Bull-nose rabbet plane.
Bung-hole borer.
Bung start.
Burgoyne.
Burner pliers.
Burnisher.
Bush hammer.
Bush hook.
Butter knife.
Button fastener.
Cabinet file.
Cabinet-maker's clamp.
Calking beetle.
Calking chisel.
Calking iron.
Calking mallet.
Calking tools.
Calking vise.
Candy shears.
Cane knife.
Can filler.
Can hook.
Cant hook.
Capper.
Carpenter's clamp.
Carpet hammer.
Carpet stretcher.
Car pusher.
Cartridge capper.
Carver's tools.
Cavil.
Centering tool.
Center mold.
Chain hook.
Chaser.
Cheese knife.
Chemist's tongs.
Cherry.
Cherry stoner.
Chisel.
Churn drill.
Cigar knife.
Circular plane.
Clamp dog.
Clamp screw.
Claw hatchet.
Clevis tongs.
Clipper.
Clip swage.
Clutch drill.
Coal sledge.
Cock wrench.
Cocoa-nut grater.
Cold chisel.
Collar swage.
Combination auger.
Combination plane.
Compass saw.
Concave saw.
Cooper's punch.
Cork arm-board.
Cork presser.
Cork screw.
Corn hook.
Corn knife.
Corundum tool.
Cotton hook.
Countersink.
Crandall.
Crank ratchet-brace.
Cross-file.
Cross-peen hammer.
Crow.
Cupping tool.
Curling stick.
Currier's knife.
Curry-comb.
Curved mattress needle.
Cutting nippers.
Cutting punch.
Dado plane.
Darby.
Dental tools. (See SURGICAL APPARATUS, etc.)
Die.
Die-dog.
Die holder.
Die stock.
Differential ratchet brace.
Ditch cleaner.
Dog head.
Door clamp.
Double clamp.
Double cut saw.
Double ender.
Double-face hammer.
Double-jaw vise.
Double screw vise.
Dowel pointer.
Drain cleaner.
Draining tools.
Drain tile layer.
Draw filing.
Drawing hook.
Drawing knife.
Drift hammer.
Drill.
Drill bench.
Drill holder.
Drilling clip.
Drill press.
Driving hammer.
Duplex punch.
Earth borer.
Egg beater.
Egg whip.
Emery band.
Emery board.
Emery stick.
Emery stone.
Engineer's hammer.
Equilibrium tool.
Expanding drill.
Expanding reamer.
Expansion bit.
Expansive hollow auger.
Extractor.
Face hammer.
Facing tool.
Farrier's hammer.
Feather.
Fid.
File.
File card.
File guard.
File holder.
Filings separator.
Finger steel.
Fireman's axe.
Firmer chisel.
Five-cant file.
Flagging iron.
Flaking hammer.
Flanging hammer.
Flat iron.
Flattener.
Flatter.
Flesher.
Fleshing-knife.
Flexible sole plane.
Float.
Floor cramp.
Floral tools.
Flower and fruit gatherer.
Fluted tap.
Fluter.
Fluting iron.
Fluting scissors.
Foot vise.
Fork.
Forking spade.
Forming iron.
Foundry ladle.
Fountain pump.
Frame clamp.
Friezing cutter.
Fruit cutter.
Fruit pitter.
Fuller.
Furrow-gage staff.
Furrow rubber.
Furrowing machine.
Gage saw.
Garden fork.
Garden plow.
Garden roller.
Garden tools.
Garden weeder.
Gas-main drill.
Gas tube vise.
Geological hammer.
Gimlet.
Gimlet bit.
Glass cutter.
Glossing iron.
Grafter.
Grafting tool.
Grains.
Grater.
Grommet knob.
Grub hoe.
Grub hook.
Gun brush.
Half-back saw.
Half hatchet.
Hammer.
Hammer pick.
Ham tryer.
Hand clamp.
Hand corn planter.
Hand cultivator.
Hand drill.
Hand drilling hammer.
Hand hammer.
Hand jointer.
Hand matching machine.
Hand rake.
Hand saw.
Hand seed drill.
Hand seeder.
Hand stock die.
Hand vise.
Hardy.
Harpoon shuttle.
Hatchet.
Hawsing beetle.
Hawsing iron.
Hawk.
Hay band twister.
Hay fork.
Hay knife.
Hazel hoe.
H drill.
Hedge knife.
Hemp knife.
Hoe.
Hollow auger.
Hoof pick.
Hoof punch.
Hook needle.
Horner.
Horse clipper.
Horse-shoe hammer.
Horse-shoer's machine.
Horse-shoer's vise.
Hose wrench.
Husking glove.
Ice chisel.
Ice hook.
Ice tools.
Intrenching spade.
Jeweler's rest.
Joiner's clamp.
Jointer plane.
Key-hole saw.
Knapping hammer.
Kneading machine.
Knife.
Knife cleaner.
Knife guard.
Lacing cutter.
Lathing hatchet.
Lily iron.
Lip auger.
Loading plug.
Lock bedder.
Machete.
Machinist's tools.
Mainspring vise.
Mallet.
Mandrel.
Mangle.
Manure drag.
Marking gage.
Marking iron.
Marlinespike.
Mason's hammer.
Mat hook.
Mat pole.
Mattock.
Meat cutter.
Meat rocker.
Meat stuffer.
Microtome.
Mill file.
Mill pick.
Millstone dresser.
Millstone leveler.
Mincing knife.
Mineral dresser.
Miner's bar.
Miner's pick.
Mining wedge.
Miter.
Miter box.
Miter box saw.
Miter jack.
Molder's tools.

Moon knife.
Movable-back saw.
Nail anvil.
Nail gun.
Nail hammer.
Nail puller.
Nail selector.
Napping hammer.
Needle threader.
Nest.
Nicking saw.
Nut wrench.
Pallet knife.
Palm.
Panel saw.
Parallel vise.
Paste jagger.
Patent hammer.
Pavior's hammer.
Pavior's rammer.
Peach Parer.
Peat knife.
Peat spade.
Peeling axe.
Peen hammer.
Perforator.
Pick.
Pick hammer.
Pick mattock.
Pillar file.
Pin bush.
Pinchers.
Pipe cutter.
Pipe die.
Pipe fitter's vise.
Pipe grip.
Pipe-layer's tools.
Pipe threader.
Pipe threading die.
Pipe tongs.
Pipette.
Pipe vise.
Pipe wrench.
Pitching chisel.
Pitter.
Plane.
Plane bit holder.
Plane iron.
Planter.
Plant sprinkler.
Plasterer's brush.
Plasterer's trowel.
Plow.
Plug.
Plug-and-feather.
Plug tap.
Plumb and level.
Plumber's chisel.
Pocket level.
Pod auger.
Point.
Pointer.
Polishing disk.
Polishing iron.
Porte polisher.
Post auger.
Post-hole auger.
Post-hole digger.
Post-hole spoon.
Potato hook.
Pressing irons.
Primer.
Primer extractor.
Pritchell.
Proof staff.
Pruner.
Pruning saw.
Pruning shears.
Pump auger.
Punch.
Putty sieve.
Quartering hammer.
Quick-speed hand drill.
Rabbet plane.
Rag looper.
Railroad axe.
Rammer.
Rasp.
Ratchet brace.
Ratchet drill.
Ratchet wrench.
Razor.
Reamer.
Reaper.
Re-capper.
Red staff.
Reloading tool.
Re-primer.
Reversible saw.
Riffler.
Rigging screw.
Ring cone.
Ring mallet.
Rip saw.
Riveting hammer.
Round iron.
Round moon knife.
Round swage.
Sardine shears.
Sash cramp.
Sash tools.
Sausage chopper.
Sausage stuffer.
Saw.
Saw clamp.
Saw file guide.
Saw filing clamp.
Saw-filing vise.
Saw gummer.
Saw set.
Scissors.
Scoop.
Scraper.
Scraper plane.
Scratch brush.
Scratcher.
Screw clamp.
Screw driver.
Screwing stock.
Screw making tools.
Screw plate.
Screw wrench
Scuffle hoe.
Seed drill.
Set hammer.
Setting die.
Shackle jack.
Sharp peen hammer.
Shave hook
Shearer.
Shingling hatchet.
Ship auger.
Ship axe.
Shoe stretcher.
Short-hair knife.
Shovel.
Shunting bar.
Sieve.
Six canted file.
Sledge.
Slot borer.
Sluice fork.
Smoothing iron.
Smooth plane.
Snip.
Soldering iron.
Soldering tool.
Sour kraut cutter.
Spade.
Spanner.
Spawling hammer.
Spice mill.
Spike extractor.
Spike maul.
Spiral auger.
Splitting chisel.
Spoke pointer.
Spoke-shave.
Spoke trimmer.
Sprinkler.
Sprouting hoe.
Square corner swage.
Stamp punch.
Staple fastener.
Steak hammer.
Steel mortar.
Stock and die.
Stone axe.
Stone-cutter's hammer.
Stone pick.
Stone-worker's tools.
Straight peen hammer.
Straw knife.
Striking sledge.
Stuffing brush.
Sudden-grip vise.
Surgical instruments. (See separate list.)
Swage.
Swage block.
Swivel tool.
Swivel vise.
Table brush.
Tack claw.
Tamping pick.
Tap.
Taper tap.
Tap wrench.
Tenon saw.
Tinner's hammer
Tinner's snips.
Tire bender
Tire bolt clamp.
Tire setting platform.
Tire shrinker.
Tire upsetter.
Toggle iron.
Tongs.
Tongue and groove plane.
Tool holder.
Tooth axe.
Tooth chisel.
Top maul.
Track chisel.
Track drill.
Tracklayer's tools.
Tram.
Tram staff.
Trenail auger.
Trimmer.
Trimming hammer.
Trowel.
Trust hoop.
Tryer.
Try square.
Tube beader.
Tube brush.
Tube chuck.
Tube cleaner.
Tube cutter.
Tube expander.
Tube fastener.
Tube scraper.
Tube stopper.
Tube tongs.
Turning hammer.
Turning sledge.
Turning steel.
Turn pin.
Turpentine tool.
Twist drill.
Uncapping knife.
Upending tongs.
Upright vise.
Upset.
Vegetable cutter.
Veneer scraper.
Vine shear.
Vise.
Vise clamp.
Wall scraper.
Washer cutter.
Weather-boarding saw.
Weed scythe.
Welding hammer.
Well-hook.
Wire bender.
Wood-chopper's maul.
Woodworker's clamp
Worker.
Worm auger.
Wrench.
Wrench and pipe cutter.
Wrench handle.
Wringer.
Y.

Hand Wheel. 1. The brake-wheel on a car platform.

2. The throttle-wheel of a large marine or pumping engine.

Hand Winch. A hoisting apparatus worked by hand. See pp. 2776, 2777, "*Mech. Dict.*" A *crab.* Fig. 1499, p. 640, *Ibid.*

Hang'er Bolt. A screw-bolt, coarse-threaded at one end to enter wood, and threaded at the other end for a nut.

Hang'ing Block. (*Nautical.*) A block through which the *top-sail* tye is rove, then through the tye-block on the yard, and the standing part made fast to the mast head.

Hang'ing Cut'ter. A colter depending from the plow-beam. See Colter, Fig. 662, p. 210, *supra.*

Hang'ing-leg Boil'er. The Galloway boiler, which may be called a form of Cornish in which the large single flue is traversed by vertical water-pipes, which are thus exposed to the horizontal course of the products of combustion.

See Fig. 5626, Plate LXI., opp. p. 2326, "*Mech. Dict.*" Also *p*, Fig. 5621, p. 2327, *Ibid.*

Hang'ing-tube Boil'er. One having water-tubes depending in the flame space; closed at the lower ends and the upper ends secured in the crown-sheet of the fire-box. The flame circulates among these tubes, sometimes directed in its course by a baffle-plate, and passes to the chimney through a straight central flue.

See Figs. 5629, 5633, Plate LXI., opp. p. 2326, "*Mech. Dict.*" Also Figs. 2684, and *B*, Fig. 2685, *Ibid.*

Hang'ing Wall. (*Mining.*) The layer of a rock or wall over a lode.

Hank-dry'ing Ma-chine'. The hanks are placed on perforated rotating rollers or winches, and the lower ends hang in the dye of the beck. The yarn is thus alternately steeped and aired. — "*Textile Manufacturer.*"

See also Wincing Machine, "*Mech. Dict.,*" and * "*Scientific American Sup.,*" 1763.

Han'o-ve'ri-an Bit. (*Manége.*) A straight or curved cheek bit, with two or more loops for reins upon the lower or long arm; also a loop at the end of the short cheek, for receiving the leather cheek, and a rein-ring at the cheek-piece.

Han'o-ve'ri-an Chif'ney. (*Manége.*) This differs from the regular Hanoverian by having a short movable arm attached, in the same manner as the Chifney; the curb-chain is attached to the stationary cheek.

Har'bor Gas'ket. (*Nautical.*) A broad gasket, one on every other seam of the sail, to show a well-furled sail when in port.

Har'dened Glass. Glass treated by the process of M. Siemens, at Dresden.

It is formed under hydraulic or other pressure which gives the desired hardness independent of any tempering. By means of this process larger glass panes can be formed than was possible before. The glass is stronger than the tempered glass of De Bastie in the proportion of 5 to 3. The fracture is fibrous, not crystalline like the ordinary glass. At an examination instituted by the "Gewerbeverein," a leaden bullet, weighing 120 grains, was dropped upon plates of ordinary and pressed glass, supported at the four corners. The ordinary glass was fractured by a fall of the bullet from a height of 300 millimeters, while the pressed pane fractured at a height of 2,000 millimeters. A second specimen of the latter was subjected to a fall of 3,000 millimeters without breaking.

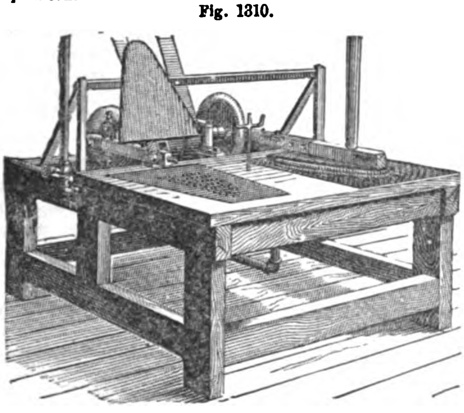
See Glass, Tempered, *supra*, for references.

Hard'en-ing Ma-chine'. A machine for rubbing and pressing hat bodies in order to felt the materials, increasing the density, diminishing the size, and making the material hard and compact.

The machine for hardening wool hat bodies operates by means of a reciprocating rubbing board. It is placed upon a strong wooden frame which serves as a table on which the hat-body rests. Into this table is fitted a steam box which is perforated on top to allow the steam, which is admitted by a pipe, to penetrate the hat bodies to be hardened.

Fig. 1308 shows a machine with two rubbing boards which receive a rapid reciprocating motion from two adjustable wrist-pins fitted to the fly-wheel disks on each end of the driving shaft. One of these rubbing boards, the nearer one, is shown thrown back and out of work. The other one is in operation.

Fig. 1310.



Hat-body Hardening Machine.

The hat bodies are built into a pile and laid upon the steam-box, coarse hardening cloths being sandwiched between each and pieces of cloth of suitable size and shape being laid inside each hat body. The object of these interposed cloths is to prevent the adherence of the hats, one to another. Two of them laid in immediate contact and rubbed while hot and wet would soon coalesce and be impossible to divide. The rubbing board, which is also covered with coarse cloth and is somewhat smaller than the hat-body, is then lowered upon the hat bodies and held down by a post which is hinged to a spring on the ceiling of the room and has a yielding pressure upon the rubbing board.

Three to five hat bodies are thus partially hardened at one operation; the projecting portions, however, not having been acted upon, the hat bodies are removed and so disposed as to bring under the rubbing board at the next operation the portions which were formerly the edges.

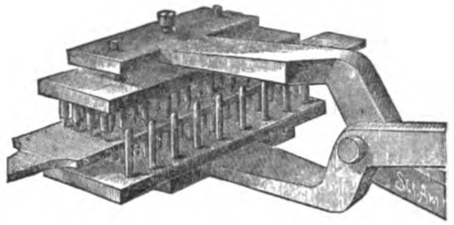
This operation completed, the hat bodies are ready for the *sizing kettle*, or battery, when to be made by hand, or to be fulled in a fulling mill if they are to be farther treated by machinery.

In some factories a separate machine is used to harden the tips of hat bodies. It consists simply of a rubbing board which acts upon a round steam chest of suitable size, upon which the hat body is placed after the sides have been hardened in the ordinary hardening machine.

Hard'en-ing Tongs. A tool to hold steel articles during the process of tempering.

A pair of tongs having T-shaped jaws is provided with pointed pins which bear upon opposite sides of the article, and prevent it from twisting out of shape when it is plunged into the water to cool, while it allows the water to com-

Fig. 1311.



Hardening Tongs.

pletely surround the article. One of the jaws is movable and is capable of adapting itself to tapering surfaces.

Hard Paste. (*Ceramics.*) A name applied to the material of real porcelain, which abounds in silex, and is so vitreous as to break with a fracture like glass. See Porcelain.

Hard'ware, House, Car'riage, Wag'on, etc. See under the following heads:—

Acorn-headed bolt.
Anchor shackle.
Ankle shackle.
Anti-rattler.
Anti-rattler fifth wheel.
Apron fastener.
Awning cleat.
Awning foot.
Awning hinge.
Awning slide.
Awning slide-rod.
Axle block.
Axle clip.
Axle lubricator.
Axle saddle.
Axle yoke.
Back spring.
Back stay end.
Ball-joint hinge.
Band.
Barn-door hanger.
Barn-door rail.
Barrel hook.
Bench sail-hook.
Beveled washer.
Bevel-head bolt.
Billet.
Bit.
Blind-fast.
Body loop.
Boiler-patch bolt.
Bolster plate.
Bolster spring.
Bolt (varieties, see list).
Bow iron.
Bow joint.
Bow spring.
Bracket.
Bridge bolt.
Bridle bit.
Buggy spring.
Bull's eye.
Butt.
Butt-hinge.
Button-head bolt.
Can hook.
Cap screw.
Car-door hanger.
Carriage bolt.
Carriage spring.
Carriage spring-lock.
Car seat spring.
Caster.
Cattle tie.
Chain stay.
Chain swivel.
Clip king-bolt.
Clip plate.
Clip yoke.
Coach clip.
Coach-door handle.
Coach hinge.
Coach lock.
Coach screw.
Collar holder.
Collar nail.
Combination lock.
Cone head bolt.
Corner iron.
Countersunk head screw.
Countersunk head square shank bolt.
Crate hinge and hasp.
C-spring
Cultivator point bolt.
Dash.
Dash foot.
Dash frame.
Dash lamp.
Dead lock.
Deck hook.
Door handle.
Door hanger.
Door spring.
Door stop.
Double washer.
Draft tug.
Drawer lock.
Drive knob.
Elevator bolt.
Elliptic-head bolt.
Elliptic spring.
Escutcheon.
Eye.
Eye bolt.
Eye ferrule.
Feed-box hasp.
Felloe holder.
Felloe joint bolt.
Felloe plate.

Fifth wheel.
Fifth wheel trueing-plate.
Flange bushing.
Flush bolt.
Foot rail.
Front stay end.
Full circle.
Gaff-topsail hook.
Gate latch.
Gridiron step.
Grommet.
Guard bolt.
Gut hook.
Half elliptic spring.
Half spring.
Hame stud.
Hammer strap.
Hand-rail bracket.
Hanger bolt.
Hanger screw.
Harness bracket.
Harness snap.
Hasp.
Head-block plate.
Hexagon head cap screw.
Hinge.
Hinge nail.
Hod.
Hook.
Hook and eye screw bolt.
Hook and eye turnbuckle.
Hound plate.
Hungarian nail.
India-rubber spring.
Jail lock.
Janus-faced lock.
Joint end.
Joint eye.
Joint holder.
Joint washer.
Key.
Key bolt.
Key fastener.
Key-head bolt.
Keyless lock.
Key ring.
King bolt.
King-bolt tie.
King-bolt yoke.
Knob screw.
Lacing hook.
Lag bolt.
Lag screw.
Lap ring.
Lariat swivel.
Letter lock.
Lining nail.
Lock (varieties, see list).
Locking baggage check.
Locking plate.
Lock nut.
Loop bolt.
Loop head.
Loop yoke.
Loose pin hinge.
Machine bolt.
Machine screw.
Maiden nut.
Match hook.
Metallic chain.
Mousing hook.
Nail.
Neck-yoke socket.
Needle.
Night latch.
Nut.
Nut lock.
Offset.
Oval point set screw.
Pad bracket.
Pad lock.
Perch loop.
Perch iron.
Perch plate.
Perch stay.
Picket pin.
Pin.
Pipe hook.
Plate hinge.
Plate washer.
Platform spring.
Platform spring shackle.
Plow bolt.
Pole coupling.
Pole crab.
Pole eye.
Pole socket.
Pole tip.
Pole yoke.
Port hinge.
Prop block.
Prop block washer.
Prop nut.
Railway track bolt.
Reach.
Reach plate.
Reach socket.
Ring.
Ring bolt.
Ring boot.
Ring handle
Rivet.
Riveting burr.
Riveting knob.
Rockaway band.
Rope clamp.
Round countersunk bolt.
Round countersunk square head bolt.
Round-head cap screw.
Rub iron.
Rudder brace.
Rudder gudgeon.
Saddle bracket.
Saddle clip.
Safety bolt.
Safety hook.
Safety loop.
Sash lock.
Sash spring-catch.
Scandinavian lock.
Screw eye.
Screw-head key.
Screw hook and eye hinge.
Screw hook and strap hinge.
Screw knob.
Scuttle.
Seat fastener.
Seat lock.
Seat spring.
Self-locking hook.
Self-mousing hook.
Set screw.
Sewer entrance.
Sewer trap.
Shackle.
Shackle bolt.
Shackle flap.
Shaft bolt.
Shaft coupling.
Shaft eye.
Shaft loop.
Shaft rubbers.
Shaft tip.
Shank spring.
Sheet slip.
Shifting carriage rail.
Shifting rail.
Ship ring bolt.
Ship spike.
Shoe bolt.
Side-bar.
Side-bar-spring shackle.
Side scuttle.
Single screw turnbuckle.
Sink bolt.
Skein screw.
Sky-light guard.
Sky-light lift.
Slat iron.
Sleeve nut.
Sleigh-shaft coupling.
Sleigh-shoe bolt.
Snap.
Socket washer.
Spider hoop.
Spike.
Spiral spring.
Sponge basket.
Spring band.
Spring-bar clip.
Spring block.
Spring buffer.
Spring cap.
Spring clip.
Spring coupling.
Spring hanger.
Spring hinge.
Spring seat.
Spring shackle.
Spring shelf.
Spring stud.
Spring washer.
Square countersunk bolt.
Square head bolt.
Square shank bolt.
Stall ring.
Stanchion.
Standard brace.
Stay chain hook.
Stay end.
Stay-end clip.
Stay-end tie.
Steeple-head bolt.
Step.
Step bolt.
Step pad.
Step shank.
Stool swivel.
Stove bolt.
Strap hinge.
Strike.
Stump joint.
Surface box.
Swivel
Swivel hook.
Tap.
Tap bolt.
T-brace.
Thimble skein.
T-hinge.
Thorough-brace brace.
Threshing machine tooth.
Tile
Time lock.
Tire bolt.
Top brace.
Top joint.
Top prop.
Top prop nut.
Track bolt.
Triangular washer.
Trip hook.
Triplet spring.
Tufting button.
Turnbuckle.
Vault light.
Vault ring.
V-bolt.
Vehicle spring.
Ventilating grate.
Wagon box.
Wagon-box-rod plate.
Wagon coupling.
Wagon lock.
Washer.
Wear iron.
Whiffletree bolt.
Whiffletree brace.
Whiffletree circle.
Whiffletree coupling.
Whiffletree hook.
Whiffletree plate.
Whiffletree tip.
Whiffletree tongue.
Whip-socket.
Window button.
Window latch.
Window quadrant.
Window sector.
Wire nail.
Wood screw.
Yale lock.
Yoke

Hare'lip In'stru-ments. (*Surgical.*) For trimming the edges, approaching the lips of the suture, securing the parts in position.

They consist of —

Scalpel.	Ligature instrument.
Scissors.	Plastic pin.
Clamp.	Pin conductor.

See pp. 59, 60, Part II., *Tiemann's* "*Armamentarium Chirurgicum.*"

Har-mon'ic An'a-ly'zer. An integrating machine, invented by Sir William Thomson, for producing mechanically the harmonic constituents of meteorological, tidal, and other curves, in order to obviate the large amount of work involved in their calculation by the ordinary methods.

"*Engineering*" . . . . * xxx. 561.

Har-mon'ic En'gine. A small electro-magnetic engine, by Edison. A diapason with weighted arms vibrates between electro-magnets, and works a small water or air-pump.

* "*Scientific American*" . . . . . . xxxix. 17.

Har-mon'i-con. A musical instrument with bars which are beaten with mallets.

The bars are made of wood, metal, stone, glass.

For *stone*, see LAPIDEON, p. 1258, "*Mech. Dict.*"
For *glass*, see HARMONICA, p. 1061, *Ibid.*
For *wood*, see WOOD HARMONICON, p. 2809, *Ibid* , and references *passim.*

Also "*Atlantic Monthly,*" vol. xxxix., pp. 523-525, where, in an article by the author on the "*Crude and Curious Inventions at the Centennial,*" 1876, are described and represented the

Marimba of Angola . . . . p. 523.
Marimba of Central Africa . . . . pp. 524, 525.
Gambangs of Siam and Malaysia . . pp. 526, 527.

See also references *passim.*

Har-mon'ic Tel'e-graph. A telephone which sends messages by audible musical tones. — *Gray.*

See Figs. 6266-6269, pp. 2516-2518, "*Mech. Dict.*"

Papers by *Pope* . .
"*Jour. Am. Electrical Society,*" i. 1.
"*Scientific American,*" lxiii. 368.
* "*Scientific Amer. Sup.,*" 2088, 2097.
* "*Jour. Soc. Teleg. Eng.,*" vii. 356.
"*Iron Age,*" xvii., April 18, p. 3.

Har-mo'ni-um. An English name for the parlor reed-organ. Distinguished from the *harmonicon*, which has bars.

Har-mon'o-graph. An instrument invented by Mr. Tisley, by which Lissajou's and Melde's figures may be drawn upon paper by a capillary glass pen containing a colored ink.

The ingenious instrument, which was originally employed merely to make curious curves, far exceeding in variety and eccentricity those of the rose-engine lathe, has now attain d great use and interest in producing graphic representations of sound vibrations from tuning forks or the voice. According to the circumstances, the curves are traced on a paper, smoked glass, or traveling ribbon, or are merely projected by mirrors upon a screen.

In a simple form the harmonograph consists of two pendulums vibrating in planes at right angles to one another, and having their rods continued above their centers of oscillation. One of these rods carries a small flat table upon which is fastened the paper upon which the figure is drawn, and the other actuates a rod which carries the pen. The center of gravity, and therefore the time of oscillation of the latter pendulums, can be altered to any required amount, so that the proportions between the periods of vibration of the two pendulums can be brought to any desired ratio to represent harmony, unison, discord, or indeed to illustrate all the harmonic combinations of waves of sound and music. The curves and figures traced out by this instrument are of great beauty, and by a recent addition to it, whereby the paper may be slowly rotated by a clock-work movement, while the vibrations are going on, very extraordinary figures are produced, some of which illustrate in a remarkable degree the laws of interference and of the polarization of light.

"*Scientific American Supplement* . . . . . 1188.

See also references under CURVE INSTRUMENT, p. 236; and ELECTRICAL DIAPASON, p. 293, *supra;* and LISSAJOU'S CURVES, PENDULUM INSTRUMENT, *infra.*

Har'ness. Diagrams, showing the principles of the disposition of heddles and harness for various kinds of weaving, may be found in *Laboulaye's "Dictionnaire des Arts et Manufactures,"* article "*Tissage,*" vol. iii., edition 1877.

Har'ness Grease.

Whale or neat's-foot oil	8 quarts.
Castor oil	1 pint.
Ivory black	¼ pound.
Rosin	¼ pound.
Beeswax	¼ pound.
Burgundy pitch	¼ oz.
Prussian blue	¼ oz.

Mix. Boil for half an hour.

Harness blacking . . "*Scientific American,*" xxxvi. 81.

Har'ness Hitch. (*Nautical.*) A kind of hitch for securing harness casks. See *h*, Fig. 2513, p. 1105, "*Mech. Dict.*" See also LIFTING TACKLE, *infra.*

Har'ness Snap. See SNAP HOOK, 23 illustrations, Fig. 5246, p. 2229, "*Mech. Dict.*"

Harp. (*Music.*) A stringed instrument played by the hand and having a compass, formerly, of 5½ octaves, but increased by Erard to 6½. It is written on two lines for the two hands. The lower line usually has the F clef, the upper the G. Erard's *double-action harp* is tuned in C♭; it has 7 pedals by which the strings may be raised a semi-tone or a whole tone. See Berlioz's "*Treatise on Modern Instrumentation and Orchestration,*" p. 62, *et seq.*

Har-poon'. A barbed javelin.

The harpoon employed in the capture of the sword-fish off the New England coast consists of a barb with jointed ears, and fastened to one end of a rope of several hundred feet in length, to the other end of which is attached an empty, well-bunged barrel, to serve as a buoy. The end of a long handle carries a pointed iron stem, over which the socket of the harpoon head referred to, usually called the *lily-iron*, is slipped. The fisherman stationed at the end of the bowsprit of a sloop drives the harpoon into the back of the neck of the fish; and if the lily-iron is fastened in the flesh, it slips off from the stem of the handle, which is pulled out as the fish darts away, and the rope and buoy are thrown overboard. The fish swims off, but becoming fatigued by the drag of the buoy, comes again to the surface, when it is drawn up by the rope and killed by a lance.

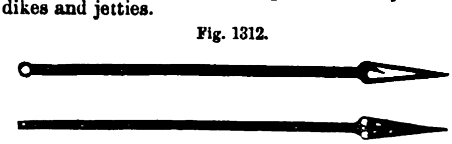
List of patents on harpoons, projectiles, rockets, bomb lances, etc., used in fishing and whaling: —

2,195	*Carsley*, Twisted flukes.
3,490	*Moore*, Vial of explosive mixture in the harpoon.
4,764	*Allen*, Bomb lance.
4,865	*Holmes et al.*, Harpoon with movable flukes.
4,872	*Randall*, Pivoted expanding flukes.
5,949	*Allen*, Gun harpoon.
7,410	*Brown*, Gun harpoon; mode of attaching line.
7,572	*Brown*, Gun lance; mode of attaching line.
7,610	*Brown*, Harpoon; mode of attaching line.
7,777	*Albertson*, Harpoon with hinged shank.
8,703	*Burt*, Exploding harpoon.
8,843	*Sonnenberg et al*, Electric whaling apparatus.
8,862	*Stillman*, A lance in a harpoon. Movable flukes.
9,047	*Brand*, Gun harpoon or bomb lance Wings on shank.
15,577	*Schofield*, Gun lance, spiral wings.
16,819	*Scholfield et al.*, Bomb lance, spiral wings.
17,178	*Sibley*, Gun lance with wings taken from the gun.
17,312	*Brand*, Bomb lance with folding spiral wings
17,370	*Grudchor et al.*, Bomb lance with percussion arrangement.
17,407	*Sibley*, Gun lance with wings.
18,848	*Kelly*, Harpoon with movable flukes.
18,568	*Bates*, Bomb lance with spiral tail.
18,824	*Scholfield*, Gun lance with wings.
19,363	*Harkness*, Harpoon with lance.
21,219	*Sibley*, Bomb lance with wings.
21,278	*Scholfield*, Gun lance with barbs.
21,949	*Doyle*, Harpoon with pivoted head.
22,064	*Andrews*, Bomb lance with interior fuse tube.
23,827	*Comins*, Bomb lance with folded wings.
24,371	*Brown*, Bomb harpoon, expanding flukes.
25,020	*Goodspeed*, Bomb lance with wings.
30,869	*Briggs*, Bomb harpoon with expanding flukes.
31,190	*Roys*, Shoulder gun for harpoons and lances.
32,830	*Goodspeed et al.*, Guide for bomb lance.
35,474	*Roys*, Rocket harpoon and bomb.
35,476	*Roys*, A whale raiser. A barbed instrument led down the harpoon line to a sunken whale.
38,207	*Adams*, Harpoon, with semi-revolving head.
40,387	*Allen*, Bomb-lance, with perforated fire-proof diaphragm.
46,437	*Barker*, Exploding harpoon.
49,548	*Pierce*, Harpoon and bomb lance.
54,211	*Roys et al.*, Rocket harpoon.
64,045	*Smith*, Gun harpoon, grooved head, to receive the pivoted barb.
71,763	*Kelley*, Gun harpoon with pivoted head.
78,675	*Kelley*, Bomb harpoon, pivoted flukes.
90,868	*Pierce*, Bomb lance.
97,693	*Rechtens*, Harpoon with bombs.
126,388	*Freeman*, Bomb harpoon.
171,553	*Cunningham*, Bomb lance.
201,793	*Kelleher*, Gun and bomb lance.
201,794	*Kelleher*, Bomb lance.
206,694	*Taylor*, Harpoon with expanding flukes.
211,777	*Pierce*, Harpoon gun.
211,778	*Pierce*, Bomb lance.
214,707	*Roys*, Bomb lance.
222,003	*Brand*, Bomb lance.

Har-poon' Gun. A small cannon, or a shoulder gun, for hurling harpoons or lances. See list, *supra.*

Har-poon' Shut'tle. (*Hydraulic Engineering.*) The standard tool for sewing mats for hydraulic dikes and jetties.

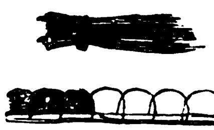
Fig. 1312.



Harpoon Shuttle.

Its weight is about 10 pounds. It is wound with 200 feet of No. 14 wire, and in operation is used by three men, two above and one below the mat. Two men pass the shuttle back and forth and around the pole in stitches 12″ to 18″ long, while a third tramps down the brush and holds the wire while the next stitch is being made. The shuttle may also be used in making an overhand or back stitch, the pole being omitted.

Fig. 1313.



Shuttle Fastening.

It was also the method employed in sewing to a wire; 2 shuttles were used in the harness-stitch, and a short shuttle in the chain stitch, and in combination with a hook needle it is used as a bobbin in making the lock-stitch. Of these methods the sewing to a wire and the lock-stitch turn the wire too short; the chain-stitch is of difficult manipulation, and the harness-stitch is expensive to make, and has great backslip when broken.

Har'ris-Cor'liss Engine. A form of Corliss engine. See Fig. 5666, p. 2341, "*Mech. Dict.*"

Engine works . . . . . * "*Sc. American*," xli. 175.

Har'row. (*Agric.*) An implement with teeth, lying flatly upon the ground, over which it is drawn to level the soil or cover seed.

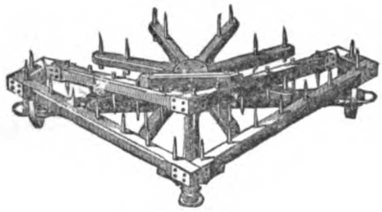
The following are shown on pp. 1067, 1068, "*Mech. Dict.*":

Brush harrow.	V-harrow.
Jointed harrow.	Double harrow.
Folding harrow.	Share harrow.
Rotary harrow.	Spiked-cylinder harrow.

See also *Chain* harrow, Fig. 589, p. 188, *supra*.
Disk harrow, Fig. 831, p. 261, *supra*.
Disking machine, Fig. 832, p. 261, *supra*.
Geddes harrow, Fig. 1194, p. 396, *supra*.

The "Penn" harrow is a Protean instrument consisting of a rotary portion revolving in a V-shaped section, and adapted to be used either single or double, and in various forms: (*a*) the rotary portion with one V, or (*b*) with two V's, forming a square; (*c*) upset and resting on its sled during removal from place to place (Fig. 1314); (*d*) the single V, or (*e*) the

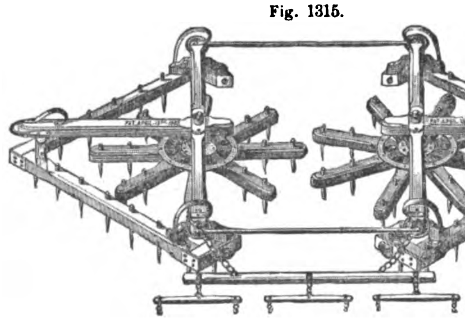
Fig. 1314.



"*Penn*" *Harrow*. (*In position to move on its sled.*)

double V, without the rotary; (*f*) the single V upset, the

Fig. 1315.

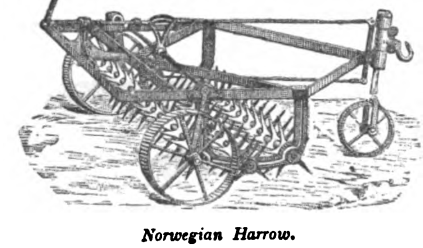


"*Penn*" *Harrow*. (*As a Gang.*)

three sled-bows acting as a corn-marker; (*g*) the complete tool (Fig. 1315) with the two V's and two rotary portions.

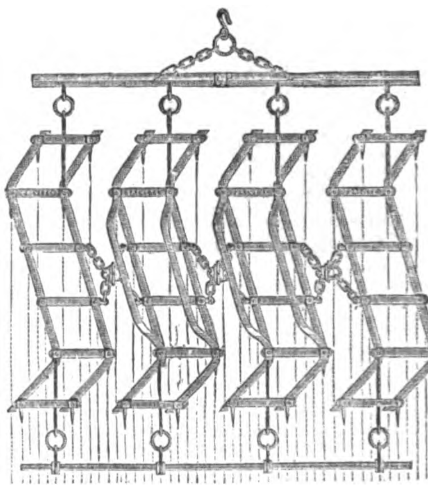
Fig. 1316 shows the Norwegian harrow. It is carried on

Fig. 1316.



Norwegian Harrow.

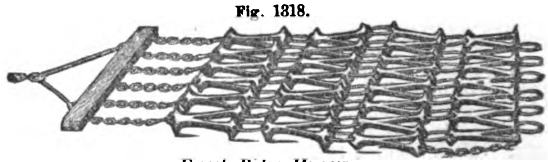
Fig. 1317.



French Articulated Harrow.

three wheels, by the forward one of which it is guided. It carries two spiked rollers, the depth of penetration of which is adjusted by means of a screw, operated by a crank from

Fig. 1318.



French Ridge Harrow.

the rear, the effect being to raise or lower the sleeve at the apex of the frame upon the pillar of the caster-wheel. The spikes are in fact star-disks, slipped upon an axial rod, and free to move thereon independently

The French articulated harrow (Puzenat, Bourbon-Lancy) has an equilibrium bar, and is made in jointed sections, from 3 to 6 in number, according to the breadth required. The arrangement of the teeth is such that with a given line of draft the surface of the ground is marked by equidistant lines. Fig. 1317.

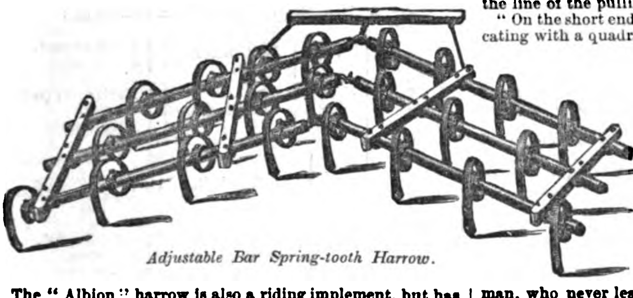
Fig. 1318 is the French *herse à billons* (*Souchou-Pinet à Langeais*), or ridge harrow; so called from its flexibility enabling it to lap over a ridge or upon the sides of a cleaning-out furrow; serving to break clods and level minor inequalities upon undulating ground. The *chain harrow*, Fig. 589, p. 188, *supra*, has the same adaptation.

Fig. 1319 shows the adjustable bar spring-tooth harrow, in which the teeth are permanently seated upon and coiled around the round bars of the frame; the bars being held in position by friction clamps, but adjustable therein so as to give the required presentation of the tooth to the soil, to regulate the depth of tilth. This without changing the position of the tooth on the bar. By rolling the bars to which the teeth are attached, forward or backward, the faces of the teeth are placed on an angle with the line of draft, by which they more readily scour, and also produce when at work a vibratory motion in addition to the coil motion, by which they more perfectly pulverize the soil, and free themselves from rubbish.

The two frames of the harrow are connected by a swivel coupling, so that the bars can be changed in either direction without affecting the working of the coupling.

Nishwitz, "Acme" pulverizing harrow is intended to combine the action of a clod-crusher, leveler, and harrow in one implement. A diagonal leveling bar runs upon the ground and carries at its rear edge a series of sword-shaped projecting colters. To the rear of the leveling bar is hinged another bar, from the rear of which projects another row of spring-steel colters, curved in form, beveled to an edge, and set at an angle with the line of draft and also at an angle with the horizon. A lever within reach of the driver (who rides) is held in position by a ratchet, and enables the operator to control the angular position of the crusher and at the same time raise or depress the colters on the hinged bar at the rear.

Fig. 1319.

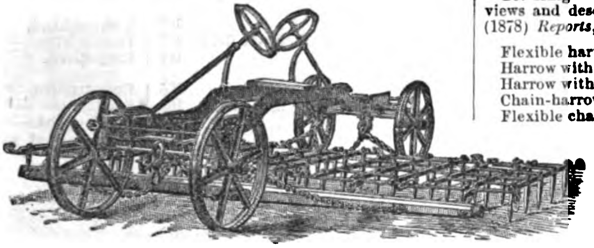


Adjustable Bar Spring-tooth Harrow.

The "Albion" harrow is also a riding implement, but has wheels and shafts. It has spring teeth depending from a bar jointed to the axle. These are curved like those of a horse-rake, but are flat, and their angle of presentation is adjustable to regulate the depth of penetration. This comes very closely to the class of cultivators.

In Europe, Britain and France especially, there is quite a variety of implements embraced in the general class of harrows, and used for cultivating or renewing the surface of ground. They may fairly be called harrows with handles, and are especially used for dragging out the twitch-grass which is such a nuisance in wheat-fields. See Fig. 1822.

Fig. 1320.



Steam Harrow.

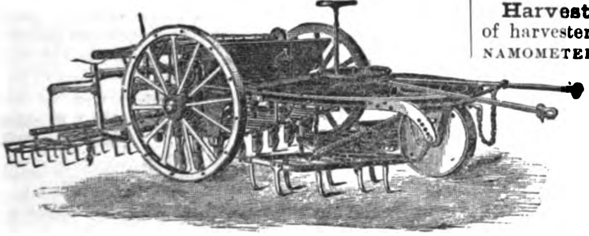
Figs. 1320 and 1321 show the adaptations of the harrow to steam cultivation.

The ordinary steam-harrow (Fig. 1320) covers a breadth of from 12′ to 18′, so that from 40 to 60 acres may be gone over in a day.

The harrow moves in either direction, and can be driven at high speed. The under frames can be removed and rollers or clod-crushers substituted for them.

The machine, Fig. 1321, has a light cultivator or heavy harrow in front of the seeding-colters and a light covering harrow following the same. The seed-drill itself, even of the largest width, requires but so small a fraction of the power of the engines, that it has been combined with the harrows. The drill has a width of 9′. In turning around, the heavy harrows are lifted by the power of the engine, and the whole implement moves at once on to new ground. The lifting and turning action is automatic.

Fig. 1321.



Steam Grain Drill and Harrow.

"The long end of a draft-bar or turning-lever is provided with two arms to which the two ends of the rope are attached. The arms are set at an angle for keeping the tail-rope clear of the implement. The lever itself is held by a vertical stud fixed to the frame considerably behind the steering-wheel. This position of the draft-stud gives the necessary liberty and power to the steering-wheel and enables it to lead the implement at almost any angle out of the line of the pulling-rope.

"On the short end of the turning-lever is a chain communicating with a quadrant on the crank-axle, and as the lever is pulled round, the chain, acting on the quadrant, turns the axle, lifts the frame, and raises the tines out of the ground.

"The plan of operation is as follows: As soon as the cultivator is brought up to the headland, the reverse pull brings the lever around, turns the quadrant, rotates the bent axle, and lifts the tines out of the ground, in which position the implement is held up by a catch; when lifted the required height, the lever strikes against a stop, and the implement turns into new ground. The man, who never leaves his seat, releases the catch, the tines drop into the ground, and the implement is re-drawn across the field." —*Knight's* "*Paris Exposition* (1878) *Reports*," * v., 85, 87.

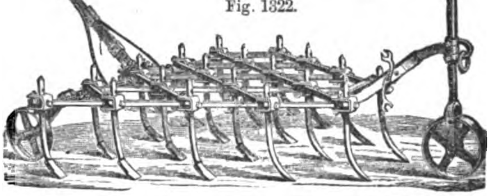
Old English harrow . .	* "*Engineering*," xxvii. 533.
Norwegian, spiked . .	* "*Engineering*," xxvii. 533.
Combined with roller.	
Campbell	* "*Min. & Sc. Press*," xxxviii. 169.
Dobbin	* "*Sc. American*," xxxviii. 199.
Green	* "*Min. & Sc. Press*," xxxv. 249
Flexible, *Howard*, Eng.	* "*Scientific American Sup.*," 939.
Nicholson, Br.	* "*Engineering*," xxviii. 86.
Duplex, *Rogers* . . .	* "*Iron Age*," xxv., April 8, p 11.

Dr. Knight's report on Class 76, at Paris, 1878, contains views and descriptions of the following, "*Paris Exposition* (1878) *Reports*," vol. v., pp. 95-98: —

Flexible harrow . . .	*Puzenat*. France.
Harrow with handles . .	*Pickslev, Sims, & Co.* England.
Harrow with handles, tine, and frame.	England.
Chain-harrow	England.
Flexible chain-harrow .	*Howard*. England.

Har′row Cul′ti-va′tor. An implement like a harrow, but supported on wheels which limit the penetration of the tines. The distance apart of the tines suits the width of rows of the drilled crop. It is used in Europe in cultivating the intervals of drilled wheat, and in killing the weeds in summer fallows. The frame is vertically adjustable by means of the lever at the rear. (Fig. 1322.)

Fig. 1322.



French Harrow Cultivator.

Harvester. For results of dynamometric trials of harvesters at Paris Exposition, 1878, see DYNAMOMETER, p. 288, *supra*. Also "*Paris Exposition Reports*," 1878, v., pp. 134, 135.

The table on p. 442 gives a functional classification of harvesters.

Har′vest-er Cut′ter. The sickle of a grain or grass cutting machine. See digest of principles, Plate XXX., p. 1489, "*Mech. Dict.*"

Hat Block′ing Ma-chine. See BLOCKING MACHINE, * p. 109, *supra*.

Hat Brim Stretch′ing Ma-chine.′ See BRIM STRETCHER, p. 135, *supra*.

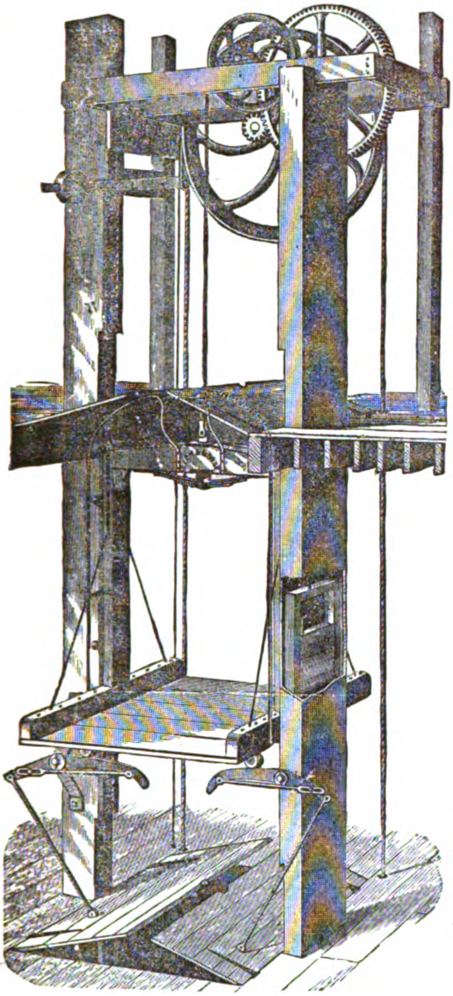
Hatch′ing Box. For hatching fish ova. See FISH CULTURE, p. 339, *supra*.

CLASSIFICATION OF HARVESTERS: BY STRUCTURE.

- **Connection of Cutting Apparatus with Frame.**
  - **Finger-bar rigidly connected.**
    - 1 To main frame.
    - 2 To hinged coupling frame.
    - 3 To vertically sliding frame.
    - 4 To flexible coupling arms.
  - **Finger bar hinged.**
    - 5 To arms rigid with main frame.
    - 6 To two arms; one rigid, the other jointed.
    - 7 To two arms, both jointed.
    - 8 To a single swiveled bar.
    - 9 To coupling frame jointed to main frame.
    - 10 To coupling frame jointed to secondary hinged frame.
    - 11 To coupling frame vibrating on main axle.
    - 12 To sliding arms.
    - 13 To pinioned shaft moving in vertical rack-ways.
  - **F.-bar reversible.**
    - 14 Endwise.
    - 15 Axially.
- **Model of Driving Cutter.**
  - 16 By simple gearing.
  - 17 By friction gearing.
  - 18 By planetary gearing.
  - 19 By gyrating gearing.
  - 20 By screw gearing.
  - 21 By changeable-speed gearing.
  - 22 By cams.
  - 23 By belts.
  - 24 By piston moved by compressed air.
- **Style of Cutters.**
  - **Reciprocating.**
    - **Rectilinear.**
      - Longitudinal.
        - 25 Single blade.
        - 26 Transversely divided blade.
        - 27 Double blades.
      - 28 Inclined.
      - 29 Transverse.
    - **Curvilinear.**
      - Longitudinal.
        - 30 Curved blade.
        - 31 Blade hung upon hinged arms.
        - 32 Series of pivoted knives.
      - 33 Inclined.
      - 34 Transverse.
  - **Rotary.**
    - 35 Cutters upon single vertical shaft.
    - 36 Cutters upon single horizontal shaft.
    - 37 Cutters upon series of vertical shafts.
    - 38 Cutters upon endless chain or belt.
    - 39 Cutters upon horizontal worm.
- **Style of finger-bar.**
  - 40 Stiff.
  - 41 Flexible.
- **Track Clearers.**
  - 42 Rigid.
  - Adjustable.
    - 43 Vertically.
    - 44 Horizontally.
  - 45 Vibrating.
  - Yielding.
    - 46 Vertically.
    - 47 Horizontally.
    - 48 Axially.
- **Dividers.**
  - 49 Rigid.
  - Yielding.
    - 50 Front to rear.
    - 51 Side to side.
    - 52 Up and down.
  - Adjustable.
    - 53 Vertically.
    - 54 Horizontally.
  - 55 Vibrating.
- **Draft.**
  - 56 Rigid with cutter frame.
  - **Jointed.**
    - 57 Upon main axle.
    - Upon cutter frame in rear of axle.
      - 58 Above.
      - 59 Below.
    - 60 Upon cutter frame in front of axle.
  - 61 Independent of tongue.
- **Discharge of grain.**
  - **Endless Apron.**
    - 62 Rear delivery.
    - Side delivery.
      - 63 On a level.
      - 64 Elevated.
  - Surface movement of platform.
    - 65 Rollers.
    - 66 Screw conveyors.
  - **Droppers.**
    - **Positive movement of platform.**
      - Tilting.
        - 67 To one side.
        - 68 To the rear.
      - 69 Swinging and tilting.
      - 70 Swinging.
      - 71 Revolving.
    - Receivers.
      - 72 Vibrating.
      - 73 Rotating.
      - 74 Dumping.
- **Automatic Rakers. — Stationary platform.**
  - **Operated from below platform.**
    - 75 Teeth upon endless belts or aprons.
    - 76 Teeth upon heads hung on belts.
    - Teeth upon reciprocating heads.
      - 77 Straight path.
      - 78 Curved path.
    - 79 Superposed heads on endless belt.
  - **Operated from above platform.**
    - **Reciprocating.**
      - Rectilinear.
        - 80 Front to rear.
        - 81 Side to side.
      - Curvilinear.
        - 82 Horizontal path.
        - 83 Vertical.
        - 84 Irregular.
    - **Rotary.**
      - Endless belt.
        - 85 Upon horizontal pulleys.
        - 86 Upon vertical pulleys.
      - About an axis.
        - 87 Horizontal.
        - 88 Vertical.
        - 89 Inclined.
  - 90 Reciprocating and rotary combined.
  - 91 Hand rakers.
- **Reels.**
  - 92 Revolving beaters on horizontal axis.
  - 93 Revolving beaters on vertical or inclined axis.
  - 94 Revolving beaters carried on endless belts.
  - 95 Reciprocating rising and falling beaters.
- **Automatic Binders.**
  - **By Fastenings.**
    - **Material.**
      - 96 Cord.
      - 97 Wire.
      - 98 Wooden withes.
      - 99 Paper band.
      - 100 Straw rope.
      - 101 Gavel.
    - **Derivation.**
      - From the fields.
        - 102 Twisted band.
        - 103 Simple wisp.
        - 104 Loop stitch.
      - From prepared material (cord, wire, etc.)
        - 105 Ends twisted.
        - 106 Ends tied.
        - 107 Ends tucked.
        - 108 Ends twisted and tucked.
        - 109 Ends clasped.
  - By manner.
    - 110 In sheaves.
    - 111 In connected bundles.
    - 112 In perpetual twist.
  - **By reception of gavel.**
    - Endwise.
      - 113 Through a funnel.
      - 114 Between jaws.
    - Transversely.
      - 115 On endless compressor belt.
      - 116 On jaws.
  - **By relation of gavel and tying mechanism.**
    - Gavel revolved beneath tying mechanism.
      - 117 Endwise.
      - 118 Axially.
    - 119 Tying mechanism rotated around gavel.
    - 120 Both stationary.
    - 121 Both moving.
    - 122 Gavel swung in semicircle.
- **Hand.**
  - 123 Tables rigid.
  - 124 Tables hinged.
  - 125 Tables swinging.
  - 126 Tables revolving.
- Reapers and Threshers. 127.
- Tedders.
  - 128 Reels.
  - 129 Kickers.
  - 130 Endless belts.
- **Rakes.**
  - **Horse Rakes.**
    - Wheeled.
      - 131 Revolving.
      - Lifting.
        - 132 By rider.
        - 133 By draft.
    - Drag.
      - 134 Revolving.
      - 135 Lifting.
- 136 Hay Cockers.
- **Loaders.**
  - Horse Hay Forks.
    - 137 Harpoon.
    - 138 Grapple.
    - 139 Corkscrew.
    - 140 Tilting.
  - 141 Hay loading rakes.

Hatch'way. The opening in a floor through which goods are lifted or lowered. Fig. 1323 shows automatic hatch doors in connection with a hand-

Fig. 1323.



Automatic Hatchway.

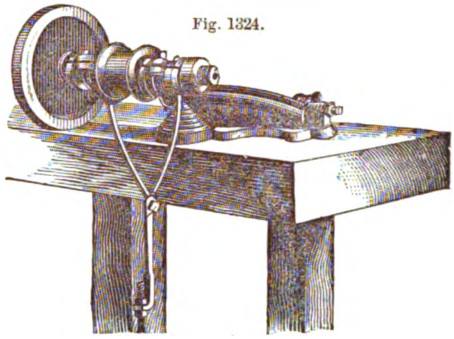
power elevator. The doors are always closed except while the platform is passing through, the platform in its ascent or descent opening the doors which close of themselves when the platform has passed. This is a guard against accidental falling down the hatchway, and also against the spread of fire by the elevator shaft. The rising rods lift the doors in ascending, and the platform actuates levers to lift the doors in descending.

Automatic cone . . . * "*Manufacturer & Builder*," viii. 53.
* "*Scientific American*," xlii. 358.

Hat-fin'ish-ing Lathe. A machine introduced by John T. Waring. It has a chuck fitted to a lathe spindle and carrying the hat, which, while rapidly revolving, is rubbed with sand or emery paper held against it. This is regarded as a very great advance in the art of hat-making machinery. Previous to this time the wool hat-body, after being sized, was rubbed with pumice-stone and then put on a block to be ironed off and touched up with sand-paper.

The finishing-lathe illustrated in Fig. 1324 is one of the forms yet in use, although in its first purpose, that of sand-papering hats, it has been superseded by later inventions. It

Fig. 1324.



Hat-finishing Lathe.

is now used to retouch the hat after it has been put on the finishing-block, and also to lay the nap with a piece of felt pressed by hand upon the surface while the hat upon the chucked block is revolving.

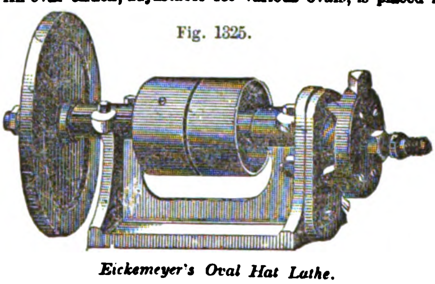
The spindle has its bearings in an adjustable frame which is held up by a helical spring. The lathe spindle is driven by a belt from a pulley above, and when the spindle is elevated by the spring, the loose belt slips on the spindle pulley. When the spindle is depressed by the foot of the operator on the treadle, the pulley is tightened against the belt, and the spindle receives rotation.

When wool hats came into more general use, oval blocks conforming more closely to the shape of the head took the place of the round blocks before in use, and this change made it necessary to use a lathe which turned in an oval path, to be able to finish the oval part of the side crown.

Fig 1325 shows the Eickemeyer oval hat lathe, the machine in most general use

An oval chuck, adjustable for various ovals, is placed in

Fig. 1325.



Eickemeyer's Oval Hat Lathe.

front of a lathe spindle, and is provided with a screw to receive the chuck in the hat-block, while an adjustable nut on the chucking screw is used to bring the hat-block into proper position to the oval.

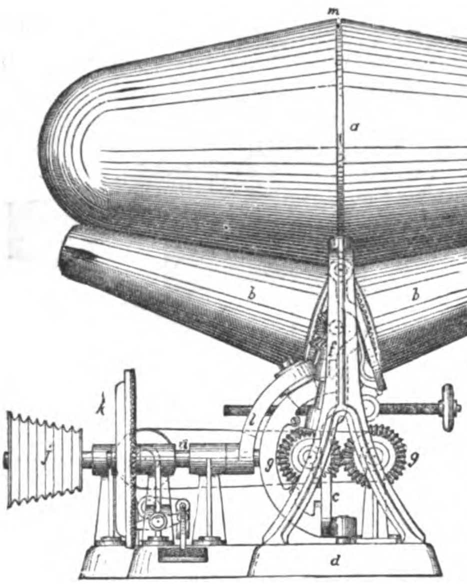
This lathe is used to finish the side crown and brim while the tip is still finished on a round lathe.

Hat-form'ing Ma-chine'. A machine for setting up hat-bodies. The wool and fur body machines are essentially different.

The first improvement in hat-making over the ancient hand processes was the hat-forming machine of Mason, followed by the patents of Grant. These machines consisted of a conical block upon which a web of wool was wound as fast as it was delivered from the carding machine.

Fig. 1326 is a front view of a wool hat former with a double cone upon which the web is wound. This double cone *a* is supported upon four conical rollers, *b*, two of which only are seen in the view. The rollers are pivoted upon a frame *c*, which is supported on a step in the bed-plate *d*, and is also pivoted on the upper end of the standard *f*. The pivot line of the frame *c* is coincident with the pitch line of the two bevel wheels *g g'*; it is at right angles with the crank-shaft *i*, and in a position close to the front of the double cone *a*.

Fig. 1326.



Wool Hat Forming Machine.

The cone pulley *j* is driven from the carding machine, and gives rotation through the gears *g g'* to the rollers *b b*, and thus to the double cone *a*. By means of a cone and pinion on a suitable countershaft, motion is given to the bevel-wheel *k*, shaft *i*, and crank *l*, which give to the supporting frame and forming cone a vibratory motion in a horizontal plane while the cone is revolving slowly on the rollers, the web from the carding machine winding on to the cone.

When a sufficient quantity of wool has been wound upon the double cone to make two hats, the *bat* is cut in two by the operator, who sets one blade of his shears into the equatorial groove which serves as a guide, and separates the two bodies while the cone is revolving.

It is of the utmost importance to lay the woolen web evenly upon the cone, and also to cross the wool fibers so as to make the hat body of equal strength in every direction; and it is also necessary to be able to adjust the supporting rollers to form cones of various shapes, and to adjust the speed to the different sizes of hats to be formed. All the woolen hat formers are therefore made adjustable in these various ways, and answer the requirements in greater or less degree, as the mechanism is more or less perfect.

The hat-forming machine for fur bodies is very different from that used for woolen bodies. Instead of a fine fleece from the carding machine wrapped upon a revolving former, the fur body former is a perforated cone with an interior exhaust blast and a fur picker which sends a fine cloud of hairs toward the cone on which they collect in a bat.

The machine is the invention of Henry A. Wells, who accomplished for the fur hat-body trade what Grant had previously done for the woolen hat-body. Wells's machine, improved by Taylor, Burr, St. John, and others, has disposed of the hatter's bow for ever. With an improved Wells machine 400 hat-bodies of superior quality can be made per day, and these, by dipping in a suitable bath, are made sufficiently firm to be sized into proper shape.

The machine is shown at Fig. 2431, p. 1075, "*Mech. Dict.*" As now used it consists of a feeding apron and a suitable picker which throws the fur upon a perforated cone.

The feeding apron and feeding rollers are upon a frame which furnishes also support for the bearings of the picker cylinder and the main driving shaft. A trunk or covered way is closely fitted to the frame and the cover which encloses the upper part of the picker cylinder. The trunk or conductor has a sectional shape corresponding somewhat with the shape of the former cone, and is adjustable in height by a supporting screw. The former cone is placed centrally upon a revolving table which has an opening in its center communicating with the inlet of the suction blower. The operator who weighs out the quantity of fur required for each hat-body places it evenly upon the feed apron, which is then started; the fur is delivered to the picker and guided by the conductor to the cone, where the fur is held by the pressure of air created by the fan which exhausts the air from the inside of the perforated cone.

When the fur for a hat has all been deposited upon the cone, a wet cloth is thrown over the tip, another cloth wrapped around the sides, and a hollow cap corresponding with the former cone is placed over the whole. The cone, with the hat-body thus held between it and the cap, is removed, another cone placed on the turning-table, and another hat-body formed as before.

To make the fibers adhere to each other the cone with its cover is then put upon a platform which is suspended by balancing weights over the dipping-tub, and is gradually submerged in hot water. The outer cone is now removed, the cloths taken off, and the hat-body slipped from the cone ready to be sized. To avoid the dipping of the hat-bodies, a sprinkling-pipe which blows hot water upon the revolving hat-body has been to some extent used, but with indifferent success, as more time is required to accomplish the object by the last-mentioned method, and the work of the machine is to this extent diminished.

Hat-li'ning Sew'ing-ma-chine'. A machine for sewing the sweat-leathers into hats; invented by Eickemeyer.

It differs from the ordinary sewing-machine in the arrangement of the work-plate, which is curved to receive and support the side crown on one of its faces while the brim is supported upon a narrow strip. In the presser-foot is a gage which guides the edge of the sweat-leather to the needle. The machine itself is pivoted to the table and can be turned around its driving shaft to enable it to be adjusted at the will of the operator in such a manner that the hat is held up without any further assistance after it has been put under the presser-foot.

The feed is an ordinary four motion which acts in the corner formed by the junction of the brim and side crown, while the presser-foot is of a right angular shape and presses upon the exterior of this angle. The hat is thus carried around, guided by the angle, which insures a perfectly even stitching of the sweat near the edge. In most cases the leather is stitched fast to the hat, leaving the stitches visible, while in other cases the edge is stitched fast and the sweat turned over to hide the stitches. By a change of the presser-foot either style can be sewed on the machine.

Fig. 1327.

Hat-sweat Sewing-machine.

To make a perfectly smooth edge on the sweat-leather where it touches the forehead, it is desirable to turn the edge of the sweat in a sweat-rolling machine, which is composed of two rollers geared together and supported in a frame, the upper one held down by a rubber spring to allow it to yield to the varying thicknesses of the leather. After the introduction of the hat-sweat sewing-machine, another improvement in the same direction, namely, a machine to make the hat linings, was invented by Eickemeyer, and improved by Judson. It consists of a table having a round or oval motion, upon which a piece of silk or other material to make the tip is secured, while another piece is put in a folding gage in such a way that the stitching will fasten the edge of the piece that forms the side crown in a circular or oval line to the flat tip.

Judson added to this attachment a pair of rotary shears, and arranged the turn table upon a swinging lever, which enabled him to trim the tips before the side crown was sewed fast.

The use of the pouncing machine has, however, done away with the necessity of lining the hat crown inside, both the outside and the inside being now pounced and presenting a smooth, finished surface.

Hat Ma'king. The manufacture of felt hats in the United States has, by the introduction of improved machinery and methods, reached a high degree of perfection and importance.

Fifty years ago the business was carried on in small establishments in towns and cities and in very small shops, even in villages. In the latter case the implements were almost as simple as those of the shoemaker, and a boss hatter, with one or two apprentices, made the hats for the surrounding district.

Wool and fur, with other hatters' supplies, were furnished by city merchants. The wool was simply carded, and the hatter, with his bow, shaped it into a hat body and then finished it.

The best machinery for making felt hats is of American origin and much of it has found its way into Europe, superintendents and workmen having come to this country to study the American method and become acquainted with the uses of the machines which have been exported to Europe.

This invasion of American machines reminds one of the complaints of the hatters of London, nearly 150 years since, in a memorial to the British Board of Trade, at the extent to which the manufacture of hats was carried on in New England and New York.

Beaver fur hats were formerly considered the best, but as that animal became scarce other furs were substituted for the body, which was covered with beaver fur on the outside. This mode of manufacture has now disappeared, and both soft and stiff felt hats are made of wool or of fur as two distinct branches of manufacture, which are carried on in different establishments and use almost entirely different machinery.

In the wool-hat factories are used all those machines which are ordinarily employed in cloth manufactories to prepare the wool for spinning; while the fur-hat factories have a set of special machines.

The hatter of 50 years ago laid the fur or wool, which had been previously prepared, on a hurdle made of wood or wire, with openings to let the dirt fall through. He then, by means of his bow, scattered the fur in all directions. The bow was usually made of ash, 6′ or 7′ long, with a catgut string stretched between the two ends. With a stick this string was caused to vibrate, and the fur driven from one end of the hurdle to the other. The layer of fur was called a *bat*, was made in a triangular shape, and formed one half of a hat body. It had to be carefully joined to another piece of the same shape, the edges overlapping each other, and the two portions, so united, with a cloth of the right shape between them, were patted on a hot-plate, while water was sprinkled upon them until the fur became partially felted and the cone-shaped hat-body had become tolerably firm.

The hat-body was now taken to the *battery* to be felted. This process consisted of rolling the body between cloths, continually changing its position in the cloth, while it was kept as hot as possible by dipping it into acidulated water kept boiling in the *sizing-kettle* by a small fire underneath. Special care was taken to shrink the hat body alike all over, and to reduce it from the size of a conical bag almost three times the dimensions of the finished hat-body. When the body was made of wool, and was to be *napped*, a cone of fur, bowed as described, was laid over it and wetted down with a brush until the fur adhered to the body firmly enough to continue the rolling between the sizing cloths, the body being kept hot by dipping it into the sizing liquor, as before, and this was continued until the loose fur had penetrated and formed a part of the body.

To give the hat-body its shape was the next operation, and this was also done on the battery. Having been thoroughly soaked in hot water, the operator laid the hat body on the plank which forms the margin of the battery, with that part of the body which was to form the brim turned up, and while turning it around on the plank pulled out the tip to form the flat portion of the hat crown. The body was now pulled on to a block of the size and shape of the finished hat crown, a cord slipped over the crown, and drawn tight at the junction of the side crown and the brim. In this condition the brim was pulled out flat and smoothed with a piece of metal called the *trencher*. While firmly secured on the block the hat was put in the coloring liquid, and after washing, trying, and stiffening, it was finished by carding the outside when a long, flowing nap was wanted, or it was rubbed over with pumice-stone, when a smooth finish was desired. After the trimming had been put on, the hat was ready for use. All the various manipulations were done by one man who had learned the hatters' trade; and the separation of these, and the division of the hat-makers into *makers*, *blockers*, and *finishers*, did not become general until the *forming* machines had come into general use.

The first improvement in hat making was made by Mason, whose wool hat-body former consisted of a conical block upon which the web of wool was wound as fast as it was delivered from the carding machine. This machine was improved by Grant. See Hat-forming Machine.

At about the period of the introduction of the wool-hat forming machine, the hat-body *hardening* machine, with reciprocating rubbing board, came into use in hat factories See Hardening Machine. It consists of a cloth-faced rubbing board, which is rapidly reciprocated upon a pile of hat-bodies lying flatly beneath it, each hat-body having within it a hard cloth, and a cloth also interposed between each body. The pile lies upon the perforated top of a steam box, so that the whole of them are kept saturated with hot steam.

Sometimes a special machine is used to harden the tips of hat-bodies. It consists of a rubbing board acting upon the top of a steam chamber of such shape that the hat-body can be slipped upon it after the sides of the body have been hardened in the ordinary machine.

Wells' machine, improved by *Taylor & Burr*, is described under Hat-forming Machine. It may be simply stated here in a general way that it consists of an apron to feed the fur, a picker cylinder to loosen and scatter it, and a perforated revolving former or cone, beneath which is an exhaust fan. The fur fed in regulated quantities is finely divided by the picker and sent whirling in the direction of the cone, upon which it collects as the air passes through the interstices and the hairs collect on the outside.

With the more extended use of the machine for forming fur hat-bodies, it became necessary to have better appliances to separate the fur from the hair and to prepare it for the former. This was accomplished in *Rotch's* fur-blowing machine, in which the fur and hair are separated and other impurities removed. This consists of a feeding apron, pickers, and a screen. The fur is presented by feed-rollers to the picker, which combs it out and scatters it, the lighter part into an upper chamber, and the heavier into a lower one, where a screen separates the tussocks of imperfectly treated matter from the hairs and dirt. The latter are removed while the former are passed back to be re-treated. See Fur-blowing Machine. Fig. 1112, p. 362, *supra*.

After the forming of hat-bodies, both fur and wool, had been successfully accomplished, the sizing or fulling of hats received the attention of inventors, and numerous attempts were made to full hats, but only a few machines proved of any value. James S. Gaylor, of Danbury, Conn., however, invented and patented a four-roller sizing machine which came into general use in wool-hat shops. The hat-bodies were rolled up in a piece of cloth and put between four rollers, which were placed in a hollow casing with their axes at an angle with each other. This position of the rollers caused the roll of hats, which was introduced into the machine at one end, to travel slowly along while turning between the rollers, two of which have, in addition to their rotary motion, a slight vibratory motion sideways, and thus the hats were slowly felted. As stated above, this machine was extensively used in wool-hat factories, but it was superseded finally by the fuller mill, which is now universally used.

The first successful attempt at fulling hat-bodies was in the factory of the Seamless Clothing Manufacturing Co., Matteawan, N. Y., where the manufacture of wool hats was commenced about 1860.

Various styles of mills are now in use. One will be found under Fulling Mill.

The batches of hats are placed in the bed of the machine, and are subjected to the blows of a beater driven by a crank, or to the pounding action of falling stocks, which are lifted by cams or trips, as the case may be. In some cases acidulated water is used in the bed to facilitate the felting, but generally fullers' soap is used. The fulling of hat-bodies in the mill is confined to hats of wool. Fur hats are sized on the battery.

Following in due sequence of history, we cannot omit noticing the advent of Kossuth in the United States, which made soft hats and flowing beards fashionable. The demand for soft fur and wool hats increased very rapidly, but the latter could not compete with the former until *T. Waring* introduced the hat-finishing lathe. Before this time the wool hat-body, after it had been sized, was rubbed off with pumice stone, and afterwards put on a block to be ironed off and touched up with sand-paper. Waring made the hat-block with a chuck which fitted to a lathe spindle, and the operator, while the hat was revolving rapidly on the lathe, held sand or emery-paper on the hat, and thus finished the hat. The advances made in the manufacture of wool hats date from the introduction of this improvement. Prior to this time wool hats were made of the lowest grades, and could not compete with fur hats, but, by the use of the finishing lathe, it became possible to give hats made of the finer grades of wool a finish closely assimilating the appearance of the lower grades of fur hats, and from this time the wool-hat trade began to rival the fur trade. See HAT-FINISHING LATHE.

Shortly after the introduction of the finishing lathe, sewing-machines were first introduced to put the lining on the brim of the hat. See HAT-LINING SEWING-MACHINE.

Consequent upon this came the hat-sweat rolling machine, which turns the edge of the leather sweat-lining in order to prevent its marking or hurting the forehead.

Next in order came a machine, invented by Eickmeyer and improved by Judson, to make the hat-lining. The tip is secured upon a table having a round or oval motion, while another piece is put in a folding gage in such a way that the stitching will fasten the edge of the piece that forms the side-crown in a circular or oval line to the flat tip. Judson added to this a pair of rotary trimming shears, and arranged the turn-table upon a swinging lever.

The pouncing machine, however, now finishes the insides of hats almost equal to the outsides, and crown-lining is almost discontinued in felt hats.

Another addition to the machinery in the manufacture of hats is that used to put the stiffening into the hat-bodies. To give the bodies a permanent shape, some stiffening material is generally put into the body; in the better class of hats a solution of shellac; in those of cheaper character, Irish moss, glue, etc. The solution is put into a trough under a pair of rollers which are geared together and driven by a belt from a line-shaft. Two troughs and two sets of rollers are generally mounted on one frame, one trough containing a thin solution into which the whole hat is plunged, and the surplus matter pressed out by passing up the hat-body between the rollers. The other trough contains a heavier solution into which is dipped that part only of the hat which is to form the brim. The troughs are heated by steam to keep the stiffening in a fluid state, and the hat-bodies, after being stiffened, are ready to be blocked.

Up to this time the hat-body is yet of a conical shape; *forming*, *hardening*, *fulling*, and *stiffening* have followed each other *seriatim*; this series is in the case of the wool hat-bodies only. It has been already explained that the operation with fur bodies is upon a special set of machines.

The blocking of the hat-body is that part of the manufacture in which the cone-shaped hat-body is pulled out around the edge to develop the brim, and the upper part is widened out to form the flat tip and the side-crown. This is described under BLOCKING MACHINE, pp. 109, 110, *supra*.

The machine of Fenn may be described in brief to have had two pairs of rollers, one pair traveling somewhat faster than the other. The edge of the conical hat-body being nipped between the rollers, the pair in advance pulled upon it faster than it passed through the hind pair and so stretched it. It was thus gradually flattened out so as to form a brim, but did not act upon the crown or tip, and as its action was slow and incomplete it only came into partial use.

The first complete machine for stretching hat-bodies, wool or fur, was the corrugation stretcher of Eickemeyer, and these machines, in various modifications to suit the different kinds of work, are now used almost exclusively in the hat factories of this country. Described and illustrated under BLOCKING MACHINE (Fig. 335, p. 109, *supra*), it need not be considered at length here. It has a ribbed and recessed former which rises vertically and pushes the hat-body into a cap which has a number of yielding levers corresponding in number with the recesses in the former. The edge-rollers on the ends of the levers push the felt into the recesses of the former and stretch it. This is repeated again and again, the hat being moved on the former between each operation. The brim and tip are thus developed.

Next in order comes the blocking machine to make the *band*, as the sharp angle formed by the junction of the brim and side-crown is known in the trade. This is done by a rising spindle which carries the hat on its block, in the first place against a clamping plate which holds the brim flat and then pushes the crown into a cylindrical banding shell whose lower edge forms the *band* or angle. See BLOCKING MACHINE, Fig. 337, *et seq*.

To adapt the principle of stretching by corrugation to fur hats a number of modifications were required. It was found advantageous to separate the *brim stretcher* from the *tip stretcher*, and to substitute round-edged bars for the round-edged rollers.

These machines are considered in their places. See BRIM STRETCHER, Fig 427, p. 135, *supra*; TIP STRETCHER, *infra*.

Eickemeyer's finishing blocking machine, known as a *hat-shaping machine*, is considered and illustrated under SHAPING MACHINE. The hat placed upon an expansible block (which has been previously contracted to its smallest diameter) and a circular series of 38 tongs is made to grasp ⅜" of the edge of the brim all round. The banding ring is thrown over the hat and locked fast. The edge of the brim being firmly held by the tongs, the operator raises the block and expands it to the desired size. The hat is then cooled and taken off, and the operation repeated on the next hat.

All the adjustments — size of band, height and diameter of crown, and width of brim — are made by gages attached to the different levers, so that the operator can set each part in a few moments, and all sizes of hats can be shaped on the same machine. A good operator will block from four to six dozen per hour. See SHAPING MACHINE.

The introduction of these machines for the stretching and blocking of hats has had a marked effect both upon the quality and facility of production of the hats so treated. When but imperfectly done, hats will in a short time lose their shape and "go to seed," as it is called in the trade, but when properly blocked on a machine, the felt is so well and equally stretched and shaped that the hat is much more durable.

Next in importance to the machine for blocking and shaping are the pouncing machines, for sand-papering the surface of the hat-body or the hat after it has been blocked.

The hat-finishing lathe, used in the wool-hat factories, was never successfully introduced in the fur-hat manufactories, owing to the fact that fur hats were usually made in small shops where power was not used, and also on account of the difference in the material.

The pouncing machines now in general use are constructed on two principles.

A rapidly rotating cutting or rubbing cylinder, which operates upon the hat-body or hat while it is fed along upon a yielding bed, is used in one class of machines. In the other class, a reciprocating motion is given to the cutting surfaces to rub in two directions.

For wool hats, and the lower grade of fur hats, the rotating cutter machines are exclusively used.

Under their own captions are described machines for pouncing hat-bodies, special machines for pouncing the brims, and for the crowns of the common grades of blocked hats, and also the reciprocating machine for the finer classes of felt hats. See POUNCING MACHINE.

The foregoing account comprises the most important machines used in the hat factories of the United States, but mention may be made of some machines used in the final finishing of the hat.

Joyce's hat-brushing machine is frequently used to remove the dust left in the hats by the pouncing machine.

Stewart's sewing-machine, adapted to sew ribbons on hats, has lately been extensively used in wool-hat factories.

Hydraulic presses to press hats into molds of proper shape, so extensively used in Europe, have not proved successful in this country, although a great many attempts have been made, and many machines patented by different inventors.

India-rubber blocks, made in the shape of the hat-block, have, however, been used in molds which surround the crowns only of the hats. See HAT PRESS.

Various styles of ironing machines are also in use, one of which is shown under IRONING MACHINE, which see.

But little improvement has been made in the finishing process of fur hats, and although many different machines have at times been used, and some with considerable success, none have been able to supersede hand labor. The use of the fulling mill to felt fur hats has also been frequently attempted, with but moderate success.

See: —

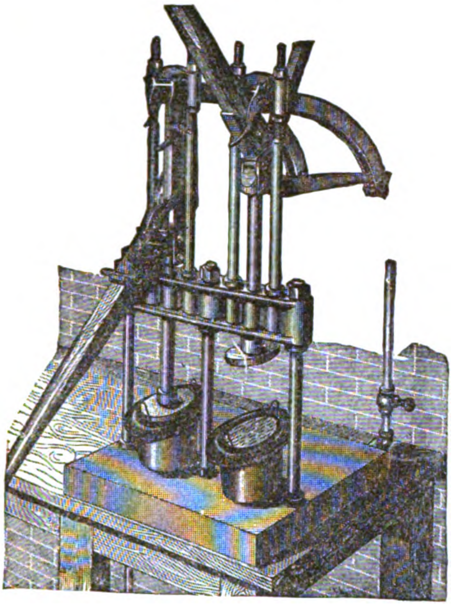
Rack, *Dorr*	* "*Scientific Amer.*," xxxvii. 360.
Felt	* "*Scientific American*," xl. 26.
Fireman's, *De Celis*	* "*Scientific Amer.*," xxxviii 407.
Forming machine	* *Laboulaye's* "*Dict.*," *etc.*, cap. "*Chapeau.*"
Making machinery	* "*Scientific Amer.*," xxxiv., 50.
Press	* *Laboulaye's* "*Dict.*," iv., cap. "*Apprêts.*"
Sweat	"*Scientific American*," xlii 3.
Hat-trade of America	"*Scientific Amer. Sup.*," 2414.

Hat Press. A machine in which pressure is brought against the inside of the hat to cause the latter to expand while hot and soft against the inside of a mold of the required shape.

Hydrulic presses are used in Europe for this purpose, but have not proved so satisfactory in the United States for some reason.

India-rubber blocks, however, made in the shape of the hat, are used in molds which surround the hat-crown only. Fig. 1328 is *Osterheld & Eickemeyer's* machine for that purpose. Three wrought-iron columns which support a cross-head are fitted into a metallic bed-plate, which is hollow and is heated by steam. A mold of brass of suitable shape is

Fig. 1328.



Hat Press.

put under a plunger operated by a hand-lever. When the mold is heated to a certain degree a hat is put into the mold, and a rubber die provided with two handles is placed inside the hat. The plunger, which has an oval flange fitting the mold loosely, is now lowered and by means of a toggle lever, which presses against the upper cross-head, the rubber is compressed, and thus the hat pressed against the hot mold. In the illustration one hat is shown as under pressure while the other is ready to press down the lever. The hat is left in this position for from 3 to 5 minutes, and it has, when removed, a smooth and glossy finish.

Hat Sha'ping Ma-chine'. See SHAPING MACHINERY. Also Figs. 2438–2441, page 1078, "*Mech. Dict.*"

Hat Sha'ving Ma-chine'. See SHAVING MACHINE.

Hat Stif'fen-ing Ma-chine'. See STIFFENING MACHINE.

Hat Stretch'ing Ma-chine'. See BLOCKING MACHINE. Fig. 335, p. 103, *supra.*

Hat Sweat. That part of the lining of a hat which comes in contact with the head.

Ventilating, *Smith* . . . * "*Scientific American*," xlii. 5.
See HAT LINING SEWING-MACHINE, *supra.*

Haul'ing En'gine. An engine for drawing cars or loads in mines or on ways or inclined planes.

Underground, Engl. . .	* "*Sc. Amer. Sup.*," 2373; * 2476.
Drum for traction engine. *Aveling & Porter*, Br. .	* "*Engineer*," xlviii. 430.
For slips, *Hayward, Tyler & Co.*, Br.	* "*Engineering*," xxiii. 362.
San Domingo mine, Spain	* "*Engineer*," xlvii. 316, 321.
Horizontal, *Tangye*, Br. .	* "*Engineer*," l. 103, 119.

Haul Seine. (*Fishing.*) A long net depending from a cork line and leaded at its lower depending edge, used to sweep large areas of water. The ends of the land line are carried ashore and being hauled upon the beach, the net assumes a V-shaped form; the bag of the net in the bend is the last to come ashore. See also SEINE.

Haul-up' Gear. 1. A portion of the saw-mill machinery devoted to drawing logs up from the yard or bay to be sawn.

2. Capstan or other machinery for hauling in the seine. Used on the Chesapeake and Potomac.

Hausse. A lifting breech-sight of a gun.

Figs. 1329, 1330, 1331, show that of the Mauser rifle, the piece adopted by the German government. It is short and at the same time adapted for long range firing.

It comprehends the following dispositions and range: —

Nick on the breech, 200 meters.

The small rear leaf lifted (Fig. 1329), 300 m.

The small leaf folded down and the forward *hausse* raised: the bottom nick (Fig. 1330), 400 meters.

The slider raised so that its lower end corresponds with figure "5" on the left, 500 meters.

Slipping to mark "6," 600 meters.

And so on up to "10" (Fig. 1331), 1,000 meters.

The sight then shifts to the upper opening in the slider, the latter being slipped down.

The bottom of the upper opening, 1,100 m.

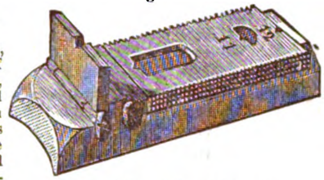
The top of the hausse, 1,200 meters.

The slider lifted to expose "13" on the right, 1,300 meters.

And so on up to "16" 1,600 meters, which is the position shown in Fig. 1331, which is shown as set for 1,000 or 1,600 meters, by using the lower or the higher notch, for the respective distances.

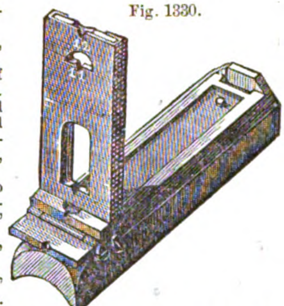
Other forms are given under SIGHT.

Fig. 1329.



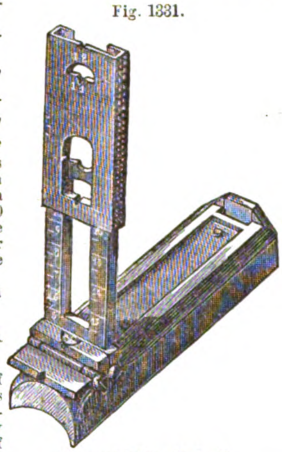
Hausse (Small Leaf Lifted).

Fig. 1330.



Hausse (Forward Hausse Raised).

Fig. 1331.



Hausse (Slider Raised).

Haw'ser. A cable.

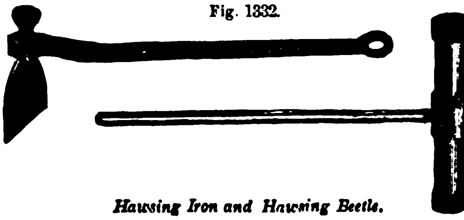
The steel hawsers of the large British ships of war are 8″ in circumference, doing the duty of hempen hawsers of 25″. 120 fathoms of 24″ hempen cable weighs 7 tons 16 cwt. 8″ wire cable 2.5 tons. The wire rope is equal in strength to a 25″ chain, the weight of which would be 16 tons.

Haw'ser Bend. (*Nautical.*) A kind of hitch shown at *l*, Fig. 2513, p. 1105, "*Mech. Dict.*"

Haw'ser Pipe. (*Nautical.*) A lining or bushing for a hawse-hole, through which passes the chain cable.

Haw'sing I'ron. A calking chisel.

Fig. 1332.



Hawsing Iron and Hawsing Beetle.

Haw'sing Mal'let. A hawsing beetle used with chisels, known as *irons*, in driving oakum into seams. Fig. 1332.

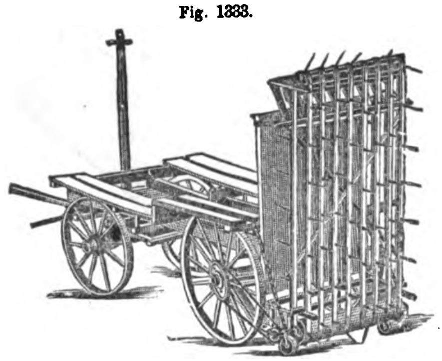
Hay Car'ri-er. A device used to suspend the horse hay-fork in a barn and travel along a bar to remove the load to a distant position, where it may be dropped. See Fig. 2449, p. 1081, "*Mech. Dict.*"

Hay Fork. (*Add.*) 3. A horse hay-fork for elevating large bunches of hay into a mow or on to a rick. See FORK, pp. 907, 908, "*Mech. Dict.*" HARPOON FORK, Fig. 2409, p. 1065, *Ibid.*

Hay Load'er. A rake with continuous elevator attached at the rear of a wagon and traveling along a windrow to load the hay on to the wagon. Foust's hay-loader is shown in Fig. 1333.

It has a wheeled frame attached by eye-bolts to the wagon and having an incline on which continuously travels a slatted

Fig. 1333.



Hay Loader.

belt having prongs which gather the hay collected by the rake. The belt is traversed by means of a sprocket wheel on the revolving axle of the trailing frame. See also Figs. 2456, 2458, p. 1083, "*Mech. Dict.*"

Hay Ma-chine'. See the following references: —

Dryer and curer, artific., *Gibbs*, Eng.	* "*Sc. Amer.*," xli. 358.
Elevator and carrier, *Smith* . . .	* "*Sc. Amer.*," xxxv. 67.
Fork, horse, *Chaffin*	* "*Sc. Amer.*," xxxv. 38.
Fork, *Harrison*	* "*Min. & Sc. Press*," xxxviii. 81.
Harpoon, *Grant*	* "*Sc. Am.*," xxxvi. 341.
Loading machine, *Loader*, Br. . .	* "*Eng'ing*," xxiv. 77.
Making machine. See HAY TEDDER.	
Press, *Dederick*	* "*Engineer*," xlvi. 91.
Press, *Dodge*, Pilter, Paris . . .	* "*Sc. Amer.*," xl. 371.
"*Hercules*," *Lever Jack Co.* . .	* "*Engineer*," xlvi. 91.
Hydraulic, Woolwich Dockyard, Br.	* "*Engineer*," xlvi. 461, 464.
Ricking App., *Hill*	* "*Sc. Am. Sup.*," 128.
Tedder, *Howard*	* "*Sc. Am.*," xxxiv. 150.
Reading Iron Works, Br. . . .	* "*Engineer*," xliii. 59.

Hay Ma'ker. 1. An apparatus invented by Gibbs, and used in England for curing hay in catchy weather. It consists of a stove, fan, and a chute, through which the grass passes to be dried.

"A portable stove made of plate iron is surmounted by a fan, which is driven by a belt from a three-horse power portable steam engine; the fans draw all the heated air and gases from the coke fire together with a volume of warmed air, which passes through a chamber surrounding the inner chamber of the stove, and blows the hot current, at a temperature of 360° Fah. or more, into the dryer. This resembles in general shape a straw elevator, consisting of a sheet-iron trough 6' in breadth, 20' long, if mounted on wheels as a portable carriage, or 40' or 50' long, if a fixture. The trough is raised at one end at a low angle, so that hay fed in at the upper end furthest from the stove shall slowly travel to the lower end near the stove — this being assisted by a slow reciprocating motion given to the bottom of the trough. A ridge of triangular section running along the middle of the trough divides it into two almost semi-circular channels, so that the hay passes down in two streams; the hot air issues through two split apertures, one on each side the base of the middle ridge, and from the entire length of the machine; and the hay is kept continually stirred and lightened up over the hot blast by a number of small iron stirrers cleverly contrived to imitate the action of forks worked by hand."

2. A machine for stirring grass in the field, to expose it to sun and air. See HAY TEDDER, Fig. 2460, p. 1083, "*Mech. Dict.*," *et infra*.

Hay Press. The subject is considered under BALING PRESS, "*Mech. Dict.*," where the varieties are separately considered under captions derived from points of construction. See list under BALING PRESS, p. 218, *Ibid.* See also Fig. 183, p. 68, *supra*. Also *ration* press, Fig. 184, *Ibid.*

The hay presses of Dederick and Dodge make bales continuously, a compressed bale being tied and discharged while another is being formed.

The Dederick press has a plunger or piston, acting in connection with a reciprocating feeder, which drives a bunch of hay within the range of the plunger between each stroke of the latter.

In the Dodge machine the hay is thrown loosely on the feed-table or troughs in front of the press, whence iron teeth carry it right into the open mouth of the machine,

Fig. 1334.

Dodge Hay Press.

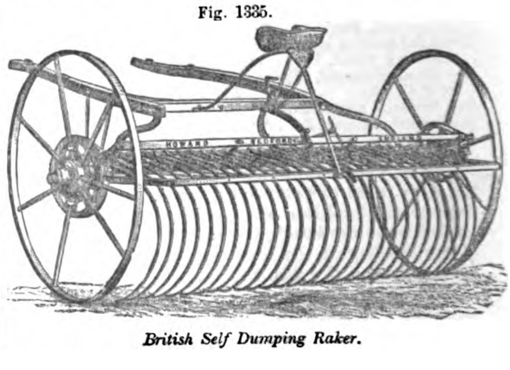
when it is seized by the revolving cones in the head-piece and drawn in from the feed-table in two continuous streams, and built up into a bale 26'' in diameter. The diameter of the bale is never increased, but the bale grows longer as layer after layer is built up. In doing this, the density of the bale is regulated by the friction-clutch, which has been previously made tight. After the bale is built such length as desired, the action of the compress-screw is brought into play by simply shifting one cog-wheel, and in a few seconds the bale is compressed endwise and shortened from about one fourth to one fifth its length without increasing its diameter. While the compression is going on, the man attending the press is passing around and fastening the two wires. When this is done, the pressure is released, the bale dropped out, and the press set for another bale.

Hay Rake. Various forms are shown in Figs. 2453–2458, pp. 1082, 1083, "*Mech. Dict.*"

The additional figure (1335) represents the Howard self-dumping riding horse-rake (Br.).

The wheels are of wrought iron and the teeth of fluted steel. When used as a riding rake the load is dumped by a foot-lever, which brings a friction-brake into action, causing the rake-head to make a portion of a revolution around

Fig. 1335.



British Self Dumping Raker.

the axle, tipping up the gang of rake-teeth and discharging the load. The clearer-rods, six in number, reach from the axle to the rear horizontal bar, on which the hind leg of the seat is supported.

When the operator is walking behind, the brake is operated by a hand-lever.

The self-dumping feature is also found in a large number of American horse hay-rakes, some of which use a clutch arrangement. In the French rake of Lhuillier, of Dijon, the same friction band is used, as just described.

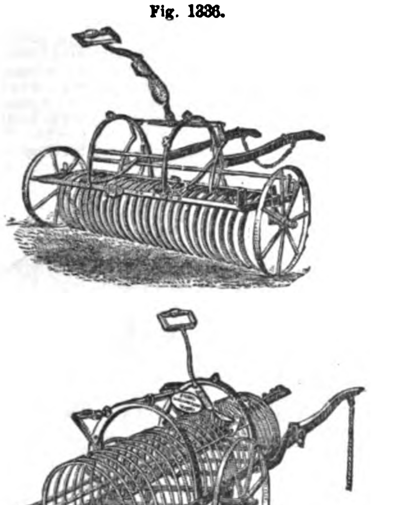
In some simple forms of American rakes the teeth are only operatable by hand lever, not using the draft power of the horse to dump the load. In one, the teeth are independent, and may be set any distance from the ground by slipping them endwise, each being held by its own jam-screw. They are thus set up for gleaning and set down for meadow work. This also admits of drawing the end teeth forward of those in the center, so as to gather the hay inward and prevent its scattering out at the ends. The upper end of each tooth plays upon a spiral spring, which allows the point to rise and pass an obstruction. It is operated by hand and foot lever.

A turning rake on a wheeled axle is made in England. The discharge is made by pressing a foot-lever at the right of the seat, when the tooth-axle is disengaged and the loaded rake revolves to the rear, discharging the load. Having accomplished half a revolution, the foot being removed from the lever, the other rake is arrested at its working position and the work is resumed. The absence of shock as the rakes fall into position is particularly urged as an advantage.

In France is made a reversible rake, in which the length of the rake can be thrown in line with the shafts to enable the machine to pass narrow gateways and doorways.

Fig. 1336 shows the two conditions.

Fig. 1336.



Reversible Rake.

Howard, Br. . . . . * "*Engineering*," xxvi. 471.
Reading Iron Co., Br. . . . . * "*Engineer*," xlii. 113.
Controlling device, *Howard*, Br. * "*Engineering*," xxviii. 447.

Dr. Knight's report on Class 76 at the Paris Exposition of 1878, gives views and descriptions of the following. See "*Paris Exposition* (1878) *Reports*," vol. v., pp. 160-163.

Steam reaper. *Aveling & Porter*	England.
Horse rake. *C. Guilleux*	France.
Riding horse-rake. *Lhuillier*	France.
Self-dumping riding horse-rake. *Howard* .	England.
Walking hay-rake	England.
Turning rake. *Riches & Watts*	England.
Reversible horse-rake	England.
Hollingsworth horse-rake. *Dodd*	United States.
Double-acting hay-tedder. *Guilleux* . . .	France.
Hay tedder. *Howard*	England.

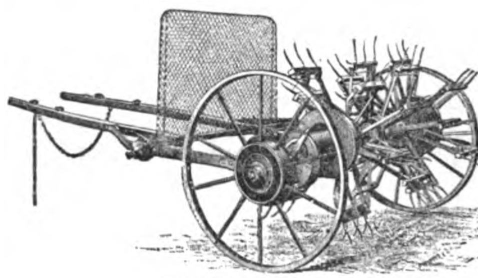
Hay Rope. Used in making large cores to wind about a core barrel before the application of loam. It permits the passage of the gases toward the perforated barrel, and as it carbonizes before the casting is cold, it facilitates the withdrawal of the barrel.

Hay Sweep. A form of rake for gathering hay, either from the windrow or the cock, to the place where it is to be stacked or ricked. It is quicker work than hauling by wagon, where the distance is small, and is used where hay is stacked in the meadow.

Hay Ted'der. An implement for stirring hay on the stubble to expose it to the sun and air and thus hasten curing.

Fig. 1337 shows the hay tedder built by Howard, of Bedford, England; the forks are disposed in zigzag order, four

Fig. 1337.

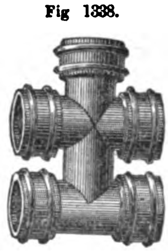


British Hay Tedder.

series of three teeth each, so that the work is practically uniform. The throwing in and out of gear is by means of a lever placed on the side out of danger of contact of the forks with the arm of the operator. The two systems of forks are regulated at such height from the ground as may suit the condition of the crop. The fork-heads revolve at a rapid rate, and the wire netting is to catch the hay and prevent it from covering the horse. By an eccentric movement of the main axle the rakes can be changed from a forward to a backward action, or *vice versa*.

Hay Un-load'er. A movable frame is placed on the wagon, and this is loaded in the field. Being drawn to the barn, tackles are secured to 4 eyebolts on the frame and the load elevated at one lift. When required to dump, the tackle at one side continues to lift, and so tips off the load.

Fig 1338.



H-Branch.

Ha'zel Hoe. A grubbing hoe for working in brush and bushes.

H-Branch. A main or pipe coupling having the form of the letter H, as in Fig. 1338.

H-Drill. A rock-drill, Fig. 1339, with a central and two end portions, resembling in section the letter H.

Head. (*Founding.*) Over the thickest part of heavy castings, a large *flow-gate* or *riser*, for the metal, is placed. Through this the contracting mass below is *fed* from time to time with hot metal, while a boy keeps the head open with a *feeding* or *working* rod.

Fig. 1339.

H-Drill.

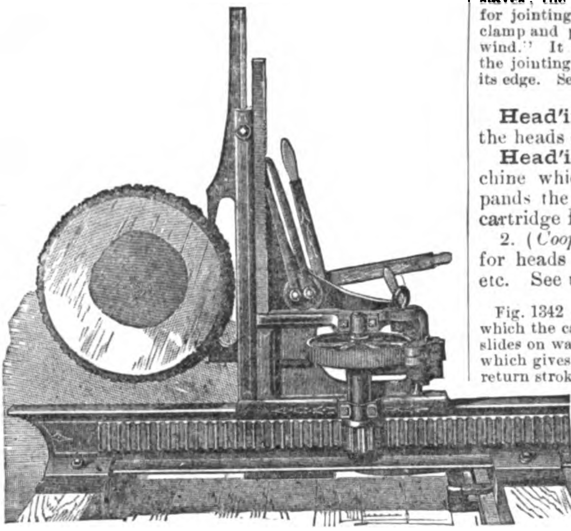
Head Axe. (*Whaling.*) For cutting off the head of the dead whale; opening the skull to obtain spermaceti; cutting off the baleen, etc.

Head Block. (*Saw-mill.*) A name which formerly signified the block which supported the head end of the log, while the tail-block supported the rear end.

Now, the device for holding the log upon the carriage while being sawn.

Gridley's head-block is shown in Fig. 1340. It exhibits a log hung up for sawing through and through, the boards being subsequently trimmed in the edger.

Fig. 1340.



Saw-mill Head-block.

Head-block. *Scofield* * "*Scientific American*," xxxviii. 291.

Head-block Plate. (*Carriage.*) An iron resting on the fore-axle and supporting the head block. It has projecting plates, one or two, for the attachment respectively of the single or double perch bars.

Head Dres'sing Ma-chine'. Used for leveling, facing, and smoothing barrel heads upon one side after the same have been jointed, doweled, and put together.

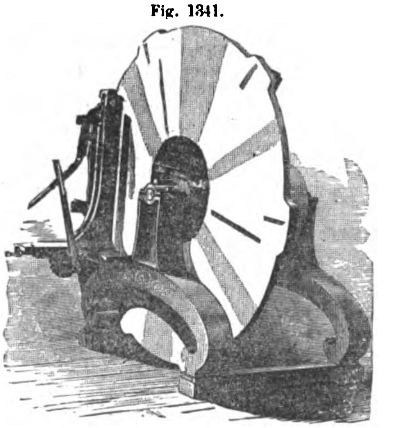
By passing the heads once through the machine they are fitted for the head rounder, and need no farther finishing. See Fig. 217, p. 77, *supra.*

Head Ear'ings. (*Nautical.*) The laniards to haul out the earings, which are ropes to fasten the upper corners of sails to their yards.

Head'ing. (*Mining.*) The vein above the drift.

Head'ing Chip'per. A machine for jointing head-staves. See HEADING JOINTER.

Fig. 1341.



Heading Jointer.

Head'ing Joint'er. A machine for planing the edges of pieces for heading.

On a heavy iron frame is mounted a large iron wheel in which are cutters for dressing and jointing the heading staves; the inner set of cutters for dressing and the outer for jointing. The piece of heading is locked in the sliding clamp and passed up to the cutters, which take it "out of wind." It is then taken from the clamp and placed upon the jointing rest, which gives a smooth and true surface to its edge. See also Fig. 218, p. 78, *supra.*

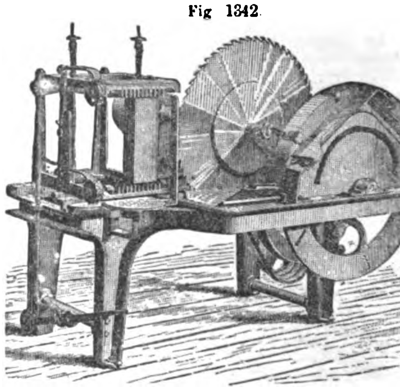
Head'ing Knife. (*Fishing.*) For cutting off the heads of halibut and other large fish.

Head'ing Ma-chine'. 1. (*Cartridge.*) A machine which presses the cartridge shell and expands the head to form a flange, which keeps the cartridge from slipping into the barrel.

2. (*Coopering.*) A machine for getting out stuff for heads of casks or barrels; dressing, turning, etc. See under various heads.

Fig. 1342 shows Lane's heading machine and jointer, in which the carriage, carrying the balk of wood to be sawn, slides on ways, and is moved by a compound crank motion, which gives a relatively slow forward motion and a quick return stroke. The feed works are driven by a single belt running from a cone pulley on the saw mandrel to a corresponding pulley on a counter-shaft carrying a paper friction pulley that in turn drives the iron friction pulley of the compound crank. The length of the stroke can be varied according to the width of the heading or shingles. The performance is 40 cuts per minute. The blocks are held in a perpendicular position and are set toward the saw between toothed rollers, the saw cutting into the side of the block. In front of the carriage is a round plate or table on which to rest the block while taking out the slab. Attached to this horizontal and partly revolving plate are the shipper handle, for starting and stopping the carriage, and an upright guard of wrought iron, that swings around in front of the saw whenever the carriage is at rest. The upper roll is raised by a treadle, enabling the operator to use both hands in taking out slabs and putting in new blocks. The saw mandrel is made of $2\frac{1}{4}''$ steel, with long bearings the full

Fig 1342.



Heading Machine.

size of the mandrel. The set rolls are adjustable to take in blocks from 11″ to 20″ long. The block is set while the carriage is moving about 1″ in passing the dead center. The iron box for catching the shingles is adjustable to the saw by screws and springs, so that should a splinter wedge between the saw and box, the box will spring away and let it pass through. A wheel-jointer, 40″ in diameter, is attached to the machine in such a position that the sawyer can stand at the saw and joint the shingles without turning his body. The jointer has two places for jointing, so that two persons can work at the same time, and it can be detached from the machine, and set in some other place, if desired. The jointer wheel is covered with an iron case, so as to prevent injury to the hands of workmen, and at the same time keep the shavings from flying.

Greenwood . . . . * "*Man. & Builder*," xi. 55.
Dressing machine, *Holmes* . . * "*Engineer*," xli. 430.
Turner, *Holmes* . . . . . * "*Engineer*," xli. 431.
* "*Man. & Builder*," xi 55.

Head'ing Pla'ner. 1. A machine for dressing down heads of casks, barrels, etc. See Fig. 217, p. 77, *supra.*

2. A small form of planing machine for dressing head staves, or made-up heading. See also STAVE DRESSER, p. 2314, "*Mech. Dict.*"

Head'ings. (*Mining.*) In placer mining, the mass of gravel above the head of the sluice.

Fig. 1343.

Head Light.

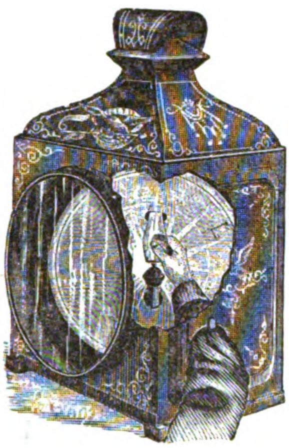
Head'ing Saw. 1. A stave saw. One for sawing head staves from the log or bulk. See STAVE CUTTER, p. 2313, "*Mech. Dict.*"

2. A saw for trimming heads to circular form. Fig. 219, p. 78, *supra.*

Head Knife. (*Whaling.*) For cutting off the head of the whale.

Head Light. In the locomotive head-light, Figs. 1343, 1344, the reflector, oil tank, burner, etc., rest on a revolving table of cast iron, and the engineer is enabled to clean both reflector and glass without removing the slide. The burner, being screwed to the oil chamber, can be removed without unsoldering and repairs made without sending the lamp to the shop.

Fig. 1344.



Locomotive Head Light.

Head Li'ning. (*Railway.*) The enameled ceiling-cloth of a car.

Head Ma-chin'e-ry. See HEADING MACHINE and cognate captions.

Head Rest. 1. (*Surgical.*) *a.* Used in torticollis, Fig. 6567, p. 2603, "*Mech. Dict.*" *b.* A tripod head-rest is used in post-mortem operations.

2. A support for the head on chairs used by dentists, photographers, barbers, etc.

Head Round'er. See BARREL-HEAD ROUNDER, Fig. 219, p. 78, *supra.*

Head Sheet. (*Nautical.*) A sail before the mast, or the foremast, in case of those vessels having more than one mast.

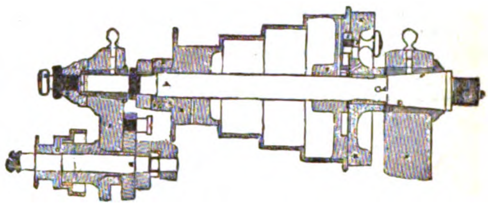
Head Spade. (*Whaling.*) Used in cutting off the head of the whale.

Head'stock. 1. That part of the lathe which carries the live spindle on which the work is chucked.

Fig. 1345 is offered as a specimen of good practice.

"The spindle *A A* is of hardened cast steel, ground perfectly cylindrical, *after having been hardened*, to avoid danger of change of form in the process of hardening, to secure absolute truth in size and shape, and to obtain perfect smoothness and the desired hardness. The box *B*, carrying this spindle, is subjected to all the strain thrown upon the latter, whether by the weight of the piece or by the force exerted by the tool. Here it is made of a single piece of steel, fitted approximately to finished size, hardened, and finally ground to exact form and to fit. The spindle bearing, *C C*, where it turns in the box, is conical, and capable of adjustment longitudinally, to take up the looseness occasioned by the wear, which takes place even with hardened steel journals running in hardened steel bearings. End-play is prevented by the nut *D D* and the set screw *E E*, which hold the spindle snugly in a position such that it may turn freely without either side or end-play. The back-end of the spindle is carried in the journal *F*, its box being held by the cap-screw *G G*. The cone-pulley *H H* turns loosely on the spindle when the back-gear is in action, and is clamped by the sliding-block *I* and screw *J*, when the spindle and the cone are to move together, the cone driving the gear *K K* directly, and the latter carrying the spindle, to which it is secured by keys. The pinion *L L*, on the cone-pulley, drives the back-gear. A spindle, *M M*, carried on the rear plate of the head-stock *N N*, carries the feed-cone pulley *O*. The belt-cone *H H* and the back-gearing are given broad bearings." — *Prof. Thurston.*

Fig. 1345



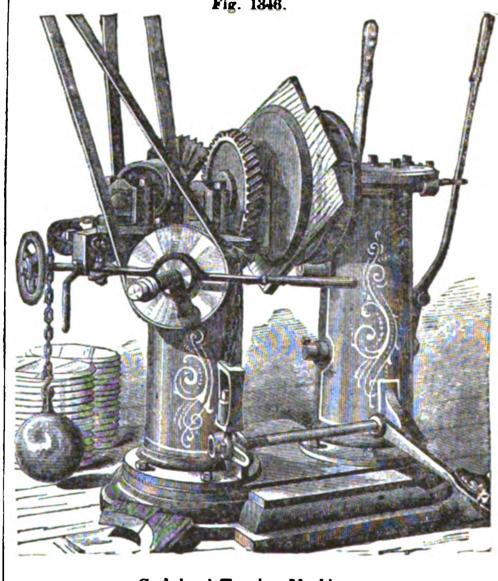
Lathe Spindle and Headstock. (*Worcester Free Institute.*)

2. (*Spinning.*) The stationary portion of a mule, containing the mechanism for effecting the different changes necessary in spinning. The other stationary portions are the creels for the bobbins and the rollers and roller-frames for reducing the thickness of sliver. See MULE.

Head Turn'er. A machine for rounding and beveling barrel-heads. Fig. 1346 shows a machine made by Holmes.

Before the unfinished head is put into the machine to be rounded, its center is found and marked by an apparatus for that purpose. When the head is put into the machine, the centering pin, which is jointed to the hand-lever beside the standard, is pushed forward by the use of the lever, and is brought in contact with the center mark on the head, thus centering it between two disks, one of which, that on the right in the illustration, is provided with a number of spring

Fig. 1346.



Cask-head Turning Machine.

pins near its periphery, which press the work against the opposite disk. The pin-disk is not connected with the driving machinery. Its spindle enters the standard on the right, in which is placed apparatus by means of which the disk is thrown forward and locked in that position, firmly holding the work. Through the rotation of the opposite disk, the pin-disk is also carried around, but for only one revolution, at the end of which stop-mechanism, in rear of the standard and not shown in the engraving, is actuated to unlock the clamp, so that the pin-disk springs back and allows the work to fall out. The disk on the left is rotated by mechanism by the driving pulley, which is thrown into or out of gear by the horizontal handle shown.

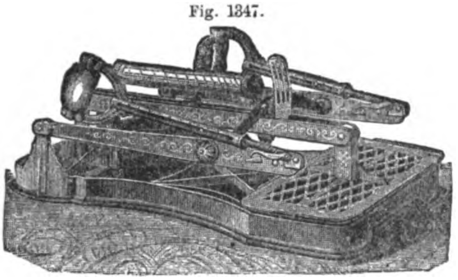
It will make round or oval heads. See also Fig 219, p. 78, *supra*. A French form is shown at BARREL-HEAD TURNING AND BEVELING MACHINE. Fig. 220, p. 78, *supra*.

Health Lift. A machine in which the patient or exerciser lifts upon handles against a graduatable weight or spring.

It originated with Dr. Windship, who devised a system of graduated yoke-lifting. Several forms have been devised: the dead-weight center-lift, the side-lift or reactionary.

The *Mann* reactionary lifter, shown in Fig. 1347, is adjustable from a power of 20 lbs. to 1,200 lbs. The handles are at

Fig. 1347.



Reactionary Lifter.

the side, and fall down to secure compactness of the machine. It has a series of compound levers lifting against the weight of the operator.

The *Marsh* and *Knight* health-lifts have an elastic resistance which reaches its maximum at the end of the lift when the knees are about straight. See also Figs. 2929–2930, p. 1306, "*Mech. Dict.*"

Hearth. (*Metallurgy.*) 1. A form of furnace in which malleable iron is obtained by direct process from the ore. A form of BLOMARY, which see.

2. An open hearth furnace in which pig iron is converted into malleable iron. The *open hearth* is in contradistinction to the reverberatory, which is domed in. The process in each is the same, it being to expose the melted iron to air to oxidize the silicon, manganese, carbon, phosphorus, sulphur, etc., present as impurities. In the hearth process the *blast* of air is driven upon the surface of the iron by inclined tuyeres in the side of the hearth, the iron gradually loses its impurities and is converted into a loup which is carried to the hammer or squeezer. The Walloon, Franche-Comté, and Lancashire are all modified forms of this idea.

3. The lowest part of a blast-furnace, generally cylindrical. It is lined with fire-brick, and the part below the tuyeres is the *crucible*, in which the iron and slag accumulate. The prolongation of the hearth towards the front of the furnace is the *forehearth*. The inclosure is the *dam*, covered by the *tymp-arch*. See Fig. 704, p. 293, "*Mech. Dict.*"

4. A form of steel furnace as distinct from the Bessemer convertor process. See OPEN-HEARTH FURNACE.

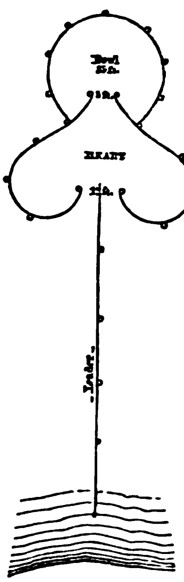
Heart. 1. (*Fishing.*) A net inclosure, into which fish are conducted by the leader, and from which they pass to an inner inclosure known as the *pound, bowl, pot,* etc. Fig. 1348. See POUND NET.

2. (*Nautical.*) A dead-eye with but one eye, and having scores for a lanyard.

Heart Net. (*Fishing.*) A net with a *leader* and a *bowl* or *pound*, between which is a heart-shaped funnel. See POUND NET.

Heart Seine. (*Fishing.*) A species of seine, with a leader, heart, and pound secured by stakes so that the upper edge is floated at the surface and the lower touches bottom.

Fig 1348



Heart Seine

Heat'er. A name applied to a stove or furnace arranged to effect the warming by convection, as with warm air, steam, hot water.

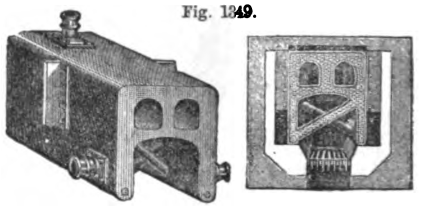
The *stove*, contrariwise, heats by radiation.

The term heater is a very inclusive one, and the subject is considered under various heads. See the list under HEATING AND LIGHTING APPLIANCES, p. 1309. and also STOVE, pp. 2409, 2410, "*Mech. Dict.*" Also list, p. 453, *infra*.

See also MAGAZINE STOVE, Figs. 5914–5922, p. 2411, "*Mech. Dict.*," and VENTILATING STOVE, Fig. 5909, p. 2410, *Ibid.*

The French furnace shown in Fig. 1349 is designed for domestic purposes and for conservatories, to be heated by circulation of hot-water pipes. The boiler is in rolled sheet-metal with riveted joints, and contains

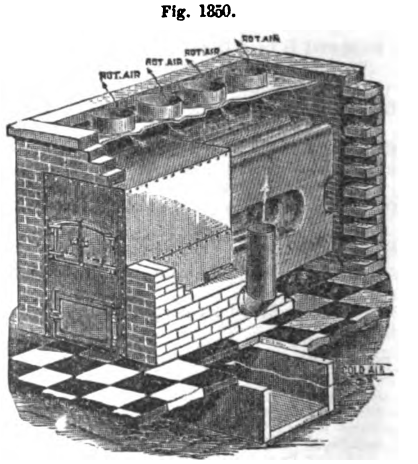
Fig. 1349.



French Green-house Heater.

the furnace, ash-pit, water-legs, and the longitudinal return flues. The boiler is in a brick structure, a space be-

Fig. 1350.



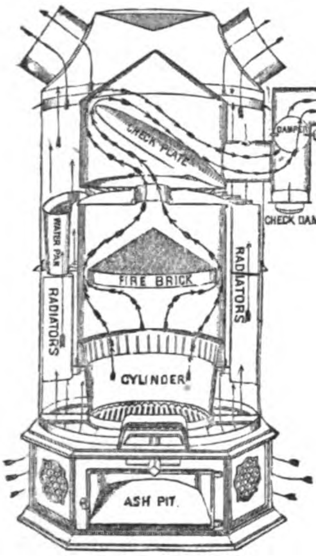
"*Simplex*" *Hot-air Heater.*

tween the two forming the re-return flue to the chimney. The water connections are shown in the perspective view.

Fig. 1350 shows Chase's "Simplex" furnace, in which the heating surface is a rectangular box, made of sheet-iron 1-10″ thick, and riveted. Its size for domestic purposes is 50 × 33″, height 52″ and heating surface 83 square feet. The top and bottom are of single plates, bent so as to rivet to the side sheets. The fire-box occupies a position in the boiler, being lined with fire-tiles, and so supported as not to touch the heating surface.

Fig. 1351 is a sectional view of what is known as a portable heater, from the fact that it is removable as a whole,

Fig. 1351.



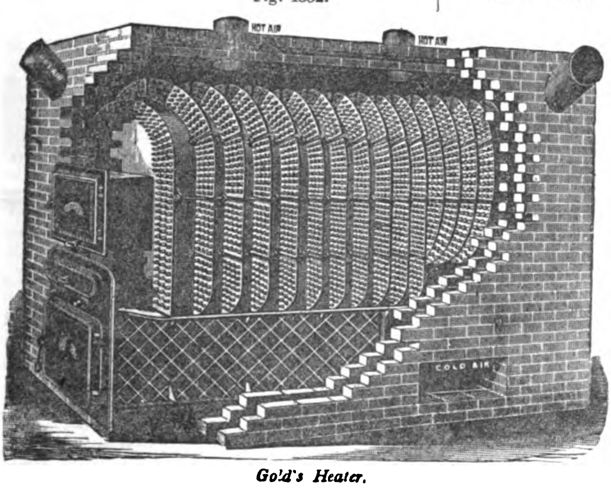
Air-tight Heater.

the brick erection forming no part of the arrangement. It has a riveted sheet-metal case.

The various parts are indicated in the figure. The flame spreads around a fire-brick which is suspended over the fire, passing through a ⅜″ space; thence to the radiator over the fire-brick, a check-plate causing it to make the circuit of the chamber before exit. Between the outer casing and the body of the heater is an annular space with corrugated lining, against which impinges the upward current of air, which is heated by contact therewith.

Fig. 1352 shows Gold's heater, which has a riveted plate-iron cylinder covered with points which greatly increase the radiating surface. Around it is a chamber of brick, inside of which and around the stove the air circulates.

Fig. 1352.



Gold's Heater.

Heat'er Cock. See Jet Valve.

Heat'er Coil. A prolonged pipe containing steam or hot water, and conducted through apartments or passages to heat them.

Coils assume many different shapes. A list may be found at Coil, on p. 207, *supra*.

Heat'ing and Light'ing. See under the following heads: —

Aërial-light apparatus.
Albo-carbon light.
Aphlogistic light.
Arch.
Arch bar.
Base burner.
Bath.
Bath heater.
Bath stove.
Blast gas-furnace.
Blast lamp.
Bleachery boiler.
Box coil.
Brazier's hearth.
Broiler.
Broiling oven.
Bunsen burner.
Bunsen lamp.
Burner.
Bye-pass.
Camp stove.
Candle.
Candle lamp.
Candle machine.
Carbonic acid gas apparatus.
Carbonizing apparatus.
Car heater.
Car warmer.
Casserole.
Cauldron.
Charcoal furnace.
Clam baker.
Clay heater.
Coffee roaster.
Coil (varieties, see list).
Coil heater.
Coil plate.
Coil screen.
Coil stand.
Coke stove.
Condensing coil.
Cooking stove.
Corrugated boiler.
Cottage range.
Cremation furnace.
Dead plate.
Dessicator.
Disinfecting stove.
Double cone coil.
Double cone lamp.
Double cone reflector.
Double lens lantern.
Double steam kettle.
Drip pan.
Dryer.
Drying closet.
Drying machine.
Dual burner.
Dutch oven.
Evaporator.
Expansion hanger.
Exsiccator.
Feed door.
Fighting lantern.
Fire front.
Fire-place heater.
Fire pot.
Flambeaulet.
Flameless lamp.
Flash light.
Flat coil.
Flat square coil.
Float lamp.
Food-cooking apparatus.
Foot rail.
Foot warmer.
Fresnel lamp.
Fresnel lens.
Fruit dryer.
Frying pan.
Gas absorber.
Gasalier.
Gas analyzer.
Gas and coke furnace.
Gas burner.
Gas burner regulator.
Gas fitter's torch.
Gas furnace.
Gas grate.
Gas heater.
Gas lantern.
Gas lighter.
Gas-light governor.
Gas-lighting torch.
Gas oven.
Gas range.
Gas stove.
Glue heater.
Glue-melting apparatus.
Grain dryer.
Grate ring.
Grate shaker.
Greenhouse boiler.
Greenhouse furnace.
Grate
Grate bar.
Grid.
Heater.
Heater coil.
Heating apparatus.
Heating drum.
Heating furnace.
Heating stove.
Helical tank-coil.
Hinge burner.
Hook plate.
Horse-car heating.
Hot-air stove.
Hot plate.
Hot-water furnace.
Hot-water heater.
Hour-glass coil.
Illumination.
Inverted arch bar.
Intensive gas burner.
Ironing stove.
Jeweler's forge.
Kerosene stove.
Kettle.
Laboratory forge.

Laboratory furnace.
Lamp
Lamp furnace.
Lamp stove.
Lantern.
Laundry apparatus
Laundry boiler.
Laundry stove.
Lime light.
Lumber dryer.
Magazine stove.
Magnesium light.
Manifold.
Mast-head lamp.
Mechanical lamp.
Oil stove.
Oven.
Oxycarbon submarine lamp.
Oyster range.
Paint burner.
Paper carbon-lamp.
Parachute light.
Peat charcoal kiln.
Petroleum burner.
Petroleum stove.
Pipe roller.
Pipe-roller stand.
Pipe stand.
Plumber's furnace.
Poke hole.
Porcelain stove.
Quadriform group-flashing light.
Radiator.
Radiator attachments.
Range.
Reading lamp.
Reel oven.
Reflecting lamp.
Register.
Register face
Reservoir stove.
Return bend.
Ribbed boiler.
Ring plate.
Ring-top furnace.
Rocking-bar.
Rose gas-burner.
Safety lamp.
Screen.
Screw burner.
Service box.
Shaker.
Signal lamp.
Signal lantern.
Siphon lamp.
Smoke-house stove.
Smoothing-iron heater.
Soap coil.
Solaire.
Solar-heat apparatus.
Soup boiler.
Spiral tank coil.
Spring burner.
Square tank coil.
Steam cooking apparatus.
Steam heater.
Stock boiler.
Stove.
Stove-pipe ventilator.
Street lamp.
Submarine lamp.
Sun burner.
Tank boiler.
Tank coil.
Tea kettle.
Tempering gas heater.
Thawing apparatus.
Thermo-refrigerant.
Tinman's stove.
Toaster.
Tri-colored lantern.
Trunnion coil.
Tuyere coil.
'Tween-deck lamp.
Tymp coil.
Urn.
Valve manifold.
Vapor burner.
Vapor lamp.
Vegetable boiler.
Velocipede light.
Ventilating jack.
Vertical lamp.
Vertical tube coil.
Washing boiler.
Water-heating apparatus.
Wine heater.

Heat'ing Ap'pa-ra'tus. It has been proposed to supply heat to domiciles and factories by mains and pipes, as in the manner familiar with water and gas.

The following is the proposition, now in course of fulfillment: —

From the central station the mains will run through every street. One line of iron pipes from 3″ to 6″ in diameter, placed about 3′ below the pavement, packed around with some non-conducting material and inclosed in a wooden box, will be the conducting mains from which the hot water will be carried by means of smaller iron pipes, ½″ to 1″ in diameter, into the houses. Auxiliary or return pipes of about the same size as the conducting mains, will be laid alongside, through which the water, after it has passed through the houses, will run back to the reservoir.

The water heated in the reservoir to from 350° to 400° Fah., will be forced out through the conducting mains, and through the pipes which connect with the houses, and to each connecting pipe will be attached a water meter. The return pipe will also be provided with a water meter. Each house is to be provided with a steam convertor, which in general terms is simply a small metal chamber inclosed in a larger chamber. The water leaves the reservoir at about 400° Fah., and as soon as it enters the inner chamber it will expand into steam. The chamber is so constructed that a pressure of ten pounds will close a valve and shut off the supply of water. The steam will force its way through a valve into the outer chamber, whence it can be conducted through steam pipes to any part of the house and used for heating, cooking, or power, and returned through the auxiliary pipe back to the reservoir.

The steam cooking ovens are coils of pipe through which the steam passes inside of the ovens. Some of the steam will be condensed in the bottom of the convertor, and can be drawn off and used as hot water.

The system as pursued by Holly has an expansion junction service-box at intervals of 100′ to 200′ to provide for contraction and expansion of the mains, and from this box service-pipes are carried to the houses to be heated. A regulator is at each house and the steam used by each consumer makes its own record upon a slip of paper moved by the clock-work of the meter. The pencil-mark denotes the quantity of steam used, and the time of day at which each radiator in the house was put on or off.

Refer to: —

Hand warmer . . . . . . * "*Sc. American*," xxxvii. 278.
Hot water, *Abbott* . . . . * "*Manuf. & Builder*," ix. 57.
For small articles. *Bourhacourt*, Fr. . . . . * "*Engineer*," xliii 250.
Heater, *Gold* . . . . . . * "*Man. & Builder*," xii. 283.
Hot water . . . . * "*Sc. Am. Sup.*," 2713.
Hot water, *Hearn*, Engl. . . "*Sc. American*," xxxix. 227.
For cities, *Holly* . . . . . "*Iron Age*," xix., Mar. 1, p. 1.
* "*Sc. American*," xli. 114.
For boiler makers, *Hewson & Wilson*, Br. . . . . . * "*Engineering*," xxviii. 358.
Stove, *Lent*, Ger. . . . . * "*Engineer*," l. 244.
Stove, *Nott* . . . . . . * "*Iron Age*," xix., Feb. 1, p. 3.
For drying chambers, *Pottier*, Br. . . . . * "*Engineer*," xlii. 357.
For cities, N. Y., *Spinola* . . * "*Iron Age*," xxiii., June 26, p. 15.
Heat Equivalent apparatus . * *Puluj*, "*Sc. Am. Sup.*," 204.

Laboulaye's "*Dict. des Arts et Manuf.*," ed. 1877, tome iv., article "*Équivalent de la Chaleur*." Apparatus of

Hirn. Laboulaye.
Joule Tresca.
Laws of Mariotte and Gay Lussac.

Heat measure, Radiant, *Ericsson*. * "*Van Nostr. Eng. Mag.*," xiv. 193.
Heat meter, *Holly* . . . . * "*Sc. American*," xli. 114.
Heat regulator, *Holly* . . . * "*Sc. American*," xli. 114.

Stove. Development of modern stove. Paper by Axel Ames, Jr., Report of Group XIV., "*Centennial Reports*," vol. v.

Heat'ing Fur'nace. The term *heating* furnace may be held to include the whole range of furnaces, a list of which is given on page 926, "*Mech. Dict.*," and another, p. 362, *supra*.

The *Gas-producing furnace* and *Regenerator Furnace* have usually features in common, although the regenerator is not a necessary concomitant of the method of using the fuel shown in GAS-GENERATING FURNACE, pp. 384-388, *supra*.

See also HEATER, and list under HEATING APPARATUS.

Heat'ing Pan. (*Oil.*) A pan for heating flax or other seed which yields oil by expression.

The pan has a steam bottom for heating by steam. Horizontal stirrers driven by vertical shafts, and balanced so that they can be lifted clear for charging or discharging, keep the charge continually stirred. A gate is provided to each pan, through which the charge is drawn. The seed, after having been heated, is filled into bags, which are placed separately between horse-hair bags, covered with leather. The same kind of bags and hair are used whether the oil is expressed by stampers, screws, or hydraulic presses.

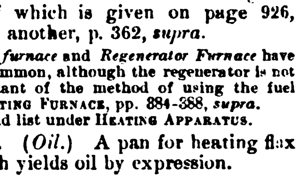
Other forms of pans for use in various other industries: sugar, confections, etc., are found under their appropriate heads in the "*Mech. Dict.*," and herein. See EVAPORATING PAN; CONFECTION PAN; VACUUM PAN; CLAY HEATER; DESSICATOR; DRIP PAN; FRUIT DRYER, etc.

Hea'ton Steel. (*Metallurgy*) Steel produced by air-blast through molten pig-iron; crude nitrate of soda, with other material, being used. See p. 2365, "*Mech. Dict.*"

Hea'ver. 1. A bar used as a lever.

2. (*Nautical.*) The tool, Fig. 1353, used by the sail-maker and sailor in marling, serving, etc.

Fig. 1353.



Sail-maker's Heaver.

Hec'to-graph. A process of dry-copying of writings or plans by reversing the freshly-written copy upon a gelatine film and subsequently applying clear sheets *seriatim* to the gelatine. See COPYGRAPH; COPYING PENCIL; and GELATINE PROCESS, *supra*.

Hed'dles. The cords governing the disposition of the warp-threads in the tissue.

See, for disposition of heddles and harness for various kinds of weaving, article "*Tissage*," *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," iii., ed. 1877.

Hedge Cut'ter. A hedge pruner. See Fig. 2479, p. 1093, "*Mech. Dict.*"

Hornsby, Eng. . . . * "*Paris Exposition Reports*," v. 239.
Walker, Br. . . . . * "*Engineer*, xlvi. 22.
Hedge knife . . . . Fig. 2483, p. 1093, "*Mech. Dict.*"

Heel At-tach'ing Ma-chine'. A machine for forcing on and securing heels to shoes or boots by pressure. — *McKay*.

Heel Build'ing Ma-chine'. A machine in which are associated, and compressed while being tacked, the lifts which form the heel.

Heel Ma-chine'. See under boot, shoe, sole, heel, etc., and other captions.

Machinery, *Bigelow* . * "*Thurston's Vienna Rep.*," iii. 309–318.
Stiffener, *Lyon* . . . * "*Iron Age*," xxii., Dec. 26, p. 1.
Cleaning machine . . "*English Mechanic*."
Kent, Br. . . . . . "*Scientific American Sup.*," 660.
Heel-spring, *Pease* . * "*Scientific American*," xl. 36.

Heel Plate. (*Fire-arm.*) The solid or skeleton plate at the butt-end of the stock. Sometimes the top and bottom are merely tipped.

Hel'i-cal Nee'dle. (*Surgical.*) A needle with a helically twisted stem to introduce a ligature around an artery or in case of ruptured perineum.

Hel'i-cal Tank Coil. A steam or hot-water heating coil of helical or flat-spiral form

He'li-o-gra'vure. The systems of heliogravure, or sun-engraving upon copper, as employed in the Austrian Military Geographical Institute, are thus referred to in *Petermann's "Mittheilungen"*: —

"The sheets of the new Austrian Ordnance map are carefully drawn on paper, on a scale of 1 : 60,000. They are then reduced photographically to a scale of 1 : 75,000, transferred upon copper, touched up, and printed. In this manner each sheet of the map can be produced in nine months, while the same amount of work engraved in the usual manner requires nearly 46 months for its completion. The whole of the Austrian staff map, consisting of 715 sheets, will thus be completed in 10, 11, or 12 years. No less than 271 have been published since 1874. The advantages of this process, as regards cost and rapidity of publication, are evident, and they fully compensate for any slight inferiority in the appearance of the work."

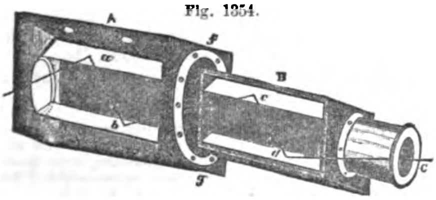
See also Heliotype, p. 1097, "*Mech. Dict.*"

He'li-o-scope. An instrument for viewing the sun.

The instrument shown in Fig. 1354 is the invention of Herr Merz, of Munich.

It is based on the law of polarization of light. If a ray of light strikes at an angle of 35° 25′ on a mirror which is mounted so that it may be turned on its axis, and the reflected ray is thrown on a second mirror placed at right an-

Fig. 1354.



Merz Helioscope.

gles to the first, the light is polarized. The polarized ray is perfectly bright if the two mirrors are parallel, but it becomes more and more faint when the upper mirror is turned, until at a right angle it disappears altogether, so that the field of vision in the second mirror is perfectly dark

In the two cases, *A* and *B* of the apparatus, are mounted four heavy mirror glasses, *a*, *b*, *c*, and *d*. The case *A* is screwed to the telescope through which the sun is to be observed. The light falls on the first mirror at an angle of 35° 25′, and is reflected to the second, from whence, by means of the mirrors *c* and *d* in the case *B*, it reaches the eye of the observer at *C*.

To effect the necessary diminution of the sun's light, the case *B* is arranged so that it may be turned around the axis of the apparatus by the ring *f g*. When the mirrors in case *B* are parallel to those in *A*, the image of the sun appears perfectly white, but the light can easily be diminished to any desired degree by simply turning the case *B*, which can be done without removing the eye from the ocular lens.

To prevent the air in the apparatus from becoming heated too much, the upper side of the case *A* is provided with a couple of holes for ventilation.

A simpler arrangement by Dr. Van der Weyde is described by him as follows: —

"I take a piece of plate glass of the same width as the diameter of the objective, and about three times as long, ground at the back so as to destroy the exterior reflection of that surface, and coat it with black varnish. I attach this before the objective under an angle of 35° 25′ with the axis of the telescope, so that the solar rays entering the instrument are polarized by the reflection of the polished surface. To the eye-piece I simply attach as analyzer a Nicol prism, and by turning the latter round its axis I reduce the intensity of the solar light to any degree desired."

Refer to "*Scientific American*," * xxxviii. 163, 186; xlii. 389.

He'li-o-tel'lus. An orrery embracing the sun and earth in its scheme. — *Hommatt*.

See also Geoscope; Orrery; Cosmoscope, etc.

He'li-o-trope. A geodetical instrument used to reflect a ray of light to a distant station. First adopted in surveying about 1821, by Gauss, a Hanoverian, for the purpose of rendering the vertices of the triangles visible in the triangulation of the kingdom of Hanover. Capt. Drummond's heliostat was used in the ordnance survey of Great Britain.

As now used, it is a stand bearing a 10″ mirror, swung like the ordinary toilet looking-glass, except that besides swinging horizontally, it is also pivoted, so as to move vertically as well. Behind the mirror, in the very center, a little of the quicksilver has been removed, so that the observer can go behind his instrument and look through a tiny hole in it toward the station he desires to signal. Having sighted the station by adjusting the mirror, he next proceeds to set up in front of the heliotrope a rod, and upon this rod is a movable stud. This stud is manipulated like the foresight of a rifle, and the observer, again standing behind his instrument, directs the adjustment of this stud until the hole in the mirror, the stud, and the distant station are in a line. The heliotrope is then ready to work, and in order to flash signals so that they can be seen at a distance, the operator takes care that his mirror reflects the sunshine on the stud just in front of him. Such signals are visible from 30, 50, to 100 miles, according to circumstances of elevation, atmosphere, etc.

In another and simple form, two opaque screens are placed about 18″ apart upon a strip of wood forming a base, and screwed or nailed fast. A hole about 1″ in diameter should be cut through each screen, the one in rear being a little larger than the other, and across each there should be drawn two fine wires or threads, so as to intersect each other. About 6″ in rear of the screens there should be placed a small mirror — 3″ in diameter would be sufficient — so mounted as to have the two motions horizontal (or in azimuth) and vertical (or in altitude). The crude instrument is then ready for operation. To throw the ray upon any given object visible to the unaided eye, turn the mirror down out of the way or remove it altogether, and sight across the wires, moving the base until the line joining the intersections of the cross wires passes through the object. Then replace the mirror carefully, so as not to disturb the line of sight, and turn it in either or both directions until the shadow of the edge of the hole in the first screen is concentric with that in the second. The reflected ray will then be visible to an observer at the given point. — *Haupt*.

The *heliotrope* is known to the British military world as the *heliograph*, which is a misnomer. The word *'trope* is the more appropriate, as it *turns* to the sun like the *helianthus* and the pretty little *heliotrope* (*H. peruvianum*) — called also *turnsole* or *girasole* — are supposed to.

The word *heliograph* and its cognate *heliogravure* have reference to writing or drawing. The word *heliometer* has its use also, indicated by the termination. The word *heliostat* has also its specific meaning, which is true of each of the following: —

'graph.	'scope.	'trope.
'meter.	'stat.	'type.

The apparatus used with the British army is known as *Mance's* heliograph.

"The signals made by it, under favorable conditions of position and atmosphere, have been read as far as 80 or 100 miles. It consists of a specially prepared mirror, with ingeniously-constructed adjusted mechanism for reflecting the sun's rays with absolute precision to any required spot, notwithstanding the sun's apparent movement. By the pressure of a finger-key the flashes are made of short or long duration, thus adapting the instrument to the Morse code of telegraphy. A second mirror is provided to permit of signaling being carried on irrespective of the sun's position. The instrument intended for field service weighs from 6 lbs. to 8 lbs., and is mounted on a light tripod stand. The working parts are protected from injury during transit, and the complete apparatus admits of being easily carried, as it is also efficiently worked, by one man.

"The apparatus has been in use for some time in India, where its working has been attended with very great success. In the winter of 1877-78 the Jowaki-Afridi expedition gave the Indian Government an opportunity of submitting it to the test of war. The two columns, under General Keyes and General Ross, operating in the Afridi hills were supplied with volunteer signalers. The instruments were simply invaluable, and helio[tropes] were supplied to each division of the subsequent Afghan expedition With Gen. Donald Stewart's column telegraphic communication was maintained by means of these instruments from the Khojak Pass to Girishk. General Roberts, from Khost, flashed his messages to the fort at Bannu, a distance of 60 miles; while Sir Samuel Browne, from the heights above Ali-Masjid, announced the capture of that fort to the expectant garrison of Peshawur by means of the Mance helio[trope]." — London "*Times.*"

Permanent heliotrope stations are now established between Tangier, Tarifa, Ceuta, and Algeçiras, and between certain W. I. Islands. It is used in the armies of the United States, France, and Belgium.

Refer to: —

Heliograph, *Anderson*, Br.	* "*Engineering*,"	xxx 221.
Heliograph, pocket, *Maj. Macgregor.*	* "*Scientific American Sup.*,"	4106.
Heliometer, *Anderson*	* "*Scientific American Sup.*,"	4030.
Heliograph, *Wynne*	"*Van Nostr. Mag.*,"	xxiii. 479.
Lesuerre	* "*Jour. Soc. Teleg. Eng.*,"	vii. 351.
Mirror telegraph	"*Sc. American*,"	xxxix. 310.

He'lix. (*Electricity.*) The coil In electromagnetic or induction machines the helix is composed of two or more coils. The inner or primary coil being of coarse wire and connected direct with the battery, and the outer or secondary coil being finer wire wound upon but completely insulated from the primary coil, and receiving its electric influences by induction from the core and inner coil.

Help'er Ring. A ring on the edge of a street-car platform for the attachment of the hook of the single-tree of the *helper horse* during the ascent of a grade.

Hem'a-cite. Bullock's blood mixed with finely comminuted mineral and vegetable substances; dried, molded under pressure, varnished. Uses for knobs and ornamental articles. — *Dibble.*

See Bois-durci, "*Mech. Dict.*," p. 320, and list of Compositions, p. 212, *supra.*

"*Iron Age*" . . . . xxiii., Feb. 20, p. 9.

Hem'i-ple'gi-a Ap'pa-ra'tus. (*Surgical.*) Supporting apparatus for a partially-paralyzed limb. *Paraplegia*, for both limbs.

Page 84, Part IV., *Tiemann's* "*Armam. Chirurgicum.*"

Hem'i-plun'ger. A proposed form of sea-going vessel, in which the habitable or fighting portion is supported by posts upon an entirely submerged portion, which is supposed to be below the level of wave-agitated water.

Tomassi, Paris . . * "*Scientific American*," xxxvi. 115.

Hem'or-rhage In'stru-ments. (*Surgical.*) Acting to prevent effusion of blood. The term may include epistaxis instruments, compresses, tourniquets, hydro-hemostats, ligating instruments, etc.

Bates's instrument for arresting urethral hemorrhage after operation consists of a thin, soft rubber pouch, ¾" wide, and 8" long. The outer end has three openings, two of which are furnished with stop-cocks. The center is traversed by a gum elastic catheter, the end of which, after piercing the lower extremity of the pouch, is fastened, and then cut off; over which part of a soft rubber catheter is passed and secured. A stylet passes through the catheter, and renders introduction easy. The apparatus measures 25 mm. in its flaccid state, and admits of any desired distention. It is used as follows: After the division of the strictures, the instrument is introduced so that the end of the catheter rests in the bladder, or just outside, if preferred; the stylet is then withdrawn and a plug inserted in the end of the catheter. The instrument is then tied in. To one stop-cock is attached a fountain syringe; to the other is attached rubber tubing for the purpose of conducting the refuse water to a receptacle at the bedside.

Hem'or-rheu'mo-scope. (*Surgical.*) An instrument for observing the flow of blood in a vein. The bowl of the instrument resting firmly upon the trunk of a superficial vein the peculiar movement of the stream of blood beneath the bowl sets the sensitive fluid column within the graduated tube into sympathetic action.

Fig. 282, Part I., *Tiemann's* "*Armam. Chirurgicum.*"

Hem'or-rhoid'al Clamp. (*Surgical.*) An invention in which a clamp is combined with a cautery. The invention of *Amusat.*

Shown in Fig. 579, p. 121, Part III., *Tiemann's* "*Armamentarium Chirurgicum.*"

Other pile-clamps are shown in Figs. 567-568, *Ibid.*

Hem'or-rhoid'al In'stru-ments. (*Surgical.*) These consist of clamp, syringe, dilator, tenaculum, artery and needle forceps, insufflator, cautery, bistoury-caché, suppositories, etc. See under the various heads.

Hem'or-rhoid'al Syr'inge. A fine, puncturing syringe, with graduated glass barrel, like a hypodermic syringe, for introducing medicaments to suppress hemorrhoids.

See Fig. 622, p. 128, Part III., *Tiemann's* "*Armamentarium Chirurgicum.*"

Hem'o-stat'ic In'stru-ments. (*Surgical.*) Those acting as styptics to prevent effusion of blood. See Epistaxis Instrument; Hydro-hemostat, etc.

Hemp Knife. A hooking knife, shaped like a pruner, and having a long handle so as to reach the lower portion of the stalk without stooping.

Hemp Sof'ten-ing Ma-chine'. A hemp brake, operating upon the rotted and subsequently dried stalks. One made recently by the Mohawk & Hudson Manufac. Co. has two fluted rolls: the lower one is 12" in diameter and 6' long. The upper one is 24" by 6'. The lower one is driven by gearing from the back shaft, and in turn it drives the upper. The shafts are 6" in diameter. The upper roll and shaft weighed about 8,500 lbs., and the complete machine about 15,000 lbs.

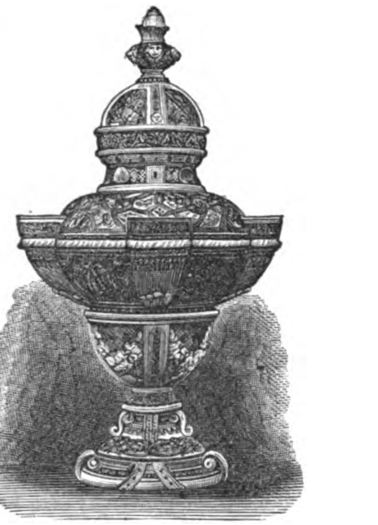
Henri-Deux Ware. (*Ceramics.*) Otherwise known as *faïence d'Oiron.* Fig. 1355.

The ware was made at Oiron, in the southwest of France, in the time of Henry II., of France, and is now very rare, but 37 pieces being known in France, according to M. Brongniart The emblems of Diane de Poitiers appear on the "Biberon," which was sold in March, 1865, to Mr. Malcolm, for £1,100. It is a little over 10" in height. The ware is very hard, quite white, and the ornamentation is inlaid, filling incisions or depressions in the body, though flush with the surface. The filling is generally ochery brown or yellow on the white background, though black, blue, pink, and green colors are known.

Hen'ri-et-ta Cloth. (*Fabric.*) A silk and wool French dress goods.

Her'a-kline. A blasting powder, invented by Dickerhoff, and used in the coal mines of France and Austria. It is composed of picric acid, saltpeter, nitrate of soda, sulphur, and sawdust. The gases produced by its combustion are said not to be injurious, and it burns comparatively slowly, so

Fig. 1355.



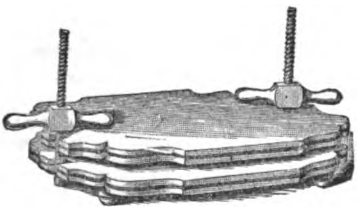
Henri-Deux Ware (Faïence d'Oïron).

that it tears apart the masses blasted, without hurling them violently about.

"*Scientific American*" . . . . . . xxxiv. 329.
"*Scientific American Supplement*" . . 134.

Her-ba'ri-um Press. A portable press consisting of a pair of boards with rising screws and

Fig. 1356.



Yale Botanical Press.

hand-nuts. The parts are all detachable so as to pack conveniently in one's valise.

Her'ni-a In'stru-ments. (*Surgical.*) For operating upon rupture; the protrusion of some part from its natural cavity, usually the abdomen. The instruments are numerous for reduction or operation.

For the former see Truss, Figs. 6700–6703, pp. 2636, 2637, "*Mech. Dict.*"; and page 9, Part IV., *Tiemann's* "*Armamentarium Chirurgicum.*"

Instruments for operation are needles, knives, directors, syringes, etc. See p. 126, Part III., *Ibid.*; Fig. 134, p. 44, Part I., *Ibid.*; Fig. 144, p. 48, Part I., *Ibid.*

Dr. White's instrument for the radical cure of hernia projects a pair of ligature needles.

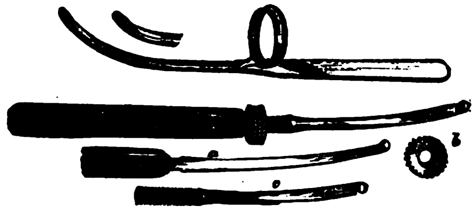
Dr. Warren's hernial ring injector is a graduated barrel with piston and with a needle which is a flat oval in section and twisted throughout its length. The needle is pierced with 10 openings on its side.

Dr Garmo's hernial syringe has a screw piston and a dome trocar needle.

Her'ni-a-tome'. (*Surgical.*) A knife for operating in cases of rupture of the bowels.

Dr. Allis's herniatome is a probe-pointed instrument with concealed blade, which is uncovered by turning the nut, after the constricting band has been reached. The Fig. 1357 represents the instrument when taken apart: *a*, the blunt-pointed blade; *b*, the nut that controls the movements of the shield; *c*, the shield that may be made to conceal or expose the blade by turning the nut *b*.

Fig. 1357.



Herniatome.

Dr. Warren's concealed bistoury for dividing the hernial ring has a saw concealed by a sheath and projected when the ring has been reached. The instrument serves as its own director.

He-veen'oid. Caoutchouc or its analogue compounded with camphor and sulphur, and vulcanized. Addition of lime or glycerine is sometimes made. — *Gerner.*

The proportions of the constituents to make a soft and hard heveenoid may be approximately given as follows: —

	Soft Heveenoid.	Hard Heveenoid.
Rubber	2 parts.	8 parts.
Camphor	2 parts.	2 parts.
Lime	1-16 part.	
Glycerine		½ part.
Sulphur	½ part.	8 parts.

Para caoutchouc is best for hard heveenoid, while Nicaragua rubber answers very well for soft heveenoid, and, in fact, is somewhat better adapted.

Hib'bard Spring. (*Railway.*) A spiral nest spring made of flat bars coiled one within another concentrically, to the number of four, wound in right and left directions, alternately.

High Grind'ing. A process of gradual reduction of the wheat by a succession of partial crushings, alternating with sifting and sorting the product. See High Milling; Cylinder Mill.

High Loom. (Fr.) *Haute lisse.* A tall tapestry loom of considerable size.

At the top and bottom of the framework composing the loom are horizontal cylinders. Around the upper one, the threads composing the warp are rolled, and around the lower one the tapestry, as it is completed yard by yard, is wound. Between these two cylinders is stretched the warp, upon the threads of which the artist marks in white chalk the outlines of the picture. To these he adds, for the purpose of fixing the light and shades, tracings from the pattern. Then, with this latter conveniently placed for reference, he stations himself against the back of his tapestry, and, with his many-colored worsteds and silks, commences the weaving of the picture. The vertical threads of the warp are divided by a heddle or cross stitch, which keeps half of them in advance of the rest; but those behind can be brought forward by means of small cords or *lisses*, one of which is attached to each warp thread. Between the two sets of threads the workman introduces his left hand and takes up as many of them as is necessary. Through these he passes his curiously-shaped wooden needle from left to right, and with its point piles the stretched thread, which in turn is passed back in the contrary direction through the space opened by shifting the front and back threads. The manipulation of the threads, the combination and proper use of the many colors and shades of worsted and silk, and the working out of the design, require a skill and delicacy only attained by long practice.

High Mil'ling. (*Milling.*) The wheat is reduced by a succession of crackings or of slight and partial crushings, alternating with sifting and sorting the product.

In *low milling* the reduction is effected in a single crushing, — the usual manner. The velocity is relatively high.

In high milling the velocity is low; the grinding surfaces at first remote, and made gradually to approximate, in successive grindings, as the products become smaller.

In high milling the reduction of the wheat is step by step, and the separation of the products is not alone according to the magnitude of the particles but also by specific gravity. See MIDDLINGS PURIFIER.

Kick, *Mehlfabrikation*, Leipsic, thus describes it: —

"If one rubs grains of wheat gently between mill-stones, which at first are 1-12″ apart, then one quarter less, and then one half less, and so on, there is obtained successively a finer and finer product. By the first operation, which we will call *clipping*, or *pointing*, a part of the shell or outside coat, the brush, and more or less of the germ, will be removed, and there will be produced grains, from which already many little particles which should not appear in the flour have been separated. The outer bran and hulled kernels coming together from between the stones may be separated from each other by passing them through a cylindrical sieve. The hulled grains, by passing them next through the stones brought nearer together, yield a cracked wheat, a product consisting of various finer particles, which may be graded by sifting. The products obtained are called *groats* (bruised or cracked fragments with bran attached), *grits* (smaller fragments), and finer particles, flour. The flour obtained consists for the most part of cells and particles from the outer portion of the grain, fragments of the bran, and of the gluten-coat, which make the flour dark. It is called *pollen*." — *Kick.*

"The *grits* will consist also of a mixture of fragments of outer and inner parts, and bits of bran of the same size, which go through the sieve with the grits. A product corresponding with this somewhat, used to be called *connell*, and is now known as *middlings*.

"The *groats* freed from the finer particles will be again ground, and this produces a second *groats*, *grits*, and flour; the second groats yield also groats, grits, and flour. Particles which are smaller than groats and larger than grits are called 'solutions;' such as are between flour and grits are called *dust;* and these must obviously be produced by cracking. By each succeeding cracking, the flour and grits produced will consist more of particles from the interior of the kernel of wheat, and as the interior cells, that is, the starch-cells, yield a whiter product, so the flour and grits will become more and more fair and white; and this, until the groats after the fourth grinding will possess the form of disks, having only a thin layer of starch-cells. In flour this phenomenon is very striking. The flour from the third groats is much fairer than that from the second or from the first groats; this is less striking in the grits, in that it is still largely mingled with particles of bran. The bran-particles are much lighter than the grits, and this property is taken advantage of to purify the grits by means of a current of air directed upon a thin sheet of falling grits. This work is accomplished by the grits-purifying machine, in which the air operates either by blast or suction.

"In the gradual grinding and purification of the grits lies the essence of the high or grits milling. This can be effected by various modifications. The wheat may be three, four, or five times cracked or bruised; the grits, which have been separated according to their size, may be more or less purified; and finally the purified grits may be either rapidly or slowly ground to flour.

"When the last traces of bran have been separated from the grits and the still finer dust, one obtains by grinding the pure grits and dust, the fairest, whitest flour, a product which it is impossible to obtain in any other way. Of this product there are several grades." — *Horsford.*

See also * CYLINDER MILL, p. 243, *supra;* ROLLER MILL, *infra*. See also diagram under GRANULATING PROCESS, p. 419, *supra*.

System	"*Am. Miller*," iv. 81.
Table of processes. Hungary . .	"*Am. Miller*," vi. 287.
Mill, *Higginbottom & Hutchinson* .	* "*Am. Miller*," viii 117.
	* "*Sc. Am. Sup.*," 2179.

High Wines. Crude alcohol of higher proof than *singlings*.

Hill'side Plow. A plow with reversible mold-board and share for turning all the furrows down-hill in plowing hill-sides. Also known as a *turning mold-board* plow, and in Britain as a *turn-wrest* plow. See illustrations and remarks, p. 2173, "*Mech Dict.*"

There are 5 systems: —

1. Two complete sets of mold-boards and shares, right and left-hand respectively, and revolvable on the beam to bring either to working position. The Brabant system, known as *brabant double*, see Figs. 854, 856, pp. 268, 269, *supra*, and Figs. 25-28, vol. v., pp. 31-33, Knight's Report, "*Paris Exposition* (1878) *Reports*."

2. The old Scotch form: also known as the French *tourne-oreille*, or *charrue Wasse*. The sole and share are permanent; the mold-board is both right and left, either being brought into action as may be desired by means of a lever, the other one shifting into the line of draft on the land-side. The same colter serves for either. The share, mold-board, and land-side are made in one piece (or to move as one), and this is journaled on a horizontal axis at the lower edge. This is unlocked and partially rotated at the end of a furrow, converting what was the land-side into a share and sole, and presenting the mold-board in the other direction. See Fig. 22, p. 29, vol. v., *Ibid.*, and Fig. 6814, p. 2663, "*Mech. Dict.*"

3. A form used also in France, in which two mold-boards, which are united on a horizontal axis on the median line, are unlocked, and then turned half around, which brings the one now uppermost to the underneath position, both the mold-boards being then presented to the right hand as they are now to the left. Fig. 23, p. 30, vol. v., "*Paris Exposition* (1878) *Reports*."

4. A form which has a right-handed and a left-handed body placed back to back; that is to say, one presented forward and the other rearward. The beam and handles turn on a vertical pivot in the center of the body, and either the right or left-handed portion can be used by turning the beam and handles and presenting them in the appropriate direction. The rear portion of each mold-board is hinged, which allows the one in use to lap over the other, which lies back; this avoids the necessity for making the body the sum of the lengths of the two bodies.

An old English turn-wrest plow, known in its day as Hays's, was constructed on the same principle, but without the hinged wings to the mold-boards. See Fig. 24, p. 30, vol. v., "*Paris Exposition Reports*."

5. A system in which two sets of mold-board and share are used, right and left-hand respectively; the one in use lowered into the furrow while the other is elevated clear of the soil without deranging its position other than the clear vertical movement. A British form shown in Fig. 2509, p. 1103, "*Mech. Dict.*"

Hind Sight. The rear sight of a gun; *open*, *California*, *peep*, *vernier*, etc., which see. See also HAUSSE, and list under SIGHT.

Hinge. See under the following heads: —

Awning hinge.	Loose-pin hinge.
Ball-joint hinge.	Plate hinge.
Butt.	Port hinge.
Butt hinge.	Screw hook-and-eye hinge.
Coach hinge.	Screw hook-and-strap hinge.
Crate hinge and hasp.	Spring hinge.
Hasp.	Strap hinge.
Hook-and-eye hinge.	T-hinge.

Hinge Burn'er. A burner the chimney ring of which is hinged to the lamp-top.

Hip'-joint Splints. (*Surgical.*) See MORBUS COXARIUS SPLINT.

Hitch. A fastening made by passing a light line around a rope, or a rope around a mast or post, so that the line, or rope, crosses its own body and binds.

For list of hitches see KNOT.

Hob. A hardened steel mandrel with a threaded portion which is fluted. Used in cutting screw tools and chasers. See HUB, * Fig. 2600, p. 1139, "*Mech. Dict.*"

Hodge Brake. (*Railway.*) A lever car-brake, invented by N. Hodge, for operating upon all the wheels of a car simultaneously from a single wheel. Fig. 642, p. 426, *Forney's* "*Car-builders' Dictionary.*"

Hoe'ing Ma-chine'. (*Agric.*) See HORSE HOE.

Hog Ring'er. A special instrument for placing anti-rooters in the snouts of hogs. The *ring* is usually a wire or plate, with prongs which are thrust through the cartilage of the nose, and bent over to prevent retraction. The ringer is a pincers which holds the *ring* and thrusts it into place.

Hogs'head Ma-chin'e-ry. See list under BARREL MACHINERY.

Hoist'ing, Shaft'ing, Gear'ing, Grap'pling, etc. See under the following heads: —

Abutment crane.
Accumulator.
Anchor fish-hook.
Angle block.
Angular belting.
Anti-friction block.
Anti-friction press.
Anti-friction roller.
Awning block.
Ball-and-socket coupling.
Balance crane.
Baromotor.
Barrel clamp.
Barrel skid.
Becket block.
Belt
Belt clamp.
Belt coupling.
Belt fastener.
Belting.
Belt-lacing.
Belt-shipper.
Belt-tightener.
Belts, tool for putting on.
Bevel gearing.
Boom-sheet block.
Brake purchase.
Builder's hoist.
Bullet.
Bull's-eye.
Buntline leader.
Bushing.
Capstan.
Cargo-block.
Cellar crane.
Cellar lift.
Chain.
Chain belt.
Chain guide.
Chain hoist.
Chain pulley.
Chain-pulley block.
Changeable speed gear.
Clew.
Clip pulley.
Clothes-line block.
Clutch.
Clutch coupling.
Clutch pulley.
Coal elevator.
Coal hoist.
Coal-hoisting tub.
Coal-whipping machine.
Cog-wheel.
Compression coupling.
Cone gear.
Cone pulley.
Conical bearing.
Connecting rod.
Conveyor.
Core wheel.
Counter-gear.
Counter-shaft.
Countershaft clutch.
Crab.
Crane.
Crane engine
Crane jib.
Cross-head.
Davit block.
Dead eye.
Deck block.
Deck-hoisting engine.
Derrick.
Derrick winch.
Detaching hook
Differential block.
Differential movement.
Differential pulley.
Differential pulley-block.
Dock block.
Dog power.
Door hanger.
Door roller.
Dovetail clutch coupling.
Draft pole
Drive chain.
Driving pulley.
Dumb waiter.
Dumb-waiter pulley.
Dumping bucket.
Eccentric.
Eccentric clamp.
Edge-laid belt.
End play.
Elevator.
Elevator boot.
Elevator bucket.
Elevator chain.
Elevator engine.
Elevator pulley.
Endless chain horse-power.
Expanding pulley.
Eye.
Eye-block.
Fast-and-loose pulleys.
Fire escape.
Flange pulley.
Flexible coupling.
Flexible mandrel.
Flexible shaft.
Floor hanger.
Foot power.
Foundry crane.
Frictional gear.
Friction clutch.
Friction clutch pulley.
Friction drum.
Friction gear.
Friction pulley.
Friction wheel.
Gantry crane.
Gear.
Gearing.
Gimmal rings.
Gin block.
Gin power.
Gin pulley.
Gin wheel.
Grain elevator
Grapple hook.
Gun lift.
Gut belting.
Hand hoist.
Hand winch.
Hanger.
Haul-up gear.
Hay-fork pulley.
Heart.
Hod elevator.
Hoist.
Hoisting and conveying apparatus.
Hoisting apparatus.
Hoisting block.
Hoisting drum.
Hoisting engine.
Hoisting machine.
Hoisting screw.
Hook-and-swivel block.
Horizontal jack.
Horse-bar.
Horse-hay-fork block.
Horse-power.
Horse-power jack.
Horse-power speed-regulator.
Hydraulic capstan.
Hydraulic crane.
Hydraulic elevator.
Hydraulic hoist.
Hydraulic jack.
Hydraulic lift.
Hydraulic valve.
Ice elevator.
Ice elevator chain.
Ice screw.
Inclined plane.
Inclined plane winding apparatus.
Intermediate motion.
Iron-strapped block.
Jack.
Jack press.
Jack screw.
Jetty crane.
Jib crane.
Jib-sheet block.
Journal.
Journal bearing.
Journal box.
Journal brass.
Key.
Knocking.
Ladder.
Lathe hoist.
Lever jack.
Lifter.
Lifting jack.
Lifting tackle.
Liquid bearing.
Lizard.
Locomotive steam-crane.
Loose-hook block.
Loose pulley.
Lost motion.
Man-rope eye.
Mast hoop.
Match-hook block.
Monkey wheel.
Motion.
Mounted power.
Open-sheave block.
Overhead crane.
Overhead traveling crane.
Overhead work.
Overhung head.
Overwinder.
Overwinding check.
Parrel truck.
Parting pulley.
Peak halyard-block.
Pedestal hanger.
Pedomotor.
Pillow block.
Pipe turnbuckle.
Pit-head gear.
Platform crane.
Pony gear.
Portable crane.
Portable hand-crane.
Portable hoist.
Portable steam crane.
Post box.
Post windlass.
Power hoisting-block.
Pulley
Pulley block.
Pulley lubricator.
Pulling jack.
Quarter-turn belt.
Quarter-twist belt.
Rack-and-pinion jack.
Radius bar.
Ratchet coupling.
Ratchet motion.
Rawhide.
Reversible winding engine.
Right-and-left coupling.
Ring bush.
Roller grip.
Roofing block.
Rope eye.
Rope driving gear.
Rope gearing
Rope-strapped block.
Rubbish pulley.
Safety apparatus.
Safety catch.
Safety hatch,
Safety hoist.
Safety winch.
Scandinavian belting.
Screw hoist.
Screw machine.
Self-dumping coal-tub.
Self-oiling bearing.
Shaft coupling.
Shaft hanger.
Shafting.
Shafting cup.
Sheave.
Sheave bushing
Ship jack.
Ship's hoist.
Single-rail crane.
Sister-hook block.
Skew-bevel wheel.
Snatch-block.
Socket gudgeon.
Spiral conveyor.
Split wheel.
Speed regulator for horse-powers.
Steam capstan.
Steam crane.
Steam winch.
Stone lifter.
Strap shifter.
Stiff-hook block.
Swing block.
Swivel block.
Swivel-hook block.
Tackle.
Tackle block.
Telescopic elevator.
Tension roller.
Thimble.
Thimble-eye block.
Tightening pulley.
Tom.
Top-mast truck.
Traction gearing.
Transfer elevator.
Traveler rope.
Traveling crane.
Traversing jack.
Tread power.
Tripod jack.
Truck.
Underground hauling engine,
Underground winding engine.
Unloading apparatus.
Universal joint.
Variable speed attachment.
Wagon crane.
Wagon jack.
Wall crane.
Warehouse hoist.
Water bearing.
Well-wheel block.
Well windlass.
Wharf crane.
Whelps.
Whip crane.
Whip gin.
Winch.
Winding engine.
Windlass.
Wire belt.
Wire rope.
Wire-rope splice.
Wire-rope thimble.
Wire-rope transmission.
Worm gearing.
Woven-wire belting.
Wrapping connector.
Wrecking crane.
Z-crank.

See references: —

Hoisting and sea-water distillery app. combined, Br.	* "*Engineer*," xlix. 334, 335.
Apparatus	* "*Scientific American Sup.*," 192.
And conveying bucket	* "*Eng. & Min. Jour.*," xxi. 271. Fig. 494, p. 150, *supra*. Fig 7006, p. 2798, "*Mech. Dict.*"
Clamp, Fr.	* "*Scientific Amer.*," xxxvii. 179.
Machinery	Figs. 3, 4, 6, 7, 8, "*Engineer*," xlix. 334.
Machine, portable	* "*Scientific Amer.*," xxxvii. 406.
Engine, *Bacon*	* "*Man. & Builder*," ix. 175.
Engine, double cylinder	* "*Man. & Builder*," xi 103.
Self-landing and delivering, *Barker*, Br.	* "*Engineering*," xxi. 380.
Hoist engine, mining. *Berry & Place*	* "*Min. & Sc. Press*," xxxiv. 225.
Machine brake, *Cherry*, Br.	* "*Engineer*," lxv 180.

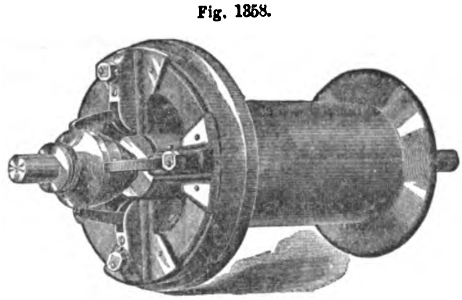
Hoist, *Clem & Morse* . * "*Iron Age*," xxv., May 6, p. 8.
Copeland & Bacon . . * "*Man. & Builder*," ix. 247.
Engine, *Davis* . . . . * "*Iron Age*," xxi., Jan 31, p 7.
Machine, *Johnson* . . . * "*Scientific American*," xxxviii. 102.
Engine, *Lidgerwood* . . * "*Man. & Builder*," xi. 154.
Engine . . . . * "*Man. & Builder*," xi. 169.
Engine, rotary.
Lidgerwood Man. Co. * "*Man. & Builder*," viii. 265.
Engine, *Mundy* . . . * "*R. R. Gazette*," xxii. 64.
Engine . . . . * "*Man. & Builder*," ix. 129.
Machine, friction . . . * "*Man. & Builder*," viii. 78.
Machine, portable . . * "*Scientific Amer.*," xxxvi. 338.
Engine for mines, *Niles* * "*Min. & Sc. Press*," xxxviii. 105, 145.
Engine, *Parke & Lacy* . * "*Min. & Sc. Press*," xxxvii. 401.
Horse-power for.
Reynolds . . . . . * "*Min. & Sc. Press*," xxxvi. 257.
And crane, self-sustaining, *Thomas*, Br. . . * "*Engineer*," xlix. 386.
Engine, portable.
Williamson . . . . * "*Scientific American Sup.*," 545.
* "*Engineering*," xxii. 7.
* "*Engineering*," xxii. 117.
Engine "Yellow Jacket" * "*Scientific American*," xli. 117.

Hoist'ing and Con-vey'ing Ap'pa-ra'tus. A system for lifting and transporting buckets used in mining, grading, loading, and discharging vessels, transporting ores, minerals, etc., from positions difficult of access

Two forms are shown: one under WIRE WAY, Fig. 7006, p. 2798, "*Mech. Dict.*"; the other under CABLE CARRIER, Fig. 494, p. 150, *supra*.

Hoist'ing Drum. A pulley on which the hoisting-rope winds. In Fig. 1358 it is shown in

Fig. 1358.



Friction Hoisting Drum.

connection with a friction clutch which conveys the motion of the shaft to the drum. The cone slips on a feather on the shaft and so locks the parts together as to revolve the drum.

Frisbie's device is also shown in section in Fig. 1097, p. 857, *supra*.

Hoist'ing En'gine. Fig. 1359 shows Frisbie's hoisting machine, operating by means of the friction-clutch in Fig. 1358. As shown, it is especially intended for pile-driving. The rope is not detached from the hammer, but unwinds from the drum, which runs free on the shaft when the friction is removed and the hammer descends to do its work.

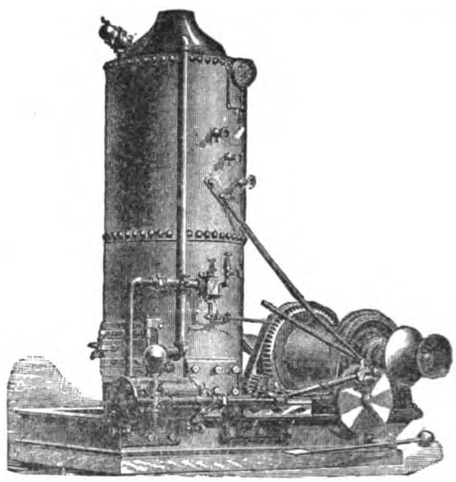
In the Lidgerwood hoisting machine, the engine is rotary and connected directly to the drum-shaft by spur-wheel and pinion. For platform elevators the machine has double or compound gearing, a brake which rests on the fly-wheel when the machine is stopped, and is lifted when the machine is started. The drum is large and has grooves for the wire cable.

In the Carr hoisting engine the engine runs constantly in the same direction, and the connection with the drum is by internal friction gearing.

See also FRICTION DRUM HOIST, Fig. 1009, p. 357; CELLAR LIFT, Fig. 573, p. 180; and ELEVATOR ENGINE, Fig. 958, p. 310, *supra*.

See also HYDRAULIC ELEVATOR; HYDRAULIC LIFT, "*Mech. Dict.*," *et infra*.

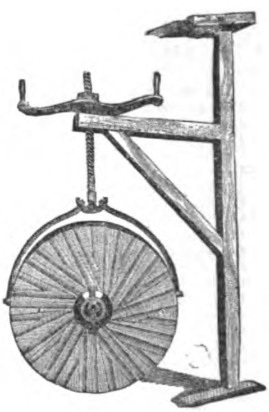
Fig. 1359.



Hoisting Engine.

Hoist'ing Screw. (*Milling.*) An elevating arrangement for lifting the runner from off the bed stone when it becomes necessary to dress either of them. The bail engages studs on the side of the stone which is then revolvable on the studs as centers in order to invert it and expose the working surface upwardly.

Fig. 1360.



Hoisting Screw.

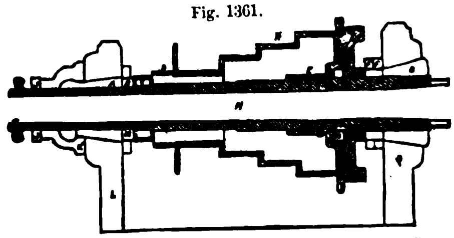
Hole Gage. A tapered metallic slip graduated to show the diameters of holes into which it may be thrust. See BARREL GAGE, Fig. 216, p. 77, *supra*.

Hol'low Plun'ger Pump. A pump made for mining and quarrying purposes, to remove water from the workings. Plunger pumps are shown in Fig. 3845, p. 1752, "*Mech. Dict.*" The tubular plunger is considered to have an advantage in muddy water.

Hol'low Spin'dle Lathe. A lathe with a head stock, the spindle of which is hollow.

P is the spindle; *H*, the hole 1¾″ diameter; *L* and *Q*, the standards of the head stock which have tapering holes to

Fig. 1361.



Section of Hollow Spindle Lathe Head with Taper Boxes.

receive the round boxes, *A* and *G*. These are turned to fit and then cut in half, being secured by the nuts, *F F* and *B*, *K*. *O* is the large spindle gear which is kept in place by the nut, *N*. *R* is a four-section cone pulley; *E*, the cone head; and *D*, the small gear on the cone. *C* is the feed-gear on the spindle. The end thrust is taken by a step held by the bracket *K* and check-nut *J*.

* "*Iron Age*," xxii., Nov. 28, p. 1.
* Fig. 2588, p. 1113, "*Mech. Dict.*"

Hol'low Spoke Wheel. (*Railway.*) A car wheel with spokes cored in casting, Figs. 166, 167, *Forney's "Car-builders' Dict."*

Hol'o-phote. (*Whole Light.*) A lamp which by refraction or reflection collects wandering rays, so that the whole of the beams are directed in the requisite course for the purpose required.

See CATOPTRIC LIGHT; DIOPTRIC LIGHT, "*Mech. Dict.*," *et supra*. Also p. 1113, "*Mech. Dict.*"
The *holophote* of Mr. Preece is a lamp for illuminating the depths of the sea. Its purpose is to detect advance of an enemy's torpedo, "*Scientific American*," xl. 358.

Ho-mo-ge'ne-ous Steel. Steel without blows (*acier sans soufflures*), *M. Euverte, Terre Noire, Fr.*

Hone. The Cinghalese hone is made of *capitia* resin combined with corundum in a state of impalpable powder, the resin rendered liquid by heat, and the corundum well incorporated. The mixture is poured into a wooden mold, and its surface leveled and smoothed while it is hot.

Oil-stone making, *Beach* . . . * "*Sc. Am. Sup.*," 293.

Hon'ey Ex-tract'or. A rotating cage in which comb honey is placed and the honey extracted by centrifugal action, the cage moving at high speed. A form of centrifugal machine. See also HYDRO-EXTRACTOR.

In Emmons's honey extractor an up and down motion is given to the comb to assist in breaking the cells.

"*Scientific American Sup.*" . . . . * 731.
"*Scientific American*" . . . . * xl. 179.

Hon'ey Knife. One with a thin blade bent at an angle to the handle.

Hood. (*Manége.*) That part of a horse blanket which covers the horse's head and neck.

Hoof Boot. (*Manége.*) A leathern boot made to fit the hoof of a horse, with an iron shoe attached; used as a protection to the hoof in case a shoe is lost, or where the hoof is in a condition that will not permit the nails being driven in it.

Hoof Cush'ion. 1. A pad in the hollow of the hoof to keep the sole moist: curative or preventive of dry cracking.

2. A roll attached to the fetlock and encircling the corona of the foot to prevent interfering.

Hoof Pick. (*Manége.*) A claw to remove stones jammed between the sole and the shoe; or the frog and the shoe.

Hook. A curved prehensile instrument. See list, pp. 1114, 1115, "*Mech. Dict.*"

1. (*Surgical.*) A frequent form in instruments, *e. g.* Hooked gorget used in supra-pubic lithotomy. Tonsil hooks, single and double; blunt hook for fistula or for parturition; tenaculi, etc.

2. (*Nautical.*) Among these are: —

Bench hook.	Match hook.
Block hook.	Self-mousing hook.
Boat hook.	Sister hook.
Clip hook.	Tackle hook,
Gaff-top-sail hook.	etc.

3. (*Fishing and Whaling.*)

a. Blubber hook.	Line hook.
Clam hook.	Lip hook.
Drail.	Lock hook.
Fly hook.	Pew gaff.
Gaff.	Spinner.
Grapple hook.	Spring hook.
Junk hook.	Squid jig.
Lance hook.	Tackle.
Lever hook.	Trawling hook, etc.

See FISH-HOOK, *supra*.

b. The backward curved portion of a wing net which constitutes it a space nearly inclosed. See STAKE NET.

4. A means for suspension. BARREL HOOK, Fig. 221, p. 78; BALE HOOK, Fig. 181, p. 68, *supra*.

A small hook for suspending calendars and what-not. *Heyl's* suspension hook; an ornamental plate with adhesive back surface and a wire loop-hook.

5. A means of handling: *e. g.*, BALE HOOK, Fig. 182, p. 68, *supra*.

The word *hook* appears in various and numerous compounds: —

Hook and eye screw-bolt.	Hook and eye turn-buckle.
Hook and eye hinge.	Hook and swivel block.

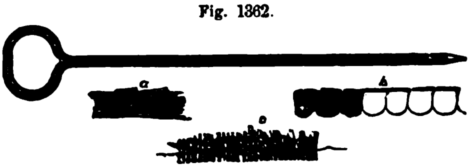
Hook and Lad'der Truck. A carriage for conveying ladders and hooks for engaging in extinguishing fires. The former useful in rescuing persons and in giving firemen entry into and points of advantage in fighting fire in buildings. The latter for pulling down dangerous walls, or buildings, which add to the extent of the conflagration.

The carriage being long, the forward truck turns under the carriage, and the hind truck is also swivelled, and is guided by a steering wheel.

Hook Nee'dle. (*Hydraulic Engineering.*) A hook-ended needle used in sewing mats for lining river banks or making levees. It is used in making the lock-stitch and also in the hook needle fastening.

The method of working is as follows: The wires are laid upon the ground, straight or crossways, as the case may be, and the material for the mat laid over them. The needle is passed through the mat, and engaging the wire pulls a loop

Fig. 1362.



Hook Needle Fastening.

up through the mat; through this loop a bobbin is passed in the lock-stitch or the butt-end of a brush in the hook needle fastening. A man at the end of the wire pulls all down very solid, and a third man stands on the wire where it crosses the brush or toggle to prevent back-slip, and presses the brush down while the next stitch is being made.

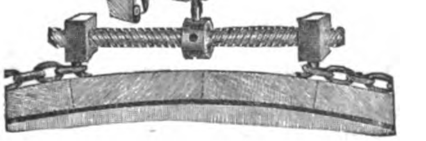
Hook Net. (*Fishing.*) One with an L-shaped continuation forming a sort of pocket. See STAKE NET. Also known as a *trap*-net.

Hook Plate. A supporter for RADIATORS, which see. See also COIL PLATE, Fig. 656, p. 203, *supra*.

Hoop. A band of metal or of wood around a cask, bale, or box.

Zollers' provisory hoop, Fig. 1363, for setting up large vats, has a right and left coupling screw, to heads on which are hooks engaging the ends of the straining chain.

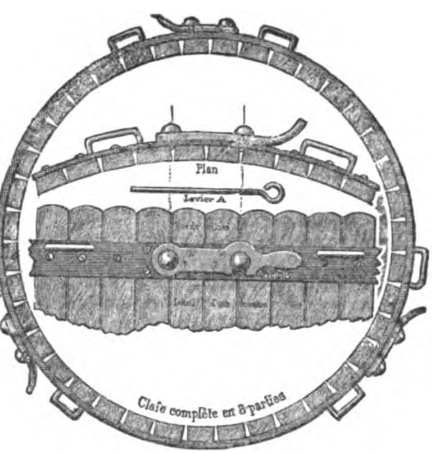
Fig. 1363.



Provisory Hook.

Fig. 1364 is a French hoop for cider and wine presses. It is made in three sections, and may be taken off when the pomace is well pressed in order to remove the exhausted material more readily.

Fig. 1364.

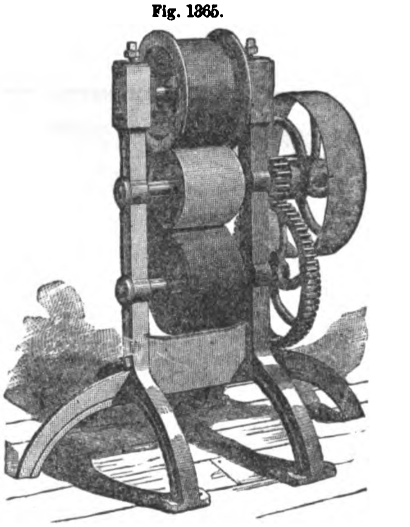


Hoop for Cider-press Vats.

Hoop-bend'ing Ma-chine'. A machine for giving flexibility to the rived sapling, for forming a hoop.

The machine has an iron frame in which are three turned

Fig. 1365.

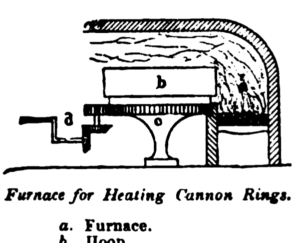


Machine for Bending Wooden Hoops.

iron pulleys. A belt is so placed upon the pulleys as to drive them all when one is put in motion. The hoop is ntered between the belt and the middle pulley, which is carried around the pulley and held close to it by the belt, which prevents its breaking.

Hoop-heat'ing Fur'nace. One for expanding a steel ring which is to be slipped on to a cannon on the building-up, or reinforce principle.

Fig. 1366.



Furnace for Heating Cannon Rings.

a. Furnace.
b. Hoop.
c. Revolving Table.
d. Crank and Gear.

When the hoop has a blue heat it is removed and slipped into place on the gun, which has been turned to a size to receive it. See ARMSTRONG GUN, "*Mech. Dict.*"

Hoop-ma'king Ma-chine'. A machine for riving hoops from the pole and finishing them.

It consists of a *splitter* and *finisher*.

A large splitter is used for heavy, that is to say, for three, four, six, or eight-part poles (which will yield that number of hoops), and a smaller splitter for smaller poles. The splitters cut through the center of the poles, and in a single rapid thrust divide at one operation each pole into all the splints which it contains.

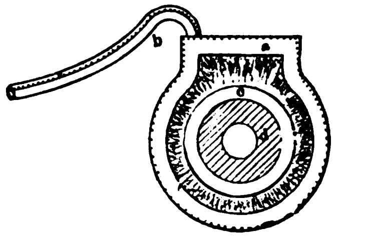
The finisher, in one rapid operation, cuts off the knots, takes out the core, finishes the face of the hoop, crimps it, and delivers it a perfect hoop, exactly even in thickness from end to end.

The splitter will split 12 to 15 poles per minute. The smaller finisher will run through 12 hoops of 6' length per minute. The larger finisher will run through 10 hoops of 7½' length per minute. — *Hart.*

Hoop-punch'ing Ma-chine'. A machine having rollers for flaring, and punches for punching and riveting respectively, the hoop-iron for making cask hoops.

Hoop-shrink'ing Ap'pa-ra'tus. An apparatus for shrinking a steel hoop which has been

Fig. 1367.



Apparatus for Cooling Hoops.

a. Watering Pot. *c.* Hoop.
b. Hose Pipe. *d.* Body of Gun.

heated to "blue" and slipped on to the core of a cannon, in the building-up or reïnforce method. It is a sort of circular watering-pot which bathes all portions of the exterior of the hoop equally.

The system of reïnforce rings is shown in the 100-ton gun, Fig. 526, p. 160, *supra*.

Hop'per. A funnel-shaped tank, spout, or vessel, either bottomless or with a movable door or flap beneath.

A coal hopper, grain hopper, etc., for discharging into cars or otherwise.

A soil hopper in a water-closet.

A car hopper, or bottom discharge of a coal car.

A weighing hopper; the cistern holding the grain and discharging below. See GRAIN SCALE.

Hop'per Barge. A barge used in dredging operations, to receive the silt from the dredger, convey it away, and drop it at any suitable place for deposit.

Hawks, Crawshay, & Co. • "*Engineering*," xxix. 354.
Dredger "Willunga," Australia . . . . . . • "*Engineer*," xlvii. 60.
Dredge, twin screw, Newhaven, Br. . . . . . • "*Engineer*," xlviii. 84, 88.

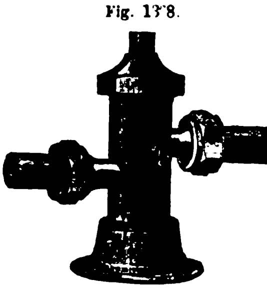
Hop'per Clos'et. A water-closet for public uses, in which the pan stands upon an S-trap and periodical flushing is depended upon for cleanliness.

Hop'per Cock. A faucet belonging to the hopper of a water-closet, so arranged as to give a wash when the seat is relieved of weight. See Fig. 1368.

Hop'per Scales. Elevator scales. See GRAIN SCALE.

Hop Pick'er. A device resembling a clothes-wringer and propelled by a treadle.

Fig. 1358.



Hopper Cock.

It consists of two rubber rollers, so constructed as to draw in the branch, while two steel rollers, having an opposite action, pick the hops from it. From the picker the hops run into a sack, which, when filled, is taken to the separator, which sorts the hops from all leaves or stems which may have gone into the sack, and thence to the hop house.

Cultivator, *Howard*, Eng. * "*Scientific Amer.*," xxxvii. 163.
Knight, Br. . . . . * "*Engineering*," xxiv. 98.

Hor'i-zon'tal Bor'ing Ma-chine'. 1. A machine with a horizontal table on which work is chucked for boring.

See HORIZONTAL LATHE, Fig. 2562, p. 1121, "*Mech. Dict.*," and Fig. 389, p. 122, *supra*.

2. A machine with horizontal boring-tool stock.

See HORIZONTAL DRILL, Fig. 2560, p. 1120, "*Mech. Dict.*"; BORING MACHINES, 811, 817, 818, 820, pp. 340, 341, *Ibid.*; UNIVERSAL BORING MACHINE, Fig. 392, p. 123, *supra*; ANGLE CAR-BORING MACHINE, Fig. 75, p. 85, *supra*.

Hor'i-zon'tal Check Valve. One arranged in a horizontal pipe, as in Fig. 609, p. 192, *supra*.

Hor'i-zon'tal En'gine. One, the piston of which works horizontally.

The following references may be consulted: —

Bertram . . . . . . * "*Scientific American Sup.*," 1472.
Brandy . . . . . . * "*Eng. & Min. Jour.*," xxvii. 2.
Blymer Co. . . . . . * "*Iron Age*," xxi., Mar. 7, p. 1.
"Buckeye" . . . . * "*Engineering*," xxii. 231.
* "*Sc. American*," xxxviii. 310.
* "*Am. Miller*," v. 126.
Corliss, 1000 h. p., Br. . * "*Engineering*," xxi. 412.
Cummer . . . . . . * "*Am. Miller*," vii. 349.
Dallam Forge . . . . * "*Engineer*," xliii. 320.
Deakin, Parker & Co., Br. . . . . * "*Engineer*," xlii. 113.
* "*Engineer*," xliii. 293.
"Eclipse" . . . . . * "*Sc. American*," xxxviii. 214.
Exeter Machine Works . * "*Scientific American*," xli. 51.
Fenby, Br. . . . . . * "*Engineering*," xxvi. 189.
Gadd . . . . * "*Engineer*," xlii. 77.
Gen. Eng. & Boiler Co. Br. . . . . * "*Engineer*," xliv. 88.
* "*Engineering*," xxiii. 341.
Gibbons, Br. . . . . * "*Engineering*," xxv. 123.
Hampson, Whitehill & Co. * "*Scientific American Sup.*," 404.
Harris-Corliss . . . . * "*Am. Miller*," v. 112.
Hindley, Br. . . . . * "*Engineer*," xlix. 394.
Marshall, Br. . . . . * "*Engineering*," xxvi. 31.
Norwalk Iron Works . * Thurston's "*Vienna Exp. Rep.*," ii. 25.
Pickering & Davis . . * Thurston, "*Vienna Rep.*," ii. 35.
Porter-Allen . . . . . * "*Manuf. & Builder*," x. 217.
* "*Iron Age*," xxii., Oct. 10, p. 1.
Reading Iron Co., Br. . * "*Engineer*," l. 39.
Robey, Br. . . . . . * "*Engineering*," xxvi. 466.
Snyder, "Little Giant" * "*Sc. American*," xxxix. 63.
Sulzer Bros, Switz. . . * Thurston's "*Vienna Exp. Rep.*," ii. 21.
Tangye, Br. . . . . . * "*Scientific American Sup.*," 3943.
* "*Engineering*," xxiv. 492.
* Thurston's "*Vienna Exp. Rep.*," ii. 29.
Turner, Br. . . . . . * "*Engineering*," xxiv. 457.
"Gippeswyk," Br. . . * "*Engineer*," xlviii. 4.
* "*Engineer*," xliv. 422.
Walschaert, Bel. . . . "*Engineering*," xxvii. 29.
Watts . . . . * "*Engineer*," xliii. 409.
* "*Scientific American Sup.*," 1316.
Condensing, *Brown* . . * "*Engineering*," xxv. 475.
Cond. exp., *Brown*, Switz. . . . . . . * "*Engineering*," xxix. 75.
Cond. exp., *Bertram*, Br. * "*Engineer*," xliv. 136.
Cond., *Brinkmann*, Ger. * "*Engineering*," xxx. 170.
Cond. exp, Collmann, Ger. . . . . * "*Engineering*," xxviii. 109.
Cond., *Deakin, Parker & Co.* . . . . * "*Engineer*," xlvi. 461.
Cond., *Dick & Stevenson*, Br. . . . . . * "*Engineering*," xxv. 184.
Cond., *Duvergier*, Fr . "*Engineering*," xxv. 425, 429.
Cond. *Fourlinnie*, Belg * "*Engineer*," xlv. 350, 364.
Cond. exp., *Lebrun*, Fr. * "*Engineering*," xxx. 246.
Cond., *Soc. Marcinelle*, Belg. . . . . . . * "*Engineer*," l. 350.
Cond high-pressure engine, *Marshall*, Br. . * "*Engineer*," xlvi. 446, 451.
Cond., *Marshall*, Br. . * "*Engineering*," xxvi. 453.
Cond. exp., *Nolet*, Belg. * "*Engineer*," xlvii. 226.
Cond., *Robey*, Br. . . * "*Engineer*," xlvii. 452.
Cond., *Ruston & Proctor*, Br. . . . . * "*Engineer*," xlvii. 470.
* "*Engineering*," xxviii. 5.
Surface cond., *Ruston & Proctor*, Br. . . . . * "*Engineer*," xlv. 289, 292, 307.
Cond., *Soc. Suisse*, Switz. . . . . . . * "*Engineer*," xlv. 365.
Cond. exp., *Sulzer*, Switz. . . . . . . * "*Engineer*," xlvi. 150.
Expansion, *Bennie*, Br. * "*Engineer*," xliv. 373.
Exp, *Collmann*, Ger. . * "*Engineer*," xlv. 144.
* "*Engineering*," xxx. 455
Exp., *Corliss*, Belgian . * "*Engineer*," xlv. 405.
Exp., *Davey, Parman & Co.*, Br. . . . . * "*Engineer*," xlviii. 5.
Exp pumping, *Escher, Wyss & Co.*, Switz. . * "*Engineering*," xxx. 348.
Exp., variable, *Gen. Eng. & Boiler Co.* . . * "*Engineering*," xxi. 357
Exp., *Halpin*, Br. . . * "*Engineering*," xxvii. 480.
Exp., *Hayward, Tyler & Co.*, Br. . . . . . * "*Engineer*," xlviii. 145.
Exp., *Marshall*, Br. . . * "*Engineer*," xlvi. 427.
Variable cut-off, *Porter-Allen* . . . . . . * "*Engineering*," xxvii. 107.
Exp., *Reading Iron Co.* Br. . . . . * "*Engineering*," xxx. 41.
Exp., *Reading Iron Works*, Br. . . . . * "*Engineer*," xlviii. 17.
Exp., *Rensing*, Ger. . . * "*Engineering*," xxx. 623.
Exp., *Ruston & Proctor*, Br. . . . . * "*Engineer*," xlviii. 447.
Exp., *Corliss*, Saltaire, Br. . . . . * "*Engineering*," xxx. 111.
Exp. gear, *Shanks*, Br. . * "*Engineer*," xlvi. 18.
* "*Engineering*," xxvii. 561.
Exp., *Socin & Wick*, Switz. . . . . . . * "*Engineer*," xlvi. 350.
Exp gear, *Virck*, Ger. . * "*Engineering*," xxviii. 187.
Exp., *Zimmerman*, Ger. * "*Engineering*," xxx. 565.
Non-cond., *Ruston & Proctor*, Br. . . . . * "*Engineering*," xxviii. 465.
Cond. pumping, Newent colliery, Br. . . . . * "*Engineer*," xlix. 27.
Pumping, St. Maur, Fr. * "*Engineering*," xxvi. 170–173.
Reversing high-pressure, *Galloway*, Br. . * "*Engineer*," l. 310.

Hor'i-zon'tal Mor'tis-ing Ma-chine'. One, the auger and bit of which act in a horizontal direction.

Fig. 3339, p. 1483, "*Mech. Dict.*"; CHAIR MORTISER, Fig. 594, p. 189, *supra*.

Hor'i-zon'tal Pump. One, the barrel of which is horizontal.

A convenient form of lever handle-pump, and the usual position in steam pumps: instances (9) on pp. 2357–2359, "*Mech. Dict.*" See list under PUMP, p. 1827, *Ibid.*

Hor'i-zon'tal Saw Mill. One, the saw of which traverses horizontally: not a frequent position, but found in some special saws.

Horn. 1. (*Railway.*) One of the projecting parts of a pedestal, between which the journal-boxes work.

Horn-block in British parlance. See PEDESTAL, Fig. 3595, p. 1647, "*Mech. Dict.*"

Horn-block facing-machine, Lond. & N. W. Ry., * "*Engineering*," xxviii. 261.

2. (*Music.*) A brass wind instrument, with a mouth-piece, made in great variety. The name characterizes a family. Speaking in the most general terms, it may be said that they are of all sizes, and consequently of pitch, as the larger tubes vibrate more slowly. The pitch is also varied by

movable crooks. Some horns have keys, other pistons, cylinders, or slides. They have also a capacity for another variation of sound, known as the *open* or *closed;* the latter produced by closing more or less the *pavilion* or bell by means of the hand.

See CORNET, p. 222, *supra*. Also instances (11), Fig. 2564, p. 1122, "*Mech. Dict.*"

Horn Block. The casting with two dependent branches, between which the axle-boxes of a car work as the springs expand and contract. A *pedestal.*

Horn'er. A tool for breaking off the awns of barley. *Awner.*

Horn Ma-chine'. A machine for sewing soles to shoes.

The shoe being slipped on a *horn*, gives name to the machine. A *horn* is shown in Plate LX., opposite p. 2162, "*Mech. Dict.*"

Horn Press. A power press for closing the side-seams of cans and boxes, which are for the purpose slipped upon a horn protruding from the standard of the machine.

Ho'ro-graph. An instrument for making a multitude of perforations on a line, as guided, through a thin paper to be used as a stencil.

It resembles the Edison electric pen in the result, but the means of driving the *Newton, Wilson & Co.* horograph is a spring and clock-work.

"*Engineer*"	* xlvii. 813.
"*Scientific American*"	* xl. 377.

Horse Bar. The lever of a horse-power. A sweep.

Horse Bis'cuit A food for campaigning horses; adopted in Prussia and Russia. Also known as *oat comfit.*

It consists of: —

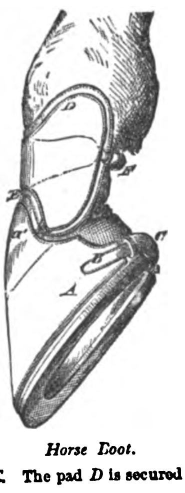
Oat flour	30
Dextrinated pea meal	30
Rye flour	30
Linseed meal	10
Or:	
Oat flour	40
Dextrinated pea meal	40
Linseed meal	20
Or:	
Pea meal	20
Wheat flour	20
Corn meal	20
Rye flour	20
Grated bread	10
Linseed meal	10

Or analogous mixtures.

$3\frac{1}{2}$ lbs. of the oat comfit are estimated to have a value equal to 12 lbs. of oats.

A daily ration is $3\frac{1}{2}$ lbs. comprising, say 26 biscuits, 4 to 5″ in diameter and 4-10″ thick. The biscuits are fed broken, dry or wet; 7 in the morning, 12 at noon, 7 in the evening.

Fig. 1369.



Horse Boot.

Horse Boot. (*Manége.*) An attachment designed to protect the hoof, pastern joint, and fetlock joint from being cut or injured by the over-reaching or interfering of the horse when being driven at high speed.

The lower portion, *A*, covers the hoof, and is secured by strap *B*, which passes around the heel. The portion *a′* covers the corona, and a tube, *C* on *B*, prevents the boot from slipping. *D* is the upper or speedy-cut boot, which is concaved in front to fit the portion *a′* of the hoof-boot, to which it is secured by straps *E E*. The pad *D* is secured by strap *F*.

Horse Car. (*Railway.*) *a.* One fitted to carry horses.

b. A street-car drawn by horses.

Horse-car heating . . .	"*Scientific American,*" xli. 393.

Horse Fix'tures.

Boot, *Fennel*	* "*Min. & Sc. Press,*" xxxv. 81.
	* "*Scientific Amer.,*" xxxvi. 386.
Collar, hameless.	
Fisher & Watson . .	* "*Scientific Amer.,*" xlii. 243.
Detacher, *Ehret* . . .	* "*Scientific American Sup.,*" 460.
Driving by electricity, Fr.	"*Iron Age,*" xix., April 12, p. 1.
Groomer, *Newton* . . .	* "*Scientific Amer.,*" xxxiv. 402.
Motions, science of . .	* "*Scientific Amer.,*" xxxix. 239.
Tail clipper, Br. . . .	* "*Engineer,*" xliv. 424.
Holdback, harness.	
Knight & Hilliard . .	* "*Scientific Amer.,*" xlii. 195.

See "*The Horse in Motion,*" *Stillman*, J. R. Osgood & Co, Boston, 1882.

Horse Groom'er. See GROOMER, p. 427, *supra.*

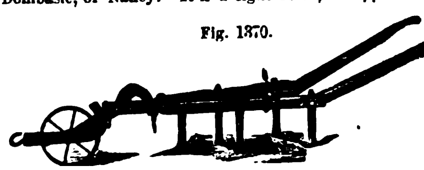
Horse Ham'mock. Used in shipping, transporting, and disembarking horses. In slinging, the canvas hammock is carried beneath the body of the horse and the cringles of the ends are carried to rings which engage the tackle-hook. Breast and breeching bands keep the horse from plunging out of the hammock.

On ship-board, the hammock is so suspended as to pass beneath the body of the horse, so as to catch him when he loses his feet in rough weather, and hold him till he recovers footing.

Horse Hoe. An implement for cultivating the ground between crops drilled in rows.

Fig. 1370 is a French horse hoe made by Meixmoron de Dombasle, of Nancy. It is a light form, an approximation

Fig. 1370.

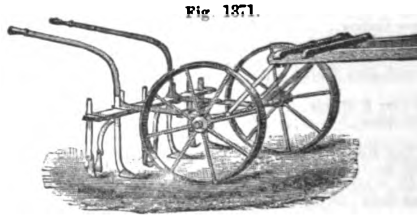


French Horse Hoe.

to the American, except in the shape of the hoes, which follows the English. The wheel in front regulates the depth, and the double adjustment by means of the perforated bars and pins gives command of the level or inclination of the frame. The latter is adjustable for different widths.

The implement shown in Fig. 1371 is also intended to follow drilled wheat, the hoes being carefully adjusted to the

Fig. 1371.



French Horse Hoe.

proper relative distance in accordance with the shares of the drill. The whole row of hoes is lifted or depressed by means of the handles.

See HOEING MACHINE, Fig. 2521, p. 1107, "*Mech. Dict.*"
See also SCARIFIER.

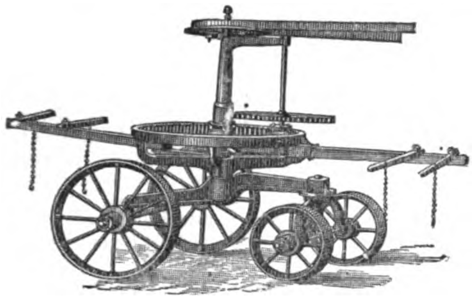
Horse Net. A net to protect a horse from flies.

Horse Pow'er. An apparatus for transferring the draft power of the horse to any machine.

Figs. 1372, 1373, 1374 show several French horse-powers, of moderate size. See also Figs. 2568-2571, pp. 1125-1127, "*Mech. Dict.*"

Fig. 1372 is a horse-power by *Girardin*, of Étampes (*Seine-et-Oise*). It is designed for two horses, and is used without dismounting.

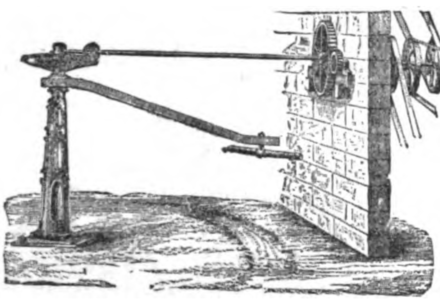
Fig. 1372.



Girardin's Mounted Horse-power.

The small horse-power with shafting, Fig. 1373, by Gautreau, of Dourdan (*Seine-et-Oise*), France, is founded on a column, the connecting-shaft going overhead. The horse-power stands on the outside of the building, and the power is transmitted by a bevel master-wheel and pinion, spur-

Fig. 1373.



Gautreau's One-horse Power.

wheel, and pinion to the pulley-shaft, which latter has a speed of 60 revolutions per minute with an ordinary speed of the horse which is attached to the sweep.

From the shafts in the building different *instruments d' intérieur*, as they are termed, are operated. Such are the straw-cutter, root-washer, root-cutter, grain-bruiser, etc.

The column is simply bolted to a foundation-plate or pillar, and the wall-gearing and shafting to a wall-plate, with but little expense of fitting, the work being simply to line and level the shafting in boxes already prepared and easily attached in place.

Fig. 1374 is another form of columnar horse-power, adapted for one or two horses. It is one of the lightest and cheapest forms.

The head is movable on the neck of the column, so as to direct the band-wheel in any radial direction from the column as an axis. It may thus be made to do duty with either one in turn of a numerous series of machines in a circular arrangement around the horse-power as a center, such as a chaff-cutter, root-cutter, corn-sheller, cider-mill, churn, or what not.

The speed-multiplier is an arrangement of spur-gears and pinions on the cruciform foot-frame, which is anchored or staked to the ground, or bolted to a floor.

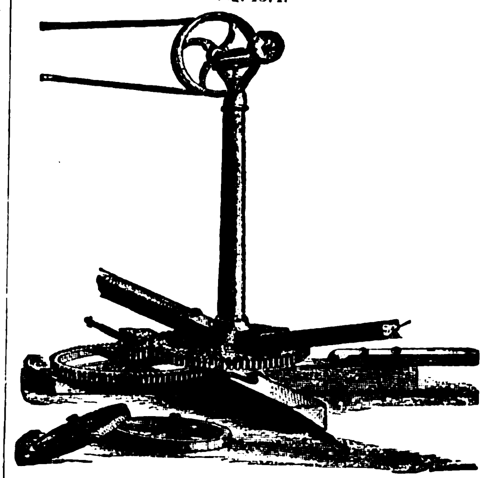
The pulley revolving in a vertical plane has one advantage over the horizontal pulley, as it allows the endless band to reach a machine whose driving-pulley is much below that on the column, whereas the horizontal pulley requires that the machines shall have a relative height.

It is transported by sufficiently elevating it to enable wheels to be slipped upon the spindles, which are shown projecting from the ends of two opposite bars of the cruciform frame. To one of the bars at right angles to the last stated is attached the tongue to which the team is geared for transporting the horse-power; or the tongue is attached to the rear of the thrasher.

The pulley-shaft may be prolonged by means of a coupling, so as to penetrate the wall of a building for the conveyance of power.

Refer to: . . . . . * "*Scientific American Sup.*," 771.
Crowley, Br. . . . . * "*Engineer*," 1. 192.

Fig. 1374.



Gautreau's Two-horse Power.

Turner, Br . . . . * "*Engineering*," xxiv. 68.
Pump, *Hayward* . . * "*Scientific American*," xxxiv, 243
Pump, *Hill* . . . . * "*Scientific American Sup.*," 605
Radway, *Emery* . . . * "*Am. Manuf.*," July 9, 1880, p. 12.
Stable floor, *Crawford* * "*Scientific American*," xliii. 294.

Dr. Knight's report on Class 76 at the Paris Exposition of 1878, gives views and descriptions of the following horse powers and thrashers. See "*Paris Exposition* (1878) *Reports*," vol. v., pp. 167–183.

One-horse overhead horse-power	*Gautreau*	France.
Vertical horse-power with overhead-rod	*Gautreau*	France
Overhead columnar horse-power with band-wheel	*Gautreau*	France.
Horse-power with ground-rod	*Gautreau*	France.
Hand-thrashing machine	*Texier & Fils*	France.
One-horse-power thrasher	*Gautreau*	France.
Portable thrasher and mounted horse-power	*Gautreau*	France.
First-class thrasher	*Ruston, Proctor & Co.*	England.
Oblique-slotted beater for thrashers	*Gérard & Fils*	France.
Band-cutting and self-feeding apparatus	*Marshall*	England.
Automatic feeder	*Ruston, Proctor & Co.*	England.
Plan of safety-feeder	*Ruston, Proctor & Co.*	England.
Straw-stacker, rigged for use	*Marshall, Sons & Co.*	England.
Straw-stacker, folded	*Marshall, Sons & Co.*	England.
Complete English thrashing apparatus	. . . . .	England.
Section of straw-burning engine furnace	*Ransomes*	England.
Straw-burning engine	*Ransomes*	England.
Straw-burning portable engine	*Ruston, Proctor & Co.*	England.
Huller for clover, lucern, etc.	*Brouhot & Co.*	France.

Horse'-pow'er Com-pu'ting Scale. A pocket sliding scale for computing from the usual data, the indicated horse-power, size for power, etc.

The instrument consists of a simple double slide-rule, and will give the power of any cylinder from 4″ to 100″ diameter, working at from 1 lb. to 100 lbs. mean pressure, within about ½ per cent. of accuracy. By placing the scales in the necessary relative positions, they give, without calculation (1), the indicated horse-power from the usual data; (2) the size of engine for any given power; (3) the piston speed due to any stroke and number of revolutions per minute; (4) the ratio the high and low pressure cylinders of compound engines bear to each other; (5) the proportion the *mean* bears to the *initial* pressure, with the steam cut off at any given point in stroke. The instrument is 4½″ × 2¼″.

Horse'-pow'er Jack. The intermediate motion of a horse-power, whereby the motion of the tumbling rod is transferred to a band-wheel shaft.

See JACK; INTERMEDIATE MOTION.

Horse'-pow'er Pump. A pump driven by animal power, as at *D*, Fig. 2569, p. 1126, "*Mech. Dict.*" The Oriental and Spanish Norias (Na' Ura) are usually driven by cattle; the wheel with pots, as in Fig. 3333, p. 1533, "*Mech. Dict.*"; or the wheel with rope and pots, *a*, Fig. 3334, *Ibid.*

Horse'-pow'er Reg'u-la'tor. A device to limit the speed of the horse-power when work is suddenly withdrawn.

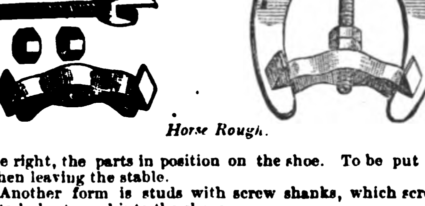
See GOVERNOR, Fig. 1230, Plate XIX.

Horse Rake. See HAY RAKE.

Horse Rough. A removable calk or stud to be attached to the shoe of a horse when traveling upon frozen ground or ice.

The Fig. 1375 shows, on the left, the pieces detached; on

Fig. 1375.



Horse Rough.

the right, the parts in position on the shoe. To be put on when leaving the stable.

Another form is studs with screw shanks, which screw into holes tapped into the shoes.

Horse Shoe. A horse shoe of raw hide is composed of three thicknesses of cow-hide compressed into a steel mold and then subjected to a chemical preparation. It is light, lasting, elastic, and requires no calks, even on asphalt.

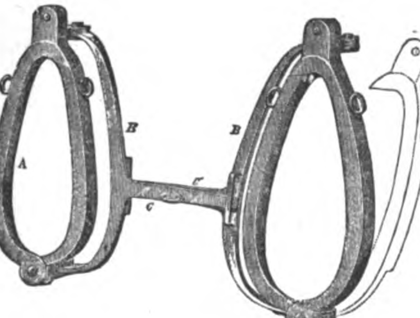
Refer to: —

Billings	* "*Scientific American*," xl. 53.
Mc Veen	* "*Am. Man.*," Mar. 7, 1879, p. 12
Potvin	* "*Scientific American*," xliii. 18.
Thistlewood	* "*Scientific American Sup.*," 240.
And swage, *Stephenson* .	* "*Scientific Amer.*," xxxiv. 355.
Bender, *Ray*	* "*Scientific American*," xxxv. 51.
Calk, *Thistlewood* . .	* "*Iron Age*," xx., Nov. 8, p. 20.
Hoof cushion	* "*Scientific American Sup.*," 2835.
Nails, manufacture of, "Globe"	* "*Scientific American*," xl. 127.
Nail machine, *Sheridan*	"*Scientific American*," xli. 88.
Steel, *Williams* . . .	"*Iron Age*," xix., April 19, p. 11.
Weighted, *Seixas* . . .	* "*Scientific American*," xlii. 102.
	* "*Iron Age*," xxv., April 15, p. 9.

Horse'-shoe Ham'mer. See FARRIER'S HAMMER; TURNING HAMMER; TURNING SLEDGE, etc. See list under HAMMER; SLEDGE.

Horse'-shoe'er's Ma-chine'. A foot-vise with treadle and toggle. The shoe is gripped by

Fig. 1376.



Horse Yoke.

placing the foot on the treadle, and the vise falls open when the foot is removed. The dies in the jaws of the vise are so shaped to give the right form to the calk as it is hammered. An anvil attachment is used for trueing up the shoe; it carries a steel die with four different-sized slots for welding on calks. See ANVIL VISE, Fig. 97, p. 42, *supra*.

Horse'-shoe Stud. A calk secured into the horse-shoe.

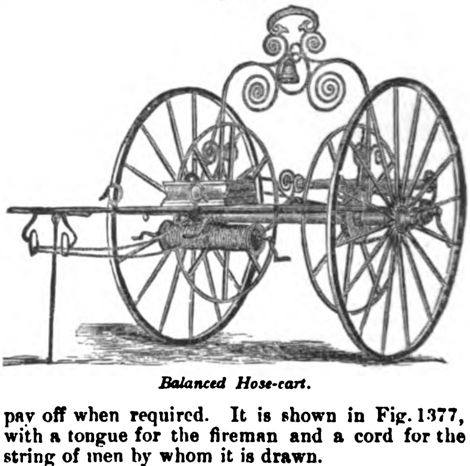
Horse Yoke. (*Agric.*) A pair of hames, *A A*, Fig. 1376, slipped upon the usual collars, and each consisting of two hinged portions to clasp upon the neck; the two hames connected by sections *B B* and a brace, *C*; the latter having a ring to which the draft chain is attached. Practically, a return to the most ancient method of harnessing. See Fig. 1251, p. 528, "*Mech. Dict.*"

Hose. Flexible pipe for conveying fluids.

Hose-carriage, *Aiken* .	* "*Scientific American*," xlii. 275.
Miller	* "*Scientific Amer.*," xxxiv. 262.
Coupling	* "*Scientific Amer.*," xxxviii. 182.
Hoffmann	* "*Scientific American*," xli. 15.
Price	* "*Scientific American*," xxxv. 383.
Coupling, wedge, *Galvin*	* "*Am. Man.*," July 25, 1879, p. 12.
Nozzle, variable, *Leggett*	* "*Iron Age*," xxi., Jan. 17, p. 3.
Nozzle, *Palmer* . . .	* "*Scientific American*," xli. 396.
	* "*Scientific American*," xlii. 54.
Pipe	"*Scientific American*," xli. 320.

Hose Cart. A two-wheeled vehicle for transporting hose. It has arrangements for winding the hose upon the drum, and allowing the hose to

Fig. 1377.



Balanced Hose-cart.

pay off when required. It is shown in Fig. 1377, with a tongue for the fireman and a cord for the string of men by whom it is drawn.

Hose Clamp. A band which can be tightened upon a hose to sustain a weak part or stop a leak.

Fig. 1378.

Hose Clamp.

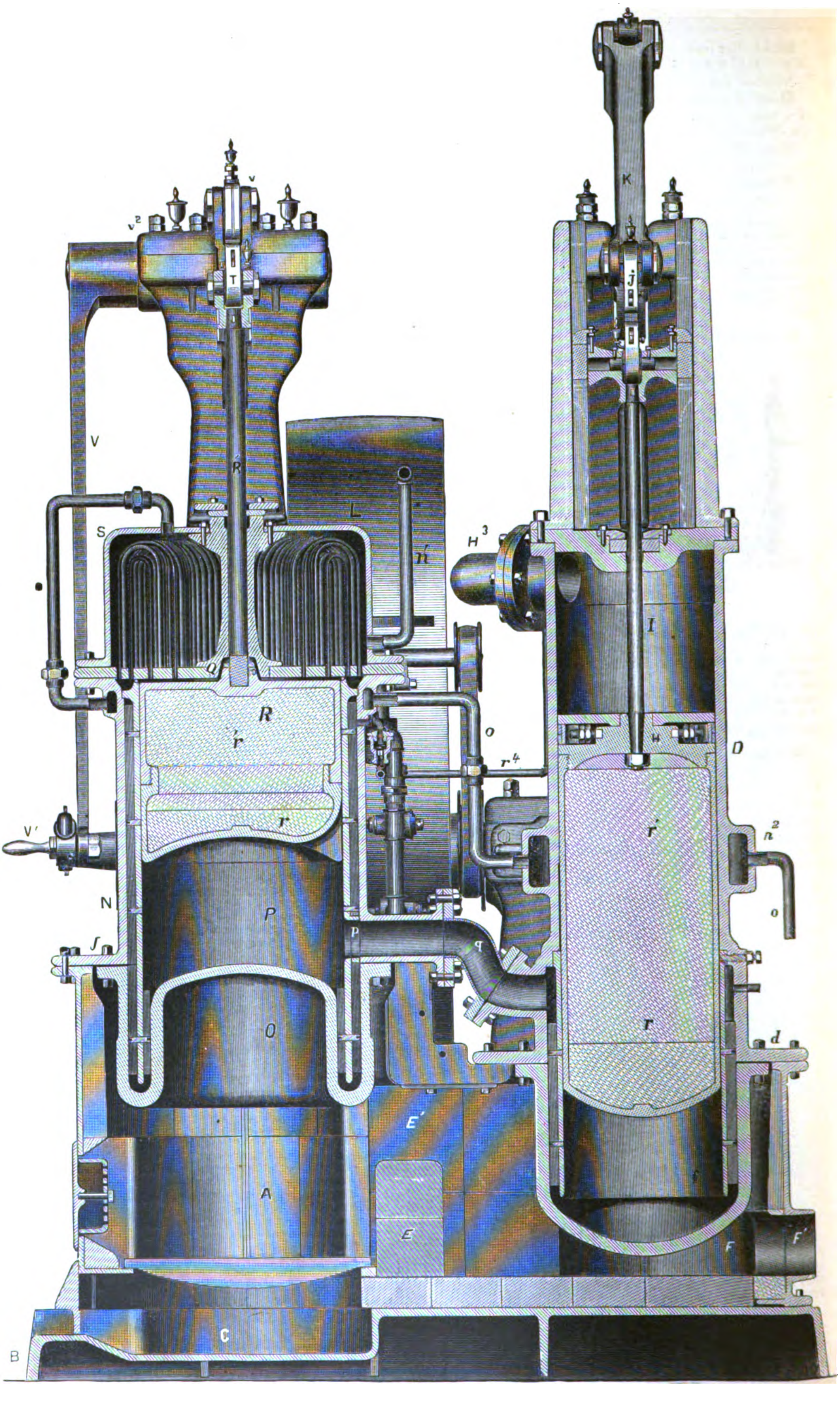
Hose Nip'ple. A short pipe, externally threaded at each end; on to one end the hose is firmly bound by lashing, the other affords junction for another section of hose or for the nozzle.

Hose Screw. The brass or gun-metal coupling for hose sections. See HOSE COUPLING, Fig. 2582, p. 1132, "*Mech. Dict.*"

Hose Sprink'ler. A rose on the end of a nozzle to give a fine spray of water.

Hose Truck. A small hose-carriage for carrying hose for domestic and garden use, washing carriages, etc.

See Fig. 2575, p. 1132, "*Mech. Dict.*"



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Hose Un'ion. See Hose Coupling, "*Mech. Dict.*," Fig. 2582, p. 1132.

Another name for the screw coupling.

Hose Un'ion Cap. A cover to close the end of a hose; a cap screwed upon the coupling at the end of the line of hose.

Hose Wrench. A spanner for coupling and uncoupling sections of hose.

Ho'sier-y Seam'ing Ma-chine'. A machine for sewing together knitted goods.

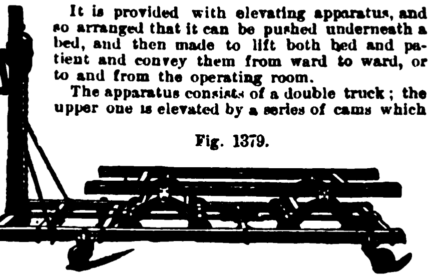
The loops of the respective pieces are slipped on to holding pins and are sewn together by a chain-stitch. The reciprocating eye-pointed needle puts a loop of yarn through the loops of the knitted fabric, the needle-yarn being caught by a reciprocating hook, which detains it while the needle retires; the goods are then fed along the distance of a stitch and the needle repeats the movement. The feed is by a rack-movement

Hos'pi-tal-bed El'e-va'tor. A truck, devised by Dr. Morton, for surgical wards especially.

It is provided with elevating apparatus, and so arranged that it can be pushed underneath a bed, and then made to lift both bed and patient and convey them from ward to ward, or to and from the operating room.

The apparatus consists of a double truck; the upper one is elevated by a series of cams which

Fig. 1379.



Hospital Bed-elevator and Truck.

run upon a narrow iron track: a long right-and-left screw, worked by an endless chain upon a crank at one end, raises and depresses the cams 400 lbs. can be lifted quite free from the floor in 4 seconds: and without difficulty a water-bed, which weighs about 700 lbs., with patient, can be elevated and readily moved. The elevation of the bed an inch or so from the floor is all that is required.

Invalid bed, *Graff*. . . * "*Scientific American*," xl. 403.

Hos'pi-tal Ward Car'riage. An invention of Dr. Morton for conveying all the necessary appliances for dressing the wounds or sores of the patients in a surgical ward.

It is a truck on 3 gutta-percha rimmed wheels, carrying a table, elevated water reservoir, and hose, the necessary pans, etc. On either side of the water-can appropriate places are partitioned off for the bandages, charpie, oiled silk, adhesive

Fig. 1380.

Hospital Ward Carriage.

plaster, and jars for holding the lint soaked in the various solutions commonly used for ward applications; drawers are placed in each end and serve as receptacles for towels, instruments, etc., etc. One large bucket, with a projecting lip, occupies one half the space under the table, into which all the refuse dressings, poultices, soiled water, and oakum, from each patient, are emptied. Another can, with two compartments, adjoins the bucket; into one of these the soiled bandages are thrown, while the other carries the fresh oakum, cotton batting, muslin, and old linen, used for the ordinary ward purposes.

One good-sized basin serves for the entire ward or series of communicating wards, since it serves merely as the receptacle for the water and discharges flowing from the part during the process of dressing. A can for hot water, for heating the adhesive plaster, completes the apparatus, which is pushed to the foot of each bed; the length of the gum-elastic tube and the elevation of the supply of water allow the stream to be carried to any part of the patient which requires cleansing, in either the recumbent or sitting posture.

Hot'-air En'gine. The subject of hot-air engines falls under several heads, as inventors have chosen names which have been accepted and become established. In the "*Mechanical Dictionary*," 11 pages have been devoted to Air Engines, nearly all of which work by increase of pressure derived from increment of heat.

The *caloric* engine of Ericsson was described in pp. * 40, 41, "*Mech. Dict.*," and a later very compact form at Figs. 510, 511, p. 155, *supra*. See references *passim*.

The *compression* engine of Rider is shown at Fig. 674, p. 216, *supra*.

One of the earliest, and certainly simplest, though not important, except as one may care to gather up all the items in the history of an art, is the English patent of Joseph Hately, 1775 of 1790, in which he proposed to utilize the force of a current of rarefied air escaping from a chimney against vanes. A smoke-jack.

Cooling arrangements for cylinder, Engl. Pats., Boulton, 1,636 of 1864; 501 and 827 of 1865.

C. W. Siemens, Engl. Pat., 2,074 of 1860, uses 4 working cylinders with communication through regenerators. A mixture of air and inflammable gas is introduced into the chambers through pipes. Cylinders cooled by currents of cold water. See 326 of 1852; 1,363 of 1856.

Woods's Engl. Pat., 739 of 1859. Air heated by passing through pipes conveyed to a cylinder under pressure.

See also Engl. Pat., Young & Kirk, 227 of 1864. Two displacing cylinders above the engine. The upper parts heated by steam jackets; the lower cooled by water. The pistons drive the air alternately from one to the other.

Mennon's, 218 of 1862. The piston of a single-acting engine is adapted on one side to draw in air and force it to the heating surface; on the other side is exposed to the motive power of the heated air. The capacity of the cylinder on each side is proportioned.

Wenham's hot-air engine (English) The air is heated in a closed combustion chamber by direct contact with the fuel, and passes with the gases evolved into the cylinder. The cylinder is single acting, the upper part of it being arranged to serve as an air pump, and there is the usual regenerator for economizing fuel.

The feature of burning under pressure and sending the gaseous products of combustion to the cylinder is found in the U. S. patents of Bennett, 1838, and Washburn, 1865. In fact it was the feature of Oliver Evans's "volcanic engine," about 1786.

The hot-air engine of Woodbury, Merrill, Patten & Woodbury is shown in elevation in Fig. 1381 and in vertical section in Plate XXI.

The essential features are a heater, regenerator, and cooler, which three, in combination, are termed a *reverser*, and in conjunction with a working cylinder, constitute a single-acting engine. The illustrations represent a double-acting engine, with two reversers and two working cylinders. These in a machine of the size represented are of the following sizes:

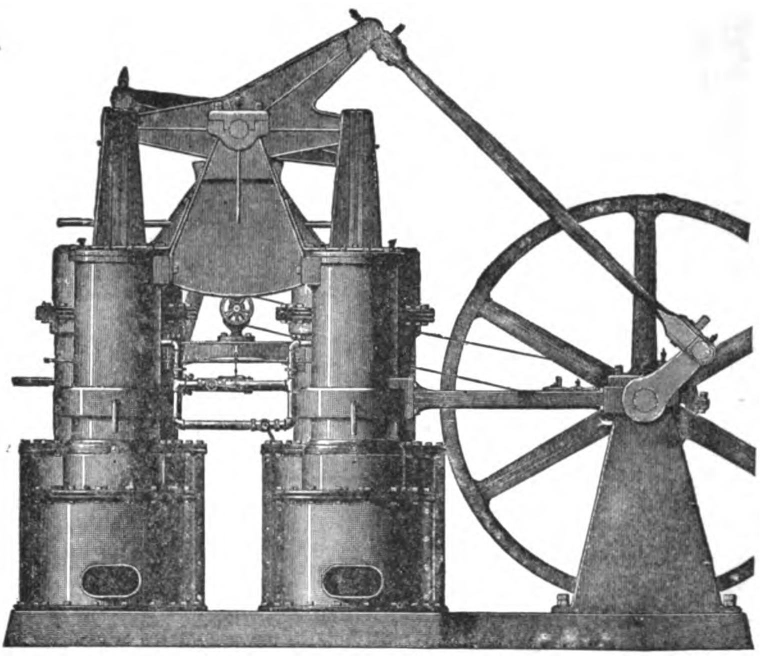
Working cylinders . . 10″ diameter . . 2′ stroke.
Reverser cylinders . . 20″ diameter . . 1′ stroke.

The air is heated and cooled on each revolution; and the rapidity with which this is effected is one of the chief objective points in machines of this character. The cooling process is performed by the circulation of water around small thin copper tubes through which the air passes.

The following statement explains the principle of the machine in the words of the inventors: —

In a machine of the size above referred to, "the displacer pistons or reverser pistons change 4,000 cubic inches of air from the hot end to the cold end by one displacer, and 4,000 cubic inches from the cold end to the hot end by the other displacer, each stroke of the engine, the engine being a double cylinder, or practically a pair of engines. In this way 8,000 cubic inches are heated and cooled by each stroke of the en-

Fig. 1381.



Hot-air Engine.

gine, or 16,000 cubic inches moved at each revolution, and of this amount 8,000 is heated and 8,000 cooled at each revolution, or at 100 revolutions per minute, which was the speed of the engine in its regular work in the Institute Fair [Mass Manuf. & Mech. Inst. Fair, Boston, 1881], 800,000 cubic inches are heated to a differential temperature of at least 400° Fah, and this is probably lower than actual practice. It is well known that atmospheric air at 30″ barometric pressure requires 13 cubic feet to weigh one pound avoirdupois, hence 800,000 cubic inches equals 470 cubic feet; 470 divided by 13 equals 36 lbs., which are heated to 500° Fah. every minute when working under 1 atmosphere of pressure, and at 4 atmospheres pressure 144 lbs. of air are heated to the same temperature. Actual experience with this motor has proved that the actual consumption of coal has not exceeded 400 lbs. in 10 hours, or 40 lbs. per hour. Per minute the consumption is one sixtieth of forty or two thirds of 1 lb per minute, and 144 lbs. of air is heated to a differential temperature of at least 400° Fah., with the combustion of two thirds of 1 lb. of fuel. It may take somewhat more heat to heat the air working under 4 atmospheres density, but it has not been realized in actual practice, or in practical work, and this practical experiment has proved that so long as the air is confined in a given space the rapidity and facility of its heating is not approximately different whether 1 atmosphere is worked or 4 atmospheres are worked; but the power developed by 4 atmospheres is enormously different in dense air from that obtained by using air under simply the natural atmospheric pressure. With 1 atmosphere the engine indicates 8 horse-power; with 4 atmospheres it indicates 26 horse-power, and in either case three quarters, at least, of the indicated horse-power is transmitted by the fly-wheel, the balance being absorbed in the friction of the engine, passing the air through the parts and running the water and air pumps. The cooling requires some 15 gallons of water per minute, the water weighing 8 lbs. 3 oz. per gallon; 15 gallons weigh 123 lbs., and this amount is required to cool 36 lbs. of air when working 1 atmosphere, and in working 4 atmospheres' density 144 lbs. of air are required, and the cooling water is raised in temperature about 20° Fah. above its normal temperature in passing through the coolers."

In Fig. 1381, which is a side elevation of the engine, the working cylinders (the smaller) are seen in front and the reverse cylinders behind.

In Plate XXI. the section passes through one working and one reversing cylinder, the connections, fire pit, bridge wall, and flue being one half of the engine as shown in Fig. 1381, the other half being precisely similar, making up a full double-acting engine with 4 cylinders having 2 working cylinders and 2 reversers. *A* is the fire-box or furnace mounted upon a bed plate and provided with the grate, ash-pit *C*, and the usual fire door. The fire-box casings extend to the rear of the combustion chamber, sufficiently far to serve as supports for the working cylinder, *D*; the rear portion being partially separated from the combustion chamber by the bridge wall *E*, above which the products of combustion pass through the flue *E′*, across the chamber *F*, and thence escape into the chimney through the passage *F′*. The working cylinder *D* is cast open at both ends and provided at its lower end with broad flanges, the outer portion of which rests upon and is securely bolted to the casing *A*, while to the inner portion of the same flange of the cylinder is bolted the fire-pot or heater. The lower portion of the cylinders, *D*, is made of somewhat greater diameter than the upper portion, and has fitted thereon the short secondary cylinder or shield *f*, the lower end of which extends down into the heater to within about an inch of the bottom, leaving space sufficient for the air to pass by under the piston in the working cylinder. The object of this is to force the air against the surface of the heater. The head at the upper end of the cylinder *D* has an opening for the passage of the piston-rod *I*, and two cupped packing rings to prevent the escape of air around said rod, the upper end of which is connected by the link *J* to one end of the beam *K*, which is also connected to the crank upon the driving shaft, mounted in bearings upon standards carrying the driving pulley *L*. The two chambers above the pistons are connected by the pipe *H*².

N is the cylinder of the reverser, provided with a broad flange, *j*, at its lower end, the outer portion of which rests upon the furnace casing *A*; to the lower end of the cylinder is bolted a curved heater, *O*, which is placed directly over the fire-grate for the purpose of receiving the direct radiation of the fire against its sides and bottom. *P* is the reverser cylinder, made of somewhat less diameter, and placed within and concentric with the cylinder *N*, with its lower end extending down into the curved heater within about an inch of the bottom, in such a manner as to form an annular chamber between the cylinders *N* and *P*, to serve as a regenerator. The upper ends of the cylinders *N* and *P* are closed by the head *Q*, which is firmly bolted to the cylinder *N*, and rests upon a rubber packing ring placed in a groove in the upper end of the cylinder *P* to form an air-tight joint and allow for unequal expansion.

The head *Q* has, set therein and projecting upward therefrom, a series of ∩-shaped pipes, one end of each of which communicates with the space between the cylinders *N* and *P*, and the other end with the interior of the cylinder *P*, above the reverser piston *R*, and is also provided with a central upwardly projecting tubular hub through which the piston rod *R′* passes, and to the upper end of which is secured the upper end of the cooler casing *S*, the lower end of which is firmly bolted through the head *Q* to the cylinder *N*, thus forming a cooling chamber inclosing the ∩-shaped pipes, which chamber is to be filled with circulating cold water.

The upper end of the piston rod *R′* is connected by the link *T* to the beam *V*, upon one side of the standard, in which said beam has its bearings, while said beam is connected upon the opposite side of said bearing by another link and piston rod to the reverser piston in the second reverser cylinder, which is constructed in all respects like the one just described.

The pistons *H* and *R*, of the working and reverser cylinders respectively, are each cast in two parts and screwed together so as to form hollow air-tight chambers therein, the lower portion of each of which is filled with fire-brick *r′*, and the upper portion with asbestos, *r′*. The beam center has firmly secured to its outer end the pendent arm *V*, provided with a pin *V′*, by means of which the beam and the reverser pistons may be worked by hand to start the engine, or by means of a hook connecting-rod and crank the beam and pistons may be worked by the power.

Air may pass freely by pipe *p q* from the interior of the reverser cylinder to the annular space, in the working cylinder and down against the heater of the working cylinder, to the space beneath the working piston *H*, and *vice versa*, as the motion of the piston may be either up or down.

An automatic bye-pass valve in a pipe, the ends of which open into both reverser cylinders, is used to equalize the pressure between the two reverser cylinders, and regulate the motion of the engine in proportion to its load.

An eccentric on the main shaft of the engine drives a small air-pump for the purpose of compressing air up to any density required; and connecting by means of r^1, with two vertical check-valves self-operating, which admit the air under pressure into the engine as required.

The water for circulation in chamber *S* to cool the air in the ∩-shaped pipes, is driven by a plunger pump, shown erect over pipe *p*. It enters *S* by means of pipe *n′*, and issues by pipe *o* to an annular chamber around the cylinder *D* at n^2, where it serves as a cut-off for the heat ascending the working cylinder, above that point against which the piston moves.

The operation is as follows: The beam being in motion, the effect is that the pistons in the reversing cylinders displace the air contained therein, by driving the air in the cold end of one of the said cylinders through the ∩-shaped tubes in chamber *S*, and the regenerator space between cylinders *P* and *N* into the heater; at the same moment driving the air in the hot end of the other reverser cylinder through the heater and the regenerator space into the tubes *n*, thereby greatly increasing the pressure on one reverser cylinder, and in the lower end of one working cylinder, and correspondingly diminishing the pressure in the other reverser cylinder and the lower end of the other working cylinder with which it communicates. The increase of pressure beneath one of the working pistons causes it to be worked upwards till it reaches the extreme of its upward stroke, when the reverser pistons change their position, thereby diminishing the pressure beneath the working piston which has just completed its upward stroke, and increasing it beneath the one that has just completed its downward stroke, thus creating a differential pressure beneath the two working pistons, by means of which the engine is driven, the pressure alternately changing from one cylinder to the other.

The power of the engine will be determined by the difference in the pressure alternately created in the reverser cylinders by the movements of their pistons, heating the air in one reverser cylinder and cooling it in the other, thereby at each stroke of the engine increasing the pressure beneath one working piston and diminishing it beneath the other working piston.

See also: *Hock & Martin* .	* "*Scientific Amer.*," xxxvii. 6.
Pumping, *Rider*	* "*Scientific Am.*," xxxviii. 131.
	* "*Scientific Amer.*," xxxiv. 66.
Rider	* "*Engineering*," xxii. 33
	* "*Scientific Amer. Sup.*," 768.
	* "*Polytechnic Review*," ii. 175.
	* "*Manuf. and Builder*," ix. 7.
	* "*Railroad Gazette*," xxiv. 189.
	* "*Amer. Artizan*," No. 12, 1874.
Sachsenberg	* "*Scientific Amer. Sup.*," 2579.
"Tom Thumb"	* "*Scientific American*," xlii. 323.
Van Rennes, Holland . .	"*Iron Age*," xxii., Sept. 5, p. 15.
Van Rennes	* "*Scientific Amer. Sup.*," 3331.
Woodbury, Merrill & Patten	* "*Engineering*," Jan. 13, 1882.

Hot′-air Pump′ing En′gine. The application of the hot air engine to pumping is the particular purpose of some of the small motors of this class. See Fig. 510, p. 155, and Fig. 674, p. 216, *supra*. See also Hot-air Engine.

Hot′-air Reg′is-ter. A valve, usually a centrally pivoted circular plate with openings, moving upon a perforated plate at the opening of a hot-air flue. By bringing the openings in the two plates into correspondence or otherwise, the air is allowed to pass, or is shut off, respectively.

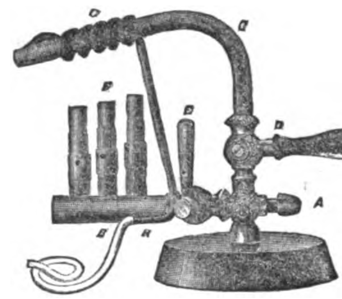
Hot′-air Stove. See Heater; Stove.

Hot′-air Syr′inge. A syringe with a chamber which heats the passing air. Used to dry cavities in teeth before filling. See Cavity Dryer, Fig. 572, p 179, *supra*.

Hot′-blast Blow′-pipe. A substitute for the ordinary blow-pipe.

The gas tubing is attached at *A*, allowing the gas to pass into both the upper and lower tubes, *B C*, and the supply can be regulated by the stop-cocks *D E*. The burners *F* heat

Fig. 1382.



Hot Blast Blow-pipe.

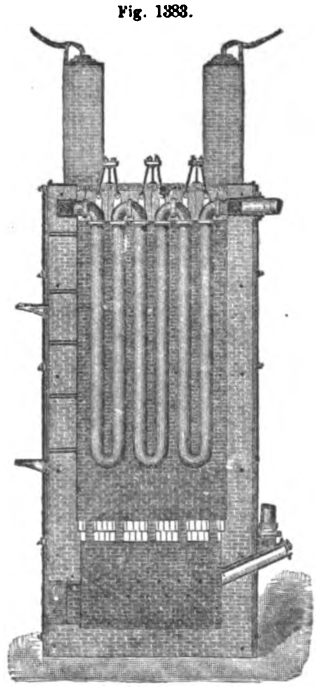
up the wire coil *G*, through which the breath passes, and it is thus thrown upon the surfaces to be acted upon in a heated condition. The mouth tubing is attached at *H*.

Hot′-blast Ov′en. (*Metallurgy.*) The Siemens' system, and modifications by Cowper and Whitwell are superseding the Player stove. *B*, Fig. 2588, p. 1134, "*Mech. Dict.*" See Gas Furnace, where the Siemens' regenerator is shown, Cowper's and Whitwell's are referred to, on page just stated. See Hot-blast Stove.

Hot′-blast Stove. Weimer's hot-blast stove, Lebanon, Pa., is shown in Fig. 1382. Its most important features are the suspension of the pipe from the roof of the stove, and the absence of the usual bed-pipes or mains.

The pipes are V-shaped, the cross section an ellipse 4″ × 12″ internally, and united by end flanges. The inlet main rests on the top end wall of the stove, and is provided with an inlet branch and three pipe branches; three rows of U pipe (three to a row) convey the air to be heated from the

Fig. 1383.



Hot-blast Stove. (*Lebanon, Pa.*)

inlet main through the first heating chamber to the transfer main, resting on the opposite side of the stove, where it is transferred to a similar lot of pipe, which convey it through chamber No. 2 to the outlet main. Each stove has two independent combustion chambers communicating each with its separate pipe chamber for the purpose of enabling the attendant to throw as much gas, and consequently heat, into the "cold" side of the stove as may be desirable, and to check a too great accumulation on the hot side. Each pipe is suspended by means of two key bolts to a 15″ wrought-iron beam, three of which traverse the top of the stove resting on wall plates. Four draft chimneys on the corners of the stove control the action of the upper pipe chambers, while the usual gas valve regulates the flow of gas to the combustion chamber.

The oven contains 18 pipes, 20′ long, the heating surface of each pipe 109 square feet.

The fire-brick stove of Whitwell, of Stockton-on-Tees, England, is intended to heat the blast of iron furnaces, and is shown in Plate XXII.

Fig. 1 is a vertical section.

Fig. 2, a horizontal section.

Fig. 3, an enlarged vertical section of the hot-blast valve, *B*, and its adjuncts.

Fig. 4 shows by an enlarged section the chimney valve, *C*, and cold-blast valve *J*.

Fig. 5 shows two ovens in elevation and the furnace in vertical section.

Fig. 6 is a plan of four ovens and a blast furnace.

The stoves are designed to replace the ordinary iron pipes used for heating the blast, substituting for them a series of fire-brick chambers and passages, which are heated by the direct contact of the flames of the burning gases taken from the furnace in the usual way. When the mass of brick is sufficiently heated the gas is shut off and the blast is admitted, and this, in passing through the same heated chambers, acquires the temperature of the bricks. The brick-work gradually cools down, but, by the time the last chamber begins to be too cool another stove has been heated up, and the blast is made to pass through that. The stoves are thus alternately heated by the burning gas and cooled by the blast. The advantages of this system are numerous. One of the greatest is uniformity of temperature of blast, which cannot be counted upon with iron pipes. The bricks are a great store-house of heat, and cool gradually. Iron pipes cool suddenly when, from any cause, the supply of burning gas is stopped. The air being brought into direct contact with the surfaces previously heated by the gas, absorbs the heat quickly and with little loss. The apparatus is simple, is easily erected, and is being extensively introduced. For cupola-furnaces, making 600 tons a week, two stoves, 12′ square by 21′ high, and with 2,270 superficial square feet of heating-surface in each, are necessary.

In heating the stove, the hot-blast valve, *B*, and the cold-blast valve, *J*, being closed, the gas-valve, *A*, is opened, through which the gas enters the stove, traverses up and down the spaces between the upright walls, and enters the chimney-flue by the valve, *C*. Heated air is supplied to the gas by means of the air-valves *a* and *c* and passages *b* and *d*, by which a most intense combustion is gained. The internal heat of the stove, as well as the combustion of the gas, is observed by the eye-pieces *e e*.

In heating the blast, the chimney-valve *C* and gas valve *A* being closed, and the hot-blast valve *B* being opened, the cold blast is admitted through the cold-blast valve *J*, and issues from the stove by the valve *B*, red hot, all other valves being closed perfectly tight.

In cleaning the stove, the top cleaning-doors, *F*, are opened and the walls scraped with the cleaning-tools, when the dust deposited on the heatin gsurfaces falls to the bottom of the stove, and is removed by the bottom cleaning-doors, *D*.

The general duty of one stove is 100 tons of pig iron per week: the average temperature of the blast, 1400° Fah. by Siemens' pyrometer.

See also: Mode of action, *Bell*	"*Iron Age*," xvii., Jan. 20, p. 7.
	"*Iron Age*," xvii., June 29, p. 1.
History and data . . .	* "*Iron Age*," xxiv., July 31, p. 1.
Stove, *Cowper*, Br. . .	* "*Engineer*," xlix. 361.
	* "*Scientific American Sup.*," 714.
Crossley, Engl.	* "*Iron Age*," xvii., Mar. 23, p. 1.
Furnace, *Holcomb* . . .	* "*Sc. American*," xxxviii. 390.
Cupolas, *Kirk*	* "*Iron Age*," xxi., Feb. 14, p. 5.
Regenerators	* "*Sc. American Sup.*," 3738, 3739.
Stove, *Mills*, Midland furnace, Mobile . . .	* "*Engineering*," xxii. 413.
Stoves, on, *Mills* . . .	"*Van Nostrand's Mag.*," xv. 165
Stove, *Mills*	* "*Eng & Min. Jour.*," xxii. 119.
Stoves, *Siemens-Cowper-Cochrane*	* "*Iron Age*," xxiii., May 1, p. 1.
Boiler furnace, *Stribling*	* "*Scientific American*," xxxv. 4.
Stove, *Weimer*	* "*Engineering*," xxii. 214.
	* "*Eng. & Min. J.*," Oct. 28, 1876.
Oven, *Weimer*	* "*Iron Age*," xvii., Apr. 27, p. 19.
	* "*Iron Age*," xviii., Aug. 3, p. 1.
	* "*Iron Age*," xx., Dec. 13, p. 1.
	* "*Iron Age*," xxv., April 22, p. 1.
Tuyere, *Westwood* . .	* "*Engineer*," xlvi. 164.
Stove, *Whitwell* . . .	"*Iron Age*," xix., June 7, p. 5.
Whitwell; Cowper . .	* "*Scientific American Sup.*," 714
	Blake's "*Report, Vienna Exposition*," iv., § E, p. 225.

Hot Cast Por'ce-lain. (*Glass.*) A name given to an opalescent glass made in Philadelphia of

Cryolite	10.
White sand	20.
Oxide of zinc	10.

See Cast Porcelain, p. 177, *supra*; Cryolite, p. 238, *supra*.

Hot Curv'ing Ma-chine'. A machine for bending laterally a hot-rolled rail to suit a curve of any given radius. See also Cambering Machine, which gives the required vertical curve, as at the summit and foot of inclines.

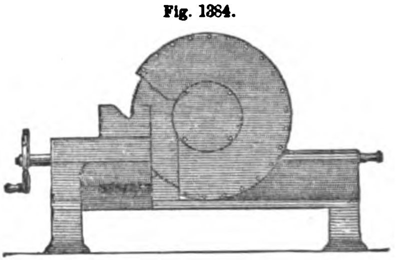
Gustin . . . "*Engineering*," * xxix 372, Fig. 7.

Hot-i'ron Saw. A saw which removes fag end or superfluous length from a rolled rail or bar while yet hot from the rolls.

The hot saw used at the Landore Siemens Steel Company swings in a frame so as to be moved to the rail, and is shown, Fig. 17, p. 14, vol. xlii., "*Engineer*."

The apparatus has a strong cast-iron frame, a grooved bed

Fig. 1384.



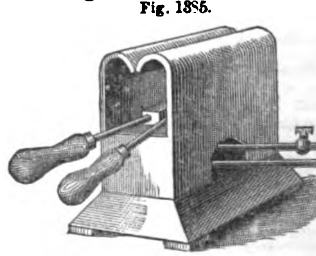
Whitworth's Saw for Hot Iron.

for holding the iron to be cut; the saw is drawn towards the iron by screw traverse. See also Iron Saw.

Iron saw, *Claridge*, Br. . . .	* "*Engineer*," xlvii. 201.
Bloom shear, Springfield, Ill. .	* "*Engineering*," xxix 371.

Hot Plate. A gas stove for heating copper bits for soldering.

Fig. 1385.



Hot Plate.

Hot Press. A machine in which pressure is aided by heat, either in calendering or expressing; the former for paper and fabrics, the latter for stearine and oils.

The stearine hot press of Morane, Paris, is shown in Fig. 1385. It has a hydraulic cylinder and pressure piston at one end, and a movable abutment at the other. The bags of material are sandwiched between hollow plates of iron, steam-heated by means of the pipes and flexible connections, the said pipes also serving to suspend the heated plates when the pressure is slackened in order to remove the cakes of

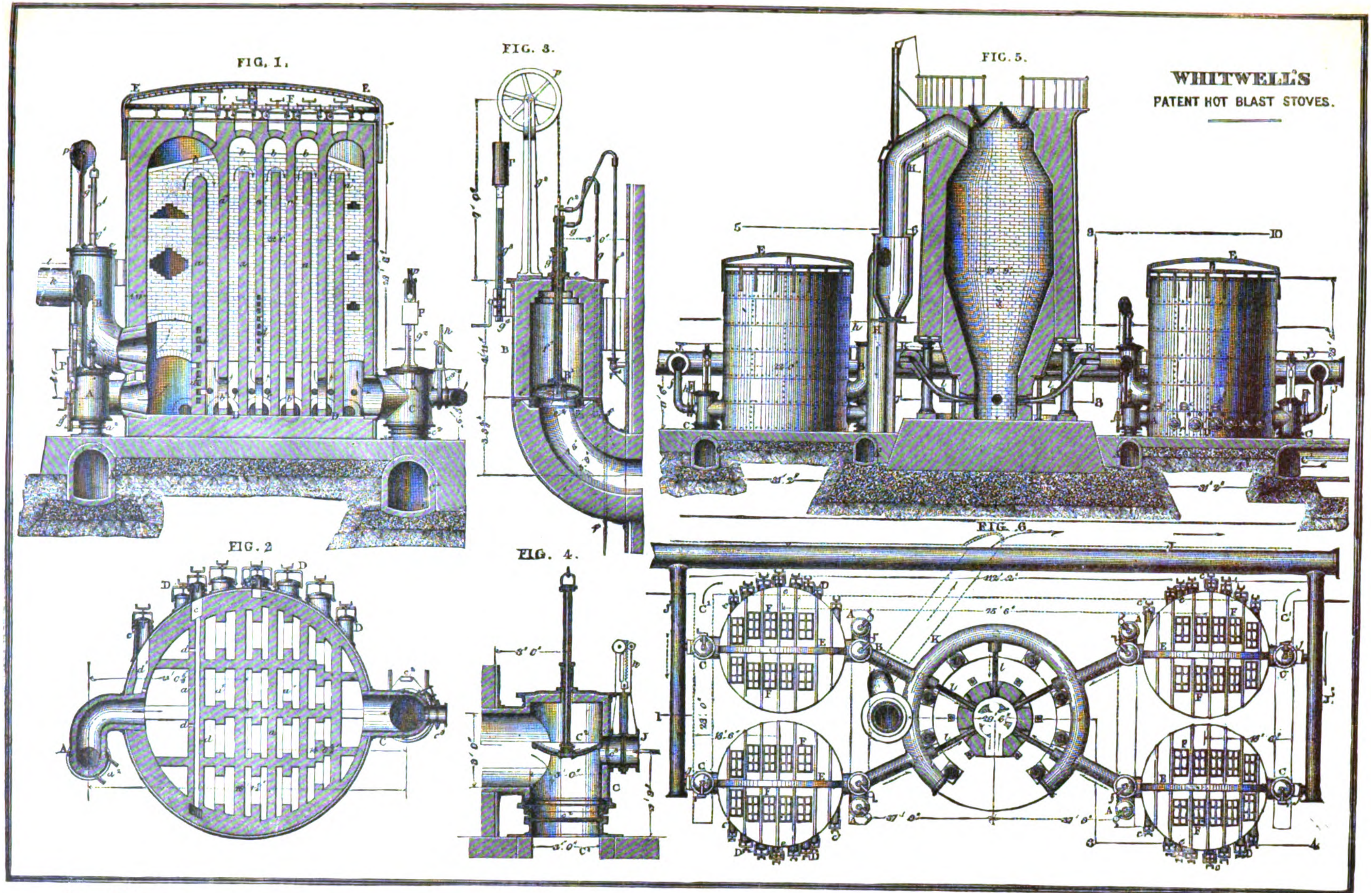
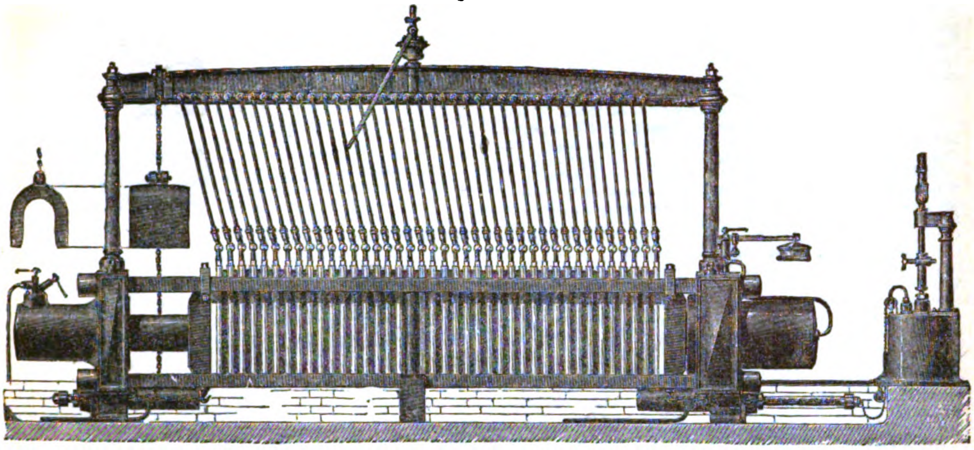


PLATE XXII.

WHITWELL'S HOT BLAST STOVES.

See page 470.

Fig. 1386.



Stearine Hot Press.

stearine. Forty bags form a charge. The slack pressure (*suppression des espaces nuisibles*) takes 3 seconds; the completion, 17 seconds; total, 20 seconds. The pressure, 800 kilos. Production, 600 kilos. stearine saponifiée. The press is self-arresting when the required pressure is reached.

Hot Saw. See HOT-IRON SAW; IRON SAW.

Hot Straight′en-ing Ma-chine′. An apparatus to receive rods or bars from the rolls and straighten them perfectly by stretching before cooling.

At the end nearest to the rolls is a clamp-head or head-stock, which slides in a U-shaped groove. At the other end of the bed, which is long enough to allow the working of bars about 80′ in length, is another sliding head, the tail-stock, which can be moved by hand along the whole length of the bed, as may be required by the various lengths of the bars to be straightened. It runs on two wheels on a rail.

The machine is operated as follows: One end of the hot bar, as it comes from the rolls, is firmly clamped in the head-stock, while the other end is secured in the tail-stock, which is so constructed that simultaneous with the clamping of the bar the tail-stock is firmly fastened to the bed-plate so that it cannot slip. Power is then applied and the slide is dragged forward with an intermittent, jerky motion, which rapidly straightens the bar and stretches it, the proper limit being determined by the operator. The clamps are released and the bar is slipped on to the adjoining hot-bed, where it is allowed to cool.

Baldwin . . . . . * "*Iron Age*," xxiv., Oct. 16, p. 1.

Hot Water Heat′er. A device for warming buildings, conservatories, etc., by means of a circulation of hot water in pipes. See HEATER, *supra*, Also p. 1136, "*Mech. Dict.*"

Hound Plate. A bracing plate at the junction of the fore end of the wagon hounds with the coupling.

Hour Glass Coil. A heating coil larger at the ends than at the mid-length, resembling an hour glass in exterior outline.

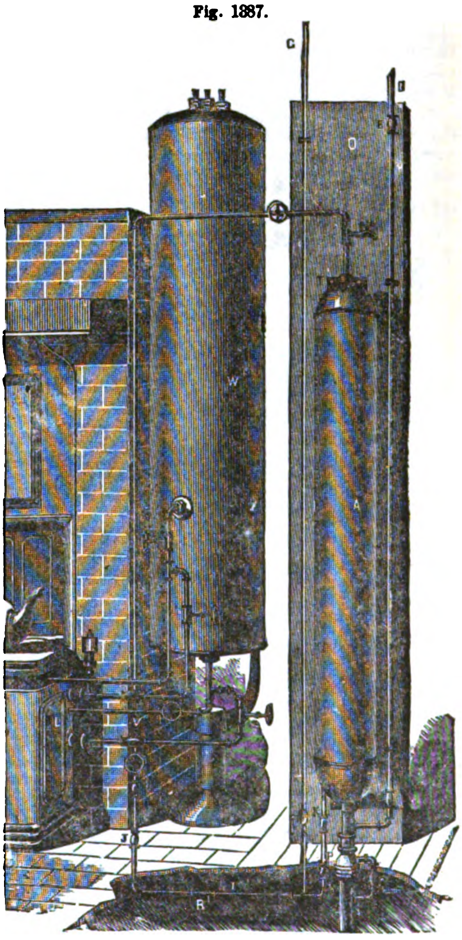
House Car. (*Railway.*) A box car, or closed freight car.

House Pump. One for the supply of a house when the pressure in the city mains is not sufficient for the high service in the house; or, when no urban water-works exist, to supply the house from ordinary wells or cisterns.

Houghton's automatic house pump is worked by the fire in the kitchen range. The cylinder *A* is a receptacle alternately for steam and water; its bottom is below the steam generator in the range, and its top not more than 25′ above the water supply, which is reached by a pipe extending from the bottom of the cylinder. The pipe has two valves, one near the near cylinder and one near the foot of the pipe. The steam generator is a back or cheek of the range furnace and has two nipples, for steam and water pipe connections respectively. The generator connects by pipe *F* with the top of the cylinder; the pipe has a cock to draw off steam or water when necessary, and a spring safety valve to obviate danger of explosion.

The pipe *G* conducts water from the tank above to supply

Fig. 1387.



Automatic House Pump.

the steam generator L through the branch I, and to condense steam in the cylinder through the branch K. In these branches are valves opening upward and towards the steam generator and cylinder, permitting water to flow into them, but closing downward by their own weight, and preventing the steam from driving the water up the pipe G, the pressure of the steam holding the valves in the pipes I and K to their seats against the weight of the column of water in the pipe G, which is pressing against the under side of them.

The cylinder and steam generator being filled with water, and a fire kindled, the water boils in the generator. The steam passes along the pipe F and expands in the top of the cylinder, and forces the water out of it up the outlet-pipe D, which rises above and empties it into the tank at the top of the house. In this pipe is a valve which prevents the water from falling back in it, and air from entering the cylinder through it. This outlet, or rising pipe, is of such diameter that the steam will drive the water before it, leaving the lower end of the pipe empty of water and filled with steam. The top of the column pouring out into the tank, it becomes shorter and correspondingly lighter, and as the weight of this column of water determines the pressure of steam, the lighter the column the lower the pressure becomes. When the pressure of steam is too low to hold the valves in the pipes I and K to their seats, the water in the pipe G flows by them and refills the generator with cold water, and jetting into the cylinder, condenses the steam in it, producing a vacuum, which is instantly filled with water forced up from the well or cistern by the pressure of the atmosphere.

This operation will repeat itself as long as the fire is kept up, and requires no attention.

Hous'ing Box. (*Railway.*) The axle-box which moves up and down in the *housing* or *pedestal.*

Hov'er-er. A warm chamber for young chickens, used in connection with an incubator to give to the young chicks an artificial protection in place of the brooding hen. An *artificial mother.*

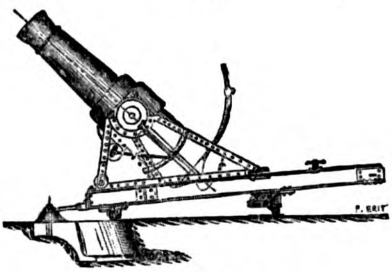
How'el-ing Ma-chine'. (*Coopering.*) See CHAMFERING MACHINE.

How'it-zer. A relatively short and large bored cannon for certain uses at short range.

Fig. 1387 shows a Spanish howitzer of 21 centimeters, système Barrios, with its carriage.

Mountain gun, sectional, *Armstrong*, Br. * "*Engineer*," xlvi. 365.
Mortar carriage, *King* . * "*Scientific American Sup.*," 514

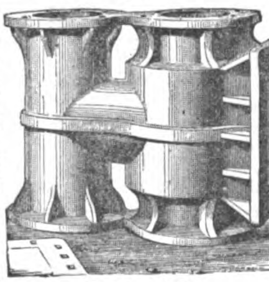
Fig. 1388.



Spanish Howitzer.

Moffatt's 6″ breech-loading flank defense, rifled howitzer, "*Ordnance Report*," 1877, Appendix R.
French rifled cast-iron howitzer, 22 cm., hooped, "*Ordnance Report*," 1878. Appendix L, Plate VII.
British 8″ rifled howitzer, *Ibid.*, Plate VII, Figs. 5, 6, 7; and p. 92.
Austrian rifled cast-iron howitzer of 21 cm. *Ibid.*, p. 96, and Plate VII. *b*, Figs. 10, 11. and figure not numbered, showing the piece mounted.
Rifled muzzle loading 6.3″ * "*Engineer*," xlv. 381.

Fig. 1389.



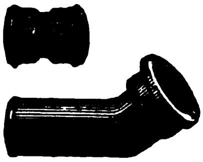
H-piece and Door.

H-piece. The section containing the valve-chamber of a Cornish engine.

By it is the door which closes the square opening by which access is had to the valve and chamber.

The door piece for a single pipe is shown at Fig. 841, p. 264, *supra.*

Fig. 1390.



Hub.

Hub. (*Add.*) 5. A short connecting pipe with a bell end for coupling pipes in line.

With two bell ends it is a *double-hub.* With one of the ends smaller than the other, it is *reducer double hub*, and connects two pipes of varying diameter. See REDUCER.

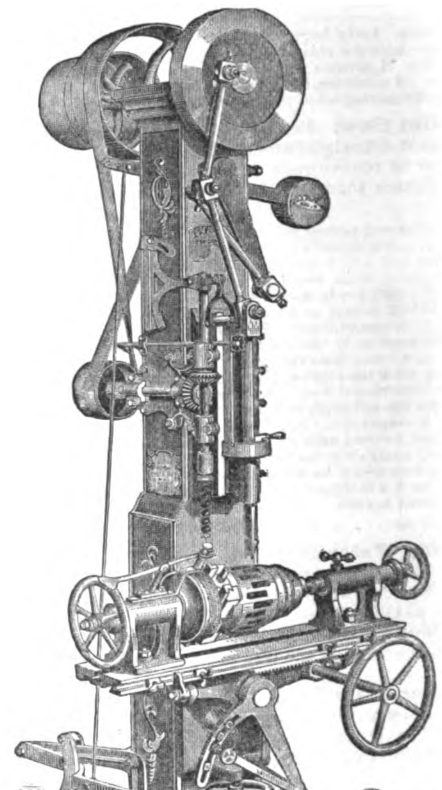
The lower figure in the illustration is a *bevel hub.*

Hub Bolt. (*Railway.*) The bolts by which the wheel plate is fastened to the hub, in the construction of paper-web car wheels.

Hub Mor'tis-er. A machine for making the spoke holes in hubs of vehicles.

The mortising and boring apparatus may both be driven by one belt from the counter shaft, or independent of each other, as may be desired.

Fig. 1391.



Hub Boring and Mortising Machine.

The hubs are confined in a screw chuck, the arms on its face being operated at the same time and by a single screw. It has a graduating wheel, spaced for 10, 12, 14, 16, and 18 spokes, thus obviating the necessity for setting out.

The dish of the mortise is regulated by a lever, having a crank and connections attached to the table. The lever has a handle with a spring stop, which works into adjustable poppets in a slot on the same circle as the lever handle describes. The lever support with the slotted piece are rigidly fixed to the center, upon which the table swings, and convenient to adjust the angle of the mortise instantly.

It has a graduated stroke, commencing at a still point above the extreme upper throw, and working gradually down into the mortise with but slight jar; the chisel mandrel is vibrated only when the chisel is brought down to the work.

Defiance Machine Works, O. . * "*Scientific Amer.*," xlii. 260.
Lane & Bodley . . . . . * "*Engineer*," xli. 450.
Perrin, Panhard & Cie. . . * "*Engineer*," xlvii. 293.
Sundry . . . . * "*Mech. Dict.*," p. 1140.

Hul'ler Gin. A cotton-gin which is adapted to gin cotton which is gathered with the bolls. See Gin, Cotton.

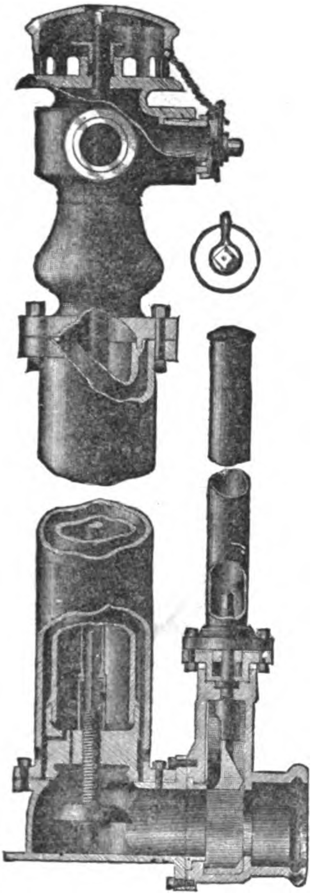
Hun-ga'ri-an Nail. A conical-headed nail, with round shank and flattened end pointed towards one side. Used in boot and shoe work. — *Field.*

Hunt'er's Knife. For attack or defense, or for flaying and eviscerating animals.

Hur'dle. 1. (*Hydraulic Engineering.*) A structure to divert a current or prevent erosion. It consists of a row of stakes with wattled willows or brush. Into the spaces between the stakes and wattling, pieces of brush are pushed, standing as branches from 4′ to 8′ above the hurdle.

"*Report of Chief of Engineers U. S. Army*, 1879," * ii. 1028.

Fig. 1392.



Street Hydrant.

2. A hurdle fence is one made of removable sections attached to driven stakes.

Wickersham . * "*Scientific Am.*," xl. 163.

Hur'dy-gur'dy Wheel. (*Mining.*) A term used in California to denote a water-wheel driven by a jet from a flume pipe.

"*Mining and Scientific Press*," * xxxv. 361, 376.
"*Engineering and Mining Journal*," * xxiv. 188, 189.

Hurst. The frame on which a run of mill-stones is placed. A *husk.*

Hy'a-lithe. (*Glass.*) An opaque glass, usually black, and of remarkable strength. Used as a substitute for porcelain for vessels for boiling liquids, for coffee and tea-pots, etc.

To the usual white-glass compound add powder of calcined bones, iron scales, and charcoal.

It is made black, green, brown, red, by suitable additions to or restriction of elements in the compound.

See *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," article "*Verre*," vol. iii., ed. 1877.

Hy'dra. A self-registering thermometer with a compound head or bulb for holding the spirits; for increasing the surface exposed to the air and thereby causing the instrument to work very rapidly.

Hy'drant. A street connection to a water-main, to obtain water at the surface for extinguishing fires or watering streets.

Holly's fire-hydrant is shown in Fig. 1392. The axial vertical screw operates the main valve, which closes as it ascends. The main valve-seat is a leathern gasket, which serves also as a packing for the lower joint of the inner pipe. The hydrants are removable without disturbing the position of the shell in the soil. The extra frost jacket and drip-valve obviate freezing. The main valve closes with the current. The drip-valve is positive in its action, being held open by the main valve when the latter is closed, and closing as soon as the main valve is opened.

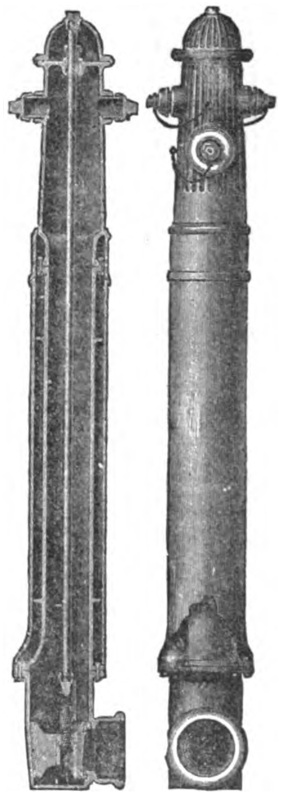
The gate at the base is for the purpose of cutting off the hydrant from the main when it is necessary to remove the former.

Fig. 1393 shows interior and exterior views of a street fire-hydrant. A key on top of the axial rod rotates the screw, which opens or closes the valve connecting with the main. The portion of the hydrant protruding above the surface has three connections for hose.

Fig. 1394 consists of two or more practically independent fire-hydrants secured to a common base, and permits the concentration of a number of independent fire-streams with a minimum amount of hose. A single casting acts as a washer, and also as a nut for all the operating screws. Either hydrant is readily detachable. — *Birkinbine.*

Fig. 1395 is another form in which the depression of the main valve uncovers the waste-pipe, and conversely.

Fig. 1393.



Fire Hydrant.

See: *Benson & Rose* . . * "*Scientific American*," xl. 390.
Birkinbine . . . . . * "*Iron Age*," xix., Feb. 8, p. 11.
"Perfection" . . . . * "*Iron Age*," xx., Nov. 22, p. 7.

Frost valve, Fig. 1102, p. 858, *supra.*

Hy'drant Cock. A faucet on a hydrant, having connections for hose and drip for waste-water when the spigot is closed.

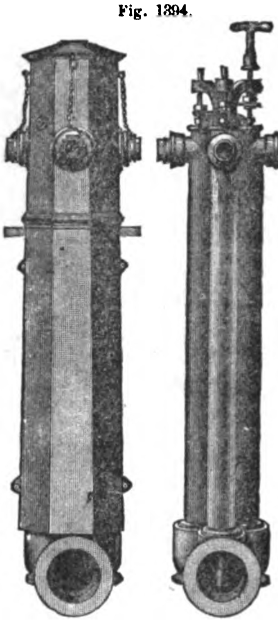
Fig. 1396 shows several forms, straight and crooked.

Hy'drant Noz'zle. A screw-nose attachable to a hydrant, and having a screw at the outer end also, for the attachment of the coupling of the watering hose.

Hy'drant Suc'tion. A connection for a fire-engine, with a hydrant reservoir or cistern. Usually of rubber or canvas hose, with interior spiral coil to prevent collapse.

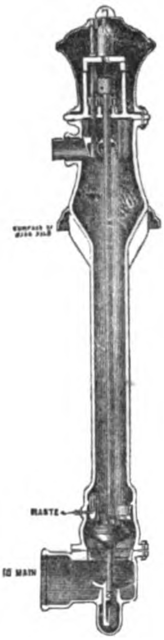
Stoddard's hydrant suction is a telescopic pipe, with screw couplings at the ends, and ball-and-socket joints to secure flexibility. See Fig. 1397.

Fig. 1394.



Cluster Hydrant.

Fig 1395.



Fire Hydrant.

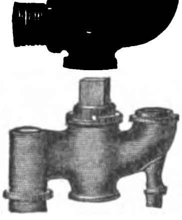
Hy'drant Valve. A valve connecting the hydrant with the main.

Fig. 1398 shows *Stone's* arrangement, which has a cast-iron body, gun-metal spindle, loose screw-down valve, and a flanged bottom for attaching to a vertical branch on the main.

Fig. 1399 is *Hawley's*, which has a gun-metal screw-valve and seating, and outlet bushed with gun-metal, screwed to fire-brigade gage.

Fig. 1400 is the Glasgow pattern, with clear straightway from the main, the valve actuated horizontally by rack and pinion.

Fig. 1396.



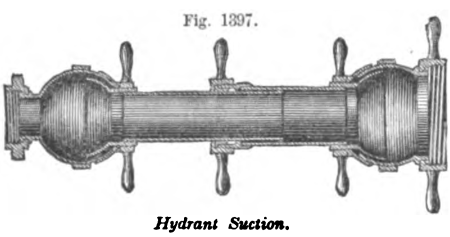
Hydrant Cock with Waste.

Hy-drau'lic Ac-cu'mu-la'tor. A device to form an accumulation of power, to be expended in assisting a machine over the pinch of a special exertion.

See ACCUMULATOR, p. 1, *supra*.

Tweddell, Br.
* "*Engineer*," xliv. 98.
* "*Engineering*," xxvi. 271.
* "*Manufac. & Builder*," xii. 105.
* "*Railroad Gazette*," viii. 563.
* "*Technologiste*," xli. 316.

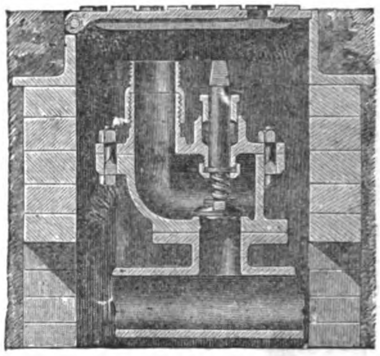
Fig. 1397.



Hydrant Suction.

Grimshaw . . . . . * "*Iron Age*," xxi., June 20, p. 7.
Mordach . . . . . * "*Iron Age*," xvii., Jan. 13, p. 9.
Bell & Marshall . . . * "*Scientific American Sup.*," 3659.
* "*English Mechanic*," xxvii. 455.
Kinney . . . . . . * "*Scientific American*," xxviii. 127.

Fig. 1398.



Hydrant Valve (British).

Hy-drau'lic Air'-pump. The application of the hydraulic engine to the pumping of air. A hydraulic blower.

An organ blower operated by hydraulic engine is shown in Fig. 3427, p. 1576, "*Mech. Dict.*"

The *trompe* used in the Catalan iron process is a hydraulic blower. See Fig. 6669, p. 2630, *Ibid*.

Fig. 1399.

Screw-down Hydrant Valve.

Fig. 1400.

Hydrant Valve (Glasgow).

See also HYDRAULIC BLOWER, *infra*, and devices in CARBURETOR, "*Mech. Dict.*" Very powerful engines are found in air compressors, especially for mining and tunneling. See AIR COMPRESSOR, *supra*, and list on p. 12, *Ibid*.

Von Pauwel . . . . * "*Manuf. & Builder*," ix. 142.

Hy-drau'lic Bal'ance. A governor or regulator placed between a water-wheel and a driving-shaft to maintain a steady motion under circumstances of changes of work by throwing machinery on or off. See HYDRAULIC REGULATOR.

Hy-drau'lic Bend'er. A hydraulic jack used in bending and straightening rails and bars. See E, Plate XXV., opposite p. 1150, "*Mech. Dict.*"

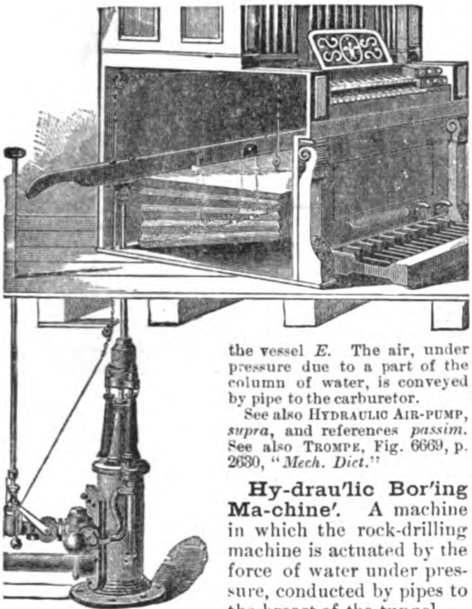
Hy-drau'lic Blow'er. An application of the hydraulic motor to the working of bellows.

Fig 1401 shows it as a reciprocating engine, worked by water from the main and oscillating the lever of the ordinary organ blowers. It is made self-regulating by attaching the upper valve of the organ by cords to the valve-lever, so as to proportion the induction of water to the condition of inflation of the bellows.

See also Figs. 3426, 3427, p. 1576, "*Mech. Dict.*"

Fig. 1402 is an application of the *trompe* to the purpose of forcing air to an apparatus for carbureting air. The injection-pipe brings water from a spring or a city main, and is fitted with a nozzle, through which the water rushes, falling through the larger pipe *C*. In so doing, air is drawn in at the suction-pipe *D*, and both air and water fall together into

Fig. 1401.



Hydraulic Organ Blower.

the vessel *E*. The air, under pressure due to a part of the column of water, is conveyed by pipe to the carburetor.

See also HYDRAULIC AIR-PUMP, *supra*, and references *passim*. See also TROMPE, Fig. 6669, p. 2630, "*Mech. Dict.*"

Hy-drau'lic Bor'ing Ma-chine'. A machine in which the rock-drilling machine is actuated by the force of water under pressure, conducted by pipes to the breast of the tunnel. The nature of the machine is in accordance with the action required, the percussion of the chisel, or the rotation of the diamond drill, — the latter, in the instance of the machine shown in Fig. 1403, made by Sulzer Brothers, of Winterthur, Switzerland.

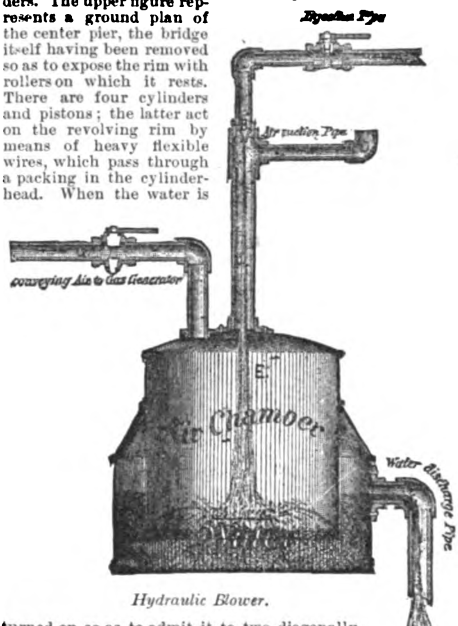
The machine for drilling the rock in the tunnel of Mont Cenis is shown in Fig. 6777, p. 2654, "*Mech. Dict.*"; the air-compressor, by which the drills are driven, is shown in Plate X., opposite p. 602, *Ibid.* The use of compressed air is much more frequent than that of water for running the drills. See pp. 2654, 2655, *Ibid.* The same may be said of the use of steam; see ROCK-DRILL, pp. 1956-1958, "*Mech. Dict.*"

Hy-drau'lic Brake. See HYDRAULIC RAILWAY BRAKE.

Hy-drau'lic Bridge Op'er-a'tor. An application of the hydraulic press to the moving of a pivot draw-bridge on its pintle, to open the waterway. See Fig. 1404, p. 476.

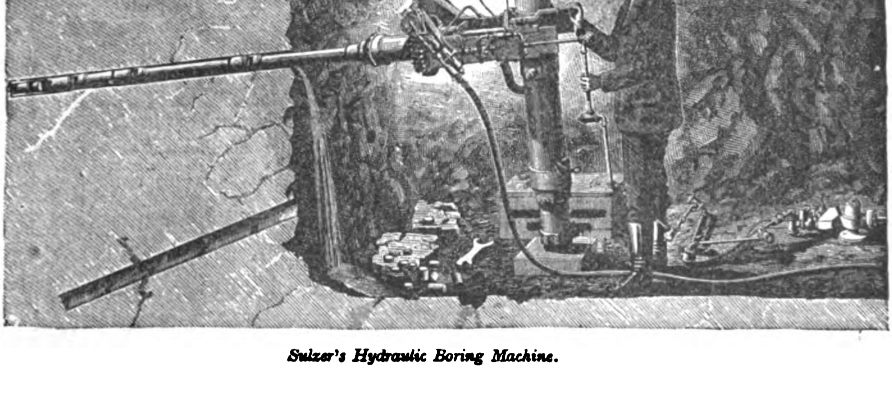
The motion is produced by the hydraulic pressure of the water on pistons in cylinders. The upper figure represents a ground plan of the center pier, the bridge itself having been removed so as to expose the rim with rollers on which it rests. There are four cylinders and pistons; the latter act on the revolving rim by means of heavy flexible wires, which pass through a packing in the cylinder-head. When the water is turned on so as to admit it to two diagonally opposite cylinders, its pressure will produce a pull on the wires, and these, being fixed to the revolving rim, will rotate it, and with it the whole draw, which rests on it. When the bridge has to be closed again, the water is turned on into the two opposite cylinders, while the same

Fig. 1402.



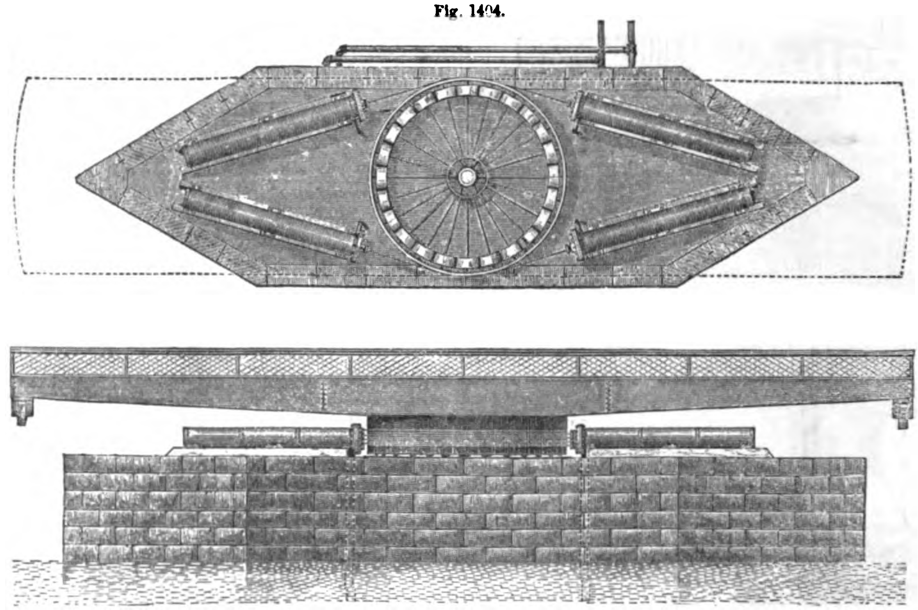
Hydraulic Blower.

Fig. 1403.



Sulzer's Hydraulic Boring Machine.

Fig. 1404.



Draw-bridge Moved by Hydraulic Pressure.

motion which turns on the water in two of the cylinders gives an exit to the water which has filled the two others. The water pipes are shown in the upper figure, one pipe for carrying the water to the pressure cylinders, which serve for opening, and the other pipe to those for closing the draw. The lower figure represents the bridge when open, resting entirely on the center pier, which is here seen longitudinally.

Hy-drau'lic Buf'fer. An arrangement of a piston in a cylinder to check the recoil of a cannon. The piston rod is made fast to the top carriage and moves in a cylinder filled with oil. The latter escapes through holes in the piston head, but with such difficulty as to impede the motion of the piston and thus act as a buffer.

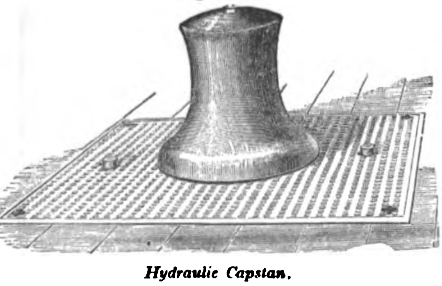
A quantity of air in the cylinder serves as a cushion to reduce the violence of the shock. The quantity of oil to be used, and the depth at the filling hole is marked on each cylinder. Otherwise known as a *recoil-check*.

See Fig. 83, Appendix L, to "*Ordnance Report*," 1877.
Plate VI., Appendix II, to "*Ordnance Report*," 1876.

Hy-drau'lic Cap'stan. One used ashore and operated by water under pressure.

Figs. 1405, 1406, show Brotherhood's three cylinder hydraulic capstan. It is a horizontal application of their familiar

Fig. 1405.

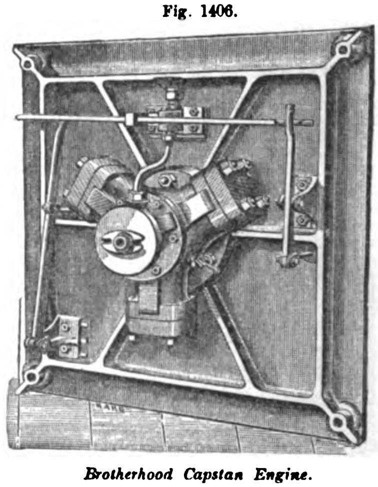


Hydraulic Capstan.

engine to the rotation of a capstan whose pintle is the common triple crank shaft of the trinary engine. Fig. 1402 shows the capstan on the plate beneath which the engine is fixed. Fig. 1406 is a view of the engine as it would appear if the plate were tipped up on edge and the bottom exposed.

The engine is very compact and is very simple. It is self contained and has but few working parts. There is but one valve in the engine, no glands, stuffing-boxes, or oscillating joints. The moving parts are subject to strain in one direction only. See also Fig. 531, p. 162, *supra*.

Fig. 1406.



Brotherhood Capstan Engine.

Hy-drau'lic Car Pro-pul'sion. A mode of propelling street cars by a hydraulic motor on each car, water being stored in each car under pressure of air at 20 to 30 atmospheres in a receiver.

The principle is the same, in most respects, as the plans proposed for air propulsion, stations at intervals refreshing the reservoir of the car. See notices under COMPRESSED-AIR ENGINE, p. 215, *supra*, and references *passim*. The water simply acts as the vehicle of transmission of the pressure of the air, and the benefit, if any, is in dealing with water rather than with air in the parts of the engine.

Hy-drau'lic Ce-ment'. Cement which will harden perfectly so as to exclude water. Cement which will harden under water.

Some limestones yield a perfect hydraulic cement, and in other cases materials are artificially united in proper proportions. See HYDRAULIC CEMENT, p. 1144, "*Mech. Dict.*"

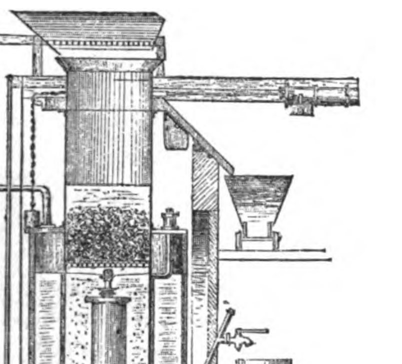
The English Portland cement, which has acquired a world-wide celebrity, is an artificial production, the special features of the manufacture of which are the following: Chalk and clay are ground together in water, the fine particles are floated away to other vessels and allowed to settle as a paste, which is thereupon collected, molded, dried, burnt, and finally ground. Certain porous, earthy, disintegrated rocks are found to be capable of cementing with lime in the natural state; that is to say, they do not require any preliminary preparation by burning as do the ordinary clays, it being simply necessary that they should be finely ground, in order that a thorough incorporation with the lime may be effected. These natural cements are generally of volcanic origin. The so-called pozzuolana and the trass are the best known of these deposits, both of which have been used from very ancient times. The pozzuolana, occurring on the coast of the bay of Naples — a species of tufa — was known on account of its cementing properties to the Romans, and by them largely employed. Vitruvius and Pliny both describe it, and state that it was mixed with an equal quantity of burnt lime for building under water. The same substance is very largely employed in the same manner at the present time. — "*Polytechnic Review.*"

See also TRASS.

Hy-drau'lic Clas'si-fi-ca'tor. (*Coal*) A coal dressing apparatus by M. Evrard, of St Etienne.

It consists of a vertical, hollow prism, either cylindrical or rectangular, 3 meters deep, the bottom of which is formed

Fig. 1407.



Evrard's Coal Dressing Machine.

by a movable piston-like inclosing rim, covered with a perforated plate, which can be raised to any height desired, as far up as the rim of the vessel, by means of a piston-rod attached to the under side and an upright hydraulic cylinder working upon it.

The vessel is prolonged beneath the piston in an open pipe of the same width and about 4 meters long, and both are submerged in a wider water-cistern, closed above and below and steam-tight, the cover being closely riveted to the outer covering of the vessel, and provided with a steam supply-pipe. By means of an intermittent supply of steam from the boiler, through the cover, into the upper part of the outer holder, the water therein receives an oscillating jerking motion, and works upon the minerals which are fed into the vessel and become heaped about 1 33 meters high upon the piston-sieve, just as with a jig-sieve. The only difference is, that the hydraulic strokes are much stronger at the start, being given with a lift as high as 20 centimeters, and then decrease to a few millimeters so that the action which follows at first just as with a slime separator, changes gradually to the action of a fine-jigging machine.

In this way a pause of one or two minutes is given, in order that the finest slime may properly settle on the piston-sieve, and then this piston is raised intermittently to the upper edge of the inner vessel, in order to scrape off the jigging-stuff over the edge in different layers, according as they lie upon the piston after sorting, and to obtain them separately as special products. The whole operation lasts about five minutes.

Hy-drau'lic Coal Mi'ner. An apparatus for breaking down coal *in situ.*

The breast of coal is undermined as usual and a hole drilled in it to hold an expanding plug of a cylindrical form worked by means of hydraulic pressure The plug is composed of two halves, which have a little wedge-shaped space between them, and are jointed at the end to the extremity of a hydraulic cylinder, and receive between them a wedge-shaped extension of the hydraulic ram or plunger, fitting exactly the widest part of the wedge-shaped space, and extending about half its length when the ram is withdrawn into the hydraulic cylinder. When the pressure is applied to the ram, the wedge-like extension is driven further along the space between the two halves of the plug, which are forced apart, so that the plug is expanded in one direction beyond its original diameter, and by lifting breaks off the mass of coal.

See HYDRAULIC BORING MACHINE, *supra.*

Hy-drau'lic Com-pres'sor. A device in a gun carriage to check the recoil of the piece by receiving the impact upon a piston which condenses air in a chamber.

See PNEUMATIC SPRING, * p 1755, "*Mech. Dict.*"
See also GUN CARRIAGE; HYDRAULIC BUFFER, *supra.*

Krupp . . . .
Rendel . . . . } * "*Engineering*," xxviii. 87.
Vavasseur . . . . . .

Hy-drau'lic Crane. One in which the elevating chain is wound by hydraulic power.

The first crane worked by hydraulic power was put up on the quay of Newcastle-upon-Tyne by Sir William Armstrong, in 1846.

Fig. 1408 gives two views of a British crane of this kind. It is shown by side and end elevations, and is fixed against the wall of a warehouse in connection with a swing crane jib on the outside. The apparatus is used in connection with an accumulator, which is a vertical cylinder, proportioned in diameter and height to the number and power of the cranes or other machines to be employed. This cylinder is fitted with a leathern collar or gland, through which works a ram or plunger with a massive cross-head on the upper end, to which is attached an annular weight-case surrounding and sliding over the above-named cylinder. The weight-case is filled with ballast until the total weight on the ram is equal to (usually) 700 lbs. per square inch; water is then forced into the cylinder or accumulator by the hydraulic pumps, until the ram, loaded as above described, reaches the top of the accumulator. At this moment a self-acting arrangement arrests the motion of the engines, but immediately the ram begins to descend, in consequence of some of the stored power having been used, the engines and pumps are set in motion automatically, and the ram is again lifted.

The water passes from the accumulator to the cylinder of the ram, and, driving out the piston, draws upon the chain and lifts the load. The principle is shown also in Fig. K, Plate XXIV., p. 1157, "*Mech. Dict.*" The jibs are frequently of greater sweep than that shown, built up of plate and angle-iron, and fixed in a central position between two tiers of doors, one crane being thus made available for both sets of doors. The top pair of cylinders, shown in Fig. 1408, are used for slewing or turning the jib, and the bottom cylinder and ram for lifting the load.

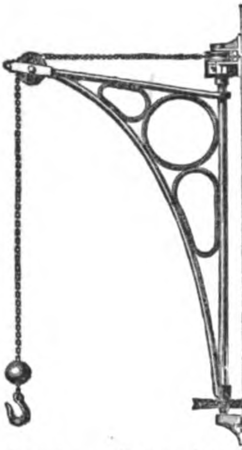
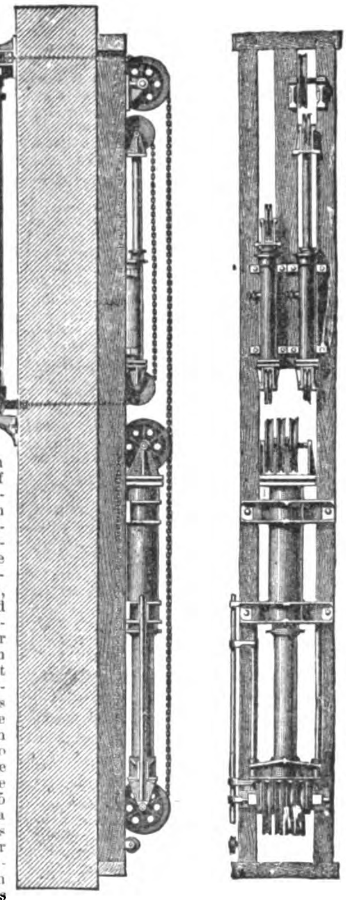
See: —

Armstrong, "*Engineer*" "*Scientific American Sup.*," 305.
160-ton . . . . . . * "*Engineer*," xli. 168, 170.
Fielding & Platt, Br. . * "*Engineer*," xliv. 88.
* "*Scientific American Sup.*," 305.
Mills, Br. . . . . . * "*Engineering*," xxiv. 134.
Tweddell, Br. . . . . * "*Engineer*," xliv. 98.

Hy-drau'lic Dump'ing. A tip for coal wagons to discharge them on to the chute.

As in similar constructions, the car or wagon is rolled on a platform, which, in most cases, rests with one end on the edge of the quay and swings around a horizontal axis,

Fig. 1408.

Hydraulic Crane.

situated at a distance from the quay of about one third of the entire length of the platform. The other end rests on a piston, moving in a cylinder filled with water, the resistance of which must be overcome during the downward journey of the platform, by which the water is forced from the cylinder into an accumulator. As soon as the car has reached its proper position on the platform, the front wheels act on a system of levers, which raise two clutches engaging the front axle of the car and holding the same in position. The car is then also secured at the rear end. The platform exerts now on the piston a pressure of about 25 atmospheres; by opening a valve, communication is opened with an accumulator of a pressure of about 20 atmospheres. The difference in pressure of five atmospheres forces the accumulator upward; this upward motion increases in rapidity as, by the change of position of the center of gravity of the car, the pressure in the cylinder is gradually increased to 40 atmospheres. As soon as the platform has attained an inclination of 45°, the accumulator has risen high enough to touch a lever, by which communication between itself and the cylinder is interrupted. Meanwhile the contents of the car have been dumped over the scoop-shaped end of the platform into the hold of the vessel below and the pressure in the cylinder has been reduced from 40 to 16 atmospheres. Connection with the accumulator having now been restored, the platform is brought into its original position by the overpressure of 20 — 16 = 4 atmospheres. Should the cargo of the car not weigh enough, a little water may be drawn from the accumulator by a separate stop-cock. Hereby the pressure is reduced and the platform lowered far enough to produce the necessary pressure by a change of position of the center of gravity of the car. Glycerine may be substituted for water when the apparatus is exposed to very low temperatures.

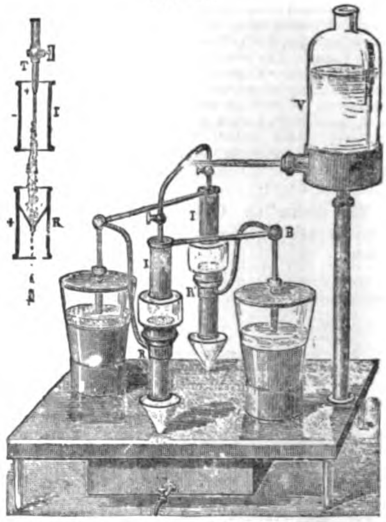
The principle involved in this apparatus is the storage of the weight of the cargo in an accumulator, and its employment for raising the empty car and platform after discharging the load.

See also references under DUMP CAR, p. 280, *supra*.

Hy-drau'lic E-lec'tric Ma-chine'. A machine in which electricity is excited by a flowing stream of water. — *Machine Électrique à Écoulement.*

The principle is illustrated in the small figure to the left in Fig. 1409, in which *T* is a metallic tube with a stop-cock, through which a small stream of water runs in drops from a reservoir, while it is electrically connected with the earth. It is surrounded by an isolated metallic cylinder, *I*, which induces a positive electrical conduction in the tube *T* and in the stream of water, by being itself once for all charged with negative electricity by contact with a piece of rubbed gutta-percha, hard rubber, sealing-wax, or equivalent substance. The cylinder *I* is called the *inductor*. These charges are indicated by the — and + signs. The falling drops of water being positive electric, communicate their charge to a funnel placed in the metallic cylinder *R*, which therefore, also, becomes positive electric, and is called the *receiver*. As electric charges always go to the outer surface of cylinders, the water flowing out of the funnel will be neutral, and all the positive electricity left behind in the outer cylinder *R*. Its charge increases continually,

Fig. 1409.



Hydraulic Electric Machine.

until the charge of the drops of liquid falling from *T* is in equilibrium with the loss, or until electric sparks fly over between the lower cylinder *R* and the upper one *I*, or until the drops from the tube *T* no longer fall down in the funnel *R*, being repelled sideways and thrown outward by the equally positively charged cylinder *R*.

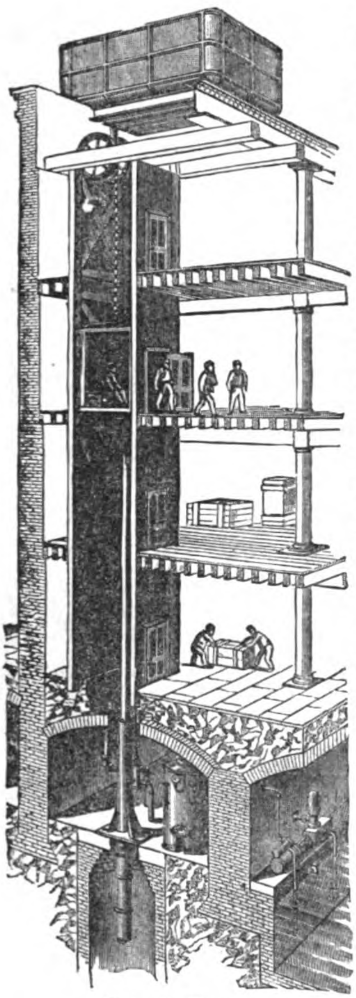
If nothing more were added to this arrangement, it would be necessary to renew the negative charge of the cylinder *I* frequently; but Fig. 1409 represents a double apparatus on this principle, invented by *Thompson*, and so arranged by duplication of parts, one set next to the other, that the electricity of the lower cylinder *R* of one charges the upper cylinder *I* of its other, of which then the electric charges will be reversed, the upper cylinder *I* will be positive, and the lower one *R* negative.

The reservoir *R* of the nearest set of cylinders is connected with the inductor *I'* of the farther set, while the receiver *R'* of this set is connected with the inductor *I* of the nearest set. The drops falling from the second inductor *I'* are then negatively charged, and give this charge to the second receiver *R'*, which increases the charge of the first inductor *I*. Added to the connections, of which, of course, one is always positive and the other negative, are two Leyden jars, *A* and *B*. The jars are truncated cones, of flint glass of good isolating quality, coated exteriorly with tinfoil, and interiorly containing a quantity of strong sulphuric acid, into which dip the lead rods, which at their lower ends have lead plates; the rods are surrounded by a glass tube and pass through the center of a cover of hard rubber. This is done to secure for the interior of these jars a perfectly uniform dry atmosphere.

The dynamic value of the electricity thus produced is derived from the power of the falling liquid: it would be equal to the work performed by gravitation on the drops of liquid during their downward route, if the drops arrived in the funnels after having lost all their velocity, and it corresponds exactly to their loss in *vis viva*. The loss of electricity is so weak in this apparatus, that the charge can be kept up for years by means of an insignificant discharge of liquid; a single drop, for instance, falling from each stop-cock every three minutes, has been found sufficient to keep up a constant charge.

The matter is considered more at length in "*Manufacturer and Builder*," * ix. 252.

Fig. 1410.



Hydraulic Elevator.

Hy-drau'lic El'e-va'-tor. A lift operated by hydraulic pressure.

Several methods of application of hydraulic force to this purpose are given in Plates XXIV., XXV., pp. 1150–1157, "*Mech. Dict.*"; and WATER ENGINE, Figs. 7101, 7102, p. 2738, *Ibid.* See also references at ELEVATOR, p. 309, *Ibid.*, and ROPE ELEVATOR, Fig. 4437, p. 1979, *Ibid.*

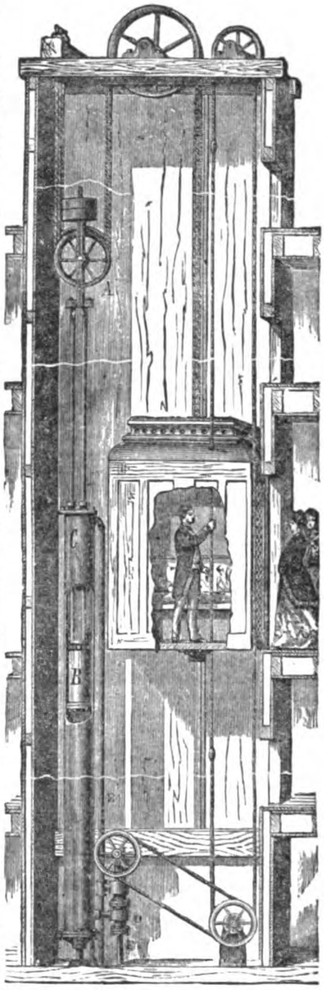
The Ascenseur Édoux is shown in Fig. 1410. It is regarded as the safest of all methods, and is remarkably smooth and noiseless in action.

It consists of a hydraulic cylinder equal in length to the height of the desired lift (sometimes 70′ and upward), placed vertically in a well or bore-hole, and a ram of area proportionate to the work to be done and the pressure of water available. The cylinder is fitted with a gland or leathern collar, and on the head of the ram rests the cage or ascending room, which is guided by suitable guide timbers. The motion is regulated by an equilibrium valve, admitting the water into the cylinder or letting it run to waste. The valve can be controlled from a rod which passes down one corner of the lift, and only requires a gentle pull to stop at any desired floor or to start again.

These lifts are always fitted with compensating counterbalances, exactly equal to the weight of the cage and the ram, insuring the utmost economy of water in working. The water pressure is obtained in various ways, from an accumulator, from the city main, or from an elevated cistern, as in the illustration, Fig. 1409, in which is a steam pump to keep the cistern supplied.

Fig 1411 is *Hale's* hydraulic elevator, in which the ram *B* in the cylinder *C* is made to draw upon a pulley, *A*, and so wind up the suspending rope of the cage. *D* is the pump, *F* water supply, and *E* pipe leading to ram cylinder *C*.

Fig. 1411.



Hydraulic Elevator.

While it is impossible to eliminate all chances of danger in lifting machinery, and preference has been expressed for the ascenseur Édoux on account of its avoidance of the use of a lifting cable, it must be acknowledged that it has one weak spot, and that is the parting of the connection between the cage and the lifting tube, in which case the counterbalance carries the cage violently upward and breaks the connection at the top, allowing the cage to drop. This was the cause of the fatal accident at the Grand Hotel in Paris, in 1878.

See: —

Water elevators . . * "*Mech. Dict.*," Figs. 7101, etc., p. 2738.
* "*Scientific American Sup.*," 105.
Burden . . . . * "*Manufact. & Builder*," x 265.
Water lifter, *Cranston* * "*Min. & Sc. Press*," xxxvi. 305.
Elevator, *Cushing* . * "*Man. & Builder*," xii. 198, 232.
Otis . . . . . . * "*Manufact. & Builder*," xi. 221.
Lift, river Weaver, Br. * "*Engineer*," l. 157, 160.
Lift, Trocadéro, Paris * "*Engineer*," xlvi. 377.
Tweddell . . . . * "*Engineer*," xliv. 98.

See several previous articles under HYDRAULIC CRANE, Fig. 1408, p. 478; GRID, Fig 1280, p. 423.

Illustrated article in *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," article "*Treuil Hydraulique*," iii., ed. 1877.

Hy-drau'lic En'gine. An engine operated by pressure of water.

Two forms of hydraulic engines are made by *Pratt & Whitney*. One with a rotary movement; it is a simple reciprocating engine worked under a water pressure of 20 pounds to the square inch or upward. It is intended for furnishing limited power for working printing presses, for small shops, etc., and the stroke is adjustable from 4″ to 10″.

The hydraulic engine for blowing pipe-organs works noiselessly and without thump, as the stroke of the piston connects directly with a partially rotary movement. It works under all pressure with equal facility.

See HYDRAULIC BLOWER, *supra*, and Figs. 3426, 3427, p. 1576 "*Mech. Dict.*"

The *Stannard* hydraulic engine resembles a small horizontal steam-engine, and is intended to be used, in any locality where a head of water can be obtained, to act as a light motor. The length of the stroke is adjustable at will, from 4″ to 8″, according to the quantity of water available, or power required. Diameter of cylinder, 5″.

White's dental engine is shown in Fig. 795, p. 250, *supra*.

The Valley Machine Co.'s engine is a small compact upright form for a domestic motor, or use in small shops.

See Figs. 2614, 2615, pp. 1145, 1146, "*Mech. Dict.*"

See also WATER-PRESSURE ENGINE, Figs. 7120–7124, pp. 2743, 2744, *Ibid.*

See: Motor, *Knecht* . . * "*Scientific American*," xli. 278.
Engine, *Richardson* . . * "*Scientific Amer.*," xxxvi. 262.
Hubbard & Allen . . * "*American Artizan*," xix. 6.
Hydrant, *Root* . . . * "*Iron Age*," xx., Oct. 25, p. 1.
Rotary, *Root* . . . . * "*Min. & Sc. Press*," xxxvi. 353.
* "*Sc. American*," xxxviii. 150.
Motor, *Schmid*, Switz. . "*Engineer*," xlvi. 210. Fig. 3.
Schmid, at Paris Exp. * "*Scientific Amer.*," xxxix. 327.

Hy-drau'lic En'gi-neer'ing. See under the following heads · —

Air camel.	Graving dock.
Air lock.	Grouser.
Apron.	Hopper barge
Aqueduct.	Hurdle.
Barrage.	Hydraulic grading.
Boom.	Jetty.
Boring anchor.	Lighthouse
Breakwater.	Lock gate.
Brush dike.	Mat.
Canal.	Mat boat.
Canal lift.	Mattress.
Canal lock.	Mattress boat.
Coffer dam.	Movable dam.
Crib breakwater.	Navvy.
Crib dam.	Overflow basin.
Curtain.	Pier.
Dam.	Pile dam.
Dike.	Pile driver.
Dipper.	Pneumatic excavator.
Draining.	Pneumatic pile.
Dredge.	Revetment.
Dredge boat.	Revetment mattress.
Dredging machine.	Rip-rap.
Drilling scow.	Sabot.
Drum barrage.	Sand fence.
Drum weir.	Screw pile.
Dry dock.	Sheer boom.
Embankment.	Shutter dam.
Fascine.	Shuttle.
Flask.	Slide.
Floating brush dike.	Sounding.
Floating derrick.	Sub-aqueous excavator.
Floating dock.	Submarine excavator.
Floating wire dike.	Submarine grapple.
Flume.	Submarine tunnel.
Gabion.	Towing.
Gabionade	Tubular foundation.
Grapnel.	Tubular pile.
Grapple.	Weir.
Grapple dredging machine.	Willow curtain.

Consult: *Stuart's*, "*Naval Dry Docks*."
Foster's, "*Submarine Blasting*."

Hy-drau'lic Force Pump. The pump used in connection with a hydraulic press. Such are shown in Plates XXV., XXVI., "*Mech. Dict.*," opp. pp. 1150, 1156. See also Boiler Prover, Fig. 763, p. 320, *Ibid.*; Hydraulic Pressure Pump, *infra.*

Hy-drau'lic Forge. A press operated by hydraulic power, as a substitute for the hammer.

Reference has been made under Steel Press, * p. 2369, "*Mech. Dict.*," to the method adopted by Révolier & Co., and others.

The Woolwich Arsenal gun carriage department has a hydraulic press for forging iron. The machine is capable of exerting a force of 3,000 tons, and it will probably supersede the steam hammers to some extent.

The Haswell system is described by *Prof. Blake* in his report, * "*Vienna Exposition* (1873) *Reports*," iv., pp. 257–262.
Prof. Thurston's report, *Ibid.*, iii. 335.
See also "*Engineering & Mining Journal*," xxiii.
"*Manufacturer & Builder*," ix. 179.

Hy-drau'lic Gage. The manometer applied to register the pressure in a hydraulic engine, press, or pump.

Hy-drau'lic Gra'ding. Views and details of experiments in grading steep river banks by means of hydraulic nozzle, preparatory to placing woven mattress work upon them as a revetment, are shown in "*Rep. U. S. Engineers*," 1880, * ii., pp. 1444–1449.

Hy-drau'lic Grid. The gridiron or platform on which a vessel is lifted by hydraulic pressure, or by camel. See Grid, p. 423, and Depositing Dock, Plate IX., *supra.*

Hy-drau'lic Gun'-car-riage. A piece provided with hydraulic apparatus for elevating into battery, depressing, and working.

See also Hydraulic Compressor.

Raskazoff, Russia . . . * "*Engineering*," xxiii. 305.

Hy-drau'lic Hoist. An arrangement for lifting vessels clear of the water, on inclines or vertically.

See *J*, Plate XXV., opp. p. 1150, "*Mech. Dict.*"
Also Grid, Fig. 1280, p. 423, *supra.*

Marine slips . . . . * "*Scientific Amer.*," xxxvii. 130.
Docks, Engl, ... * "*Scientific American Sup.*," 1096.
Marillier, Hull, Br. . . * "*Engineer*," xliv. 350.

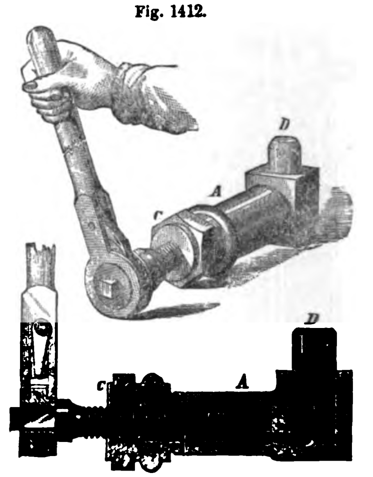
See also Hydraulic Crane; Hydraulic Elevator: Hydraulic Jack.

Hy-drau'lic Jack. An application of the hydrostatic press to a portable lifting or pushing instrument.

Several forms are shown at M, M', M'', M''', O, Plate XXV. p. 1157, "*Mech. Dict.*"

Fig. 1412 shows a jack for forcing crossheads out of piston rods, bolts from engine frames and cylinders, crank pins out

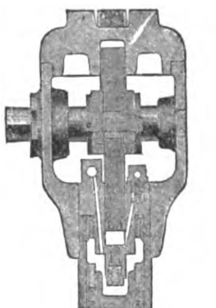
Fig. 1412.



Hydraulic Jack

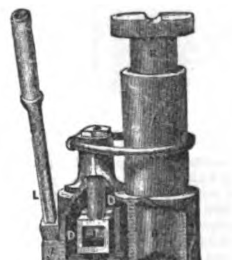
of locomotive driving-wheels, and for performing similar work in which it is necessary to employ a tool of large power in a small space. It consists of a long tube, *A*, in which works a piston, *B*. The latter is provided with suitable packing, and its rod is a screw working in the cover *C*. *D* is the ram of the jack. The handle has click and rachet so as to work by a vibratory movement.

Fig 1413.



Hydraulic Jack.

Fig. 1414.



Hydraulic Jack.

Fig. 1413 is Justice's hydraulic jack. It is filled with a liquid.

Water	1
Whiskey	6
Oil	0.5

Well shaken together before being filled into the jack. The pump-piston works in guides at top and bottom; the jack will work with any wrench or spanner, the socket of which will fit the square on the pump-shaft. The transference of the liquid from the upper chamber to the space beneath the piston is the cause of the elevation of the head and cylinder on the stem of the foot-piece.

Fig. 1414 represents the Dudgeon hydraulic jack. The vibrating lever *L* operates the plunger *D* by means of a cam, taking oil or glycerine from the chamber and forcing it by passages to the space *C* beneath the ram *B*, which rises in cylinder *A*.

The hydraulic jack has many applications, in machines bearing special names. See, among others: CRANK-PIN JACK, * Fig. 720, p. 229, *supra*; CAR-WHEEL PRESS, * Fig. 7189, p. 2768, "*Mech. Dict.*," etc. See list under HYDRAULIC MACHINERY, *infra*.

See: — *Dudgeon* * "*Amer. R. R. Jour.*," i. 647.
* *Emery's Report*, "*Centennial Reports*," vi., Group XX., p. 37.
Compound, *Harrison*, Br. * "*Engineer*," xlii. 21.

Hy-drau'lick-ing. (*Mining.*) Washing down a placer claim by the use of hose or *giant nozzle*.

"The water is sold by the inch, that being the customary quantity which escapes through an orifice one inch square with the water 6″ deep above the top of the orifice; as measured, an inch of water is considered equal to 2¼′ cubic per minute. The mining ditches of California (1871) carry at least 100,000″, or about 2,500,000,000 gallons in 24 hours. This water is carried in open canals, in wooden frames, and iron pipes. The latter are used now invariably in crossing deep ravines, and the necessities of the positions have led to the adoption of heroic engineering precedents in regard to the thickness of metal, coupled with diameter of pipe. Thus the Swartsville pipe, 16″ diameter, under 180′ pressure, of No. 18 sheet iron, was laid in 1861, not painted inside, but painted on the out. San Juan, 30″ diameter, Nos. 12 and 14 iron, 55′ head, coated inside and out, laid in 1861. Chinese camp, Nos. 12, 14, 16, and 18 iron, maximum head 800′, was laid in 1868. The pipes are double riveted on the longitudinal seams, put together like stove-pipes and riveted, and coated with coal tar.

"Most of the water thus distributed is used, as is said, *to hydraulic*, that is, to wash banks of auriferous earth by throwing a stream of water upon them through a hose and pipe. Hydraulic claims are usually in hills. The water is brought to the bottom of the hill by an iron pipe or by a hose. The hose is of heavy duck, and from 4 to 10″ diameter, sometimes surrounded by iron rings 2″ wide and 3″ apart, connected by 4 ropes. It is important to preserve as great a head as possible, with flexibility of hose. The nozzles are like those of fire-engine hose, sometimes as large as 8″ diameter, with a discharge of 300 to 800″ of water. The miners usually turn the stream upon the banks near the bottom until a large mass of earth tumbles down. They then wash all this away into the sluice, and then cut the bank again at the bottom. The water usually costs 10 cents per inch per day, and dirt in this way has been in some places excavated at a profit when it contained one cent's worth of gold in a cubic foot. The same hydraulic process has been used for excavation merely."

See FLUME, Fig. 2041, p. 891, "*Mech. Dict.*"

Hy-drau'lic Lift. Lifting apparatus operating by pressure of water. See HYDRAULIC ELEVATOR; HYDRAULIC HOIST; HYDRAULIC PRESS.

Hy-drau'lic Lo'co-mo'tive. A device for traveling up a flume by power derived from the flow of water.

Leaman . . . . * "*Scientific American*," xxxvi. 79.

Hy-drau'lic Ma-chin'e-ry. Companies are now established in England for the production and renting of hydraulic power, distributed by mains. Such are the Chester and the Hull (Br.) Hydraulic Engineering Co.'s.

The application of hydraulic power to the lifting of passengers in hotels and stores, goods in warehouses, and factories; and also to the working of cranes, dock-gates, swing-bridges, elevating and tipping coal-wagons, etc., has become quite common in Britain and America. In the latter, either local pumps or the city mains are used; in Britain the same occurs, but there are also companies which rent power.

The subject has been considered, as to its history and the elaboration of its methods and applications, in a paper read by Sir W. G. Armstrong, before the *British Instit. of Civil Engineers*, 1877, reproduced in "*Iron Age*," xix., June 28, p. 3.

"In Hull (Br.) the system does not differ essentially from an ordinary water service, in which the necessary head of water is obtained by pumping direct into the mains against the pressure in an air-vessel or stand-pipe. The difference consists in the higher pressure employed — generally from 600 lbs. to 800 lbs. per square inch — and in the use of dead weight accumulators for maintaining a uniform pressure, and allowing for the variation in the rate of consumption of the water. In nearly all towns where a good pressure in the water main exists, the force due to the pressure is being utilized with great advantage for the working of cranes and hoists and other purposes, and the water is generally paid for at a rate per 1,000 gallons consumed. The pressure in the ordinary water mains of a city rarely exceeds 60 lbs. on the square inch, and it is obvious that if the pressure were increased to 600 lbs. on the square inch only one tenth of the water would be used to do the same amount of work, and the machinery employed to utilize the power need be only one tenth the capacity. The higher pressure also gives a greater speed and certainty of action.

"What the Hull Hydraulic Power Company have done is to lay a main of about a mile in length through the streets bordering the Old Harbor at Hull, in which are built most of the public wharves and warehouses of the city. This main is charged at a pressure of 600 lbs. on the square inch by pumping engines erected at a convenient spot on the line of main. Not the least important point in the value of such an undertaking is that the water being used exclusively for working machinery does not require to be of a quality necessary for domestic purposes, and there are but few towns where the supply of pure water is so ample that the utilization of inferior supplies is a matter of no moment.

"Any person on the line of main requiring to use cranes, or hoists, or printing machines, hydraulic presses, etc., has thus at his door a simple and economical power available at any moment by paying only for the amount he actually uses. In fact, the consumer can buy his power in the same way as he buys his gas, and with no more trouble in the one case than in the other. There are several other advantages in the system which will at once occur to the reader, such as the reduction of the risk of fire in warehouses through the substitution of water for steam power, and the saving of room effected by dispensing with boilers and engines. The water mains required for the system, though of great strength, are not of large size. The main laid at Hull is 6″ in diameter, which will be ample for all requirements there, and would probably be seldom exceeded should the system ever come to be adopted in the largest cities of the kingdom. Two pairs of pumping engines, of 60 horse-power each, have been erected, and the engine-house has been built to accommodate two other pairs of the same size, which will be added as the demand for the power increases. The engine-house is covered by a cast-iron tank, into which the water is pumped in the first instance from the river, and allowed to settle before being pumped into the main. A minimum charge is to be paid by consumers according to the size of the machinery to be worked, amounting for an ordinary river-side warehouse crane to about £52 per annum; and the cost of working will amount to about ½d. for each ton lifted 40′."

Hull, Br.	"*Engineering*," xxii. 279
Accumulator, *Best & Marshall*	* "*Eng. Mechanic*," xxvii. 455.
	* "*Sc. American Sup.*," 3659.
Grimshaw	* "*Iron Age*," xxi., June 20, p. 7.
Kingston-upon-Hull .	"*Van Nostr. Mag.*," xviii. 211.
Kimely	* "*Scientific Am.*," xxviii. 127.
Merdach, Fr. . . .	"*Iron Age*," xvii., Jan. 13, p. 9.
Tweddell, Br.	* "*Engineer*," xliv. 98
	* "*Engineering*," xxvi. 271.
	* "*Man. & Builder*," xii. 105.
	* "*R. R. Gazette*," viii. 568.
Air pump, *Van Pauwel* .	* "*Man. & Builder*," ix. 142.
Brake.	
Barker, Midl. Ry., Br. .	* "*Engineer*," xliii. 302.
Bridge opener, Harlem .	* "*Man. & Builder*," xi. 6.
Car propeller, *Rosseau* .	* "*Scientific American*."
Compressor for gun carriages, *Krupp* . .	* "*Engineering*," xxviii. 87.
Rendell	* "*Engineering*," xxviii. 87.
Vavasseur	* "*Engineering*," xxviii. 87.
Crane, 160 ton	* "*Engineer*," xli. 168, 170.
Fielding & Platt, Br. .	* "*Engineer*," xliv. 88.
Mills, Br.	* "*Engineering*," xxiv. 134.
Tweddell, Br. . . .	* "*Engineer*," xliv. 98.
Dumping	* "*Sc. American Sup.*," 2487.
Elevator, *Burden* . . .	* "*Man. & Builder*," xvi. 265.
Otis	* "*Man. & Builder*," xi. 221.
Tweddell	* "*Engineer*," xliv. 98.
Engine, *Knecht*	* "*Sc. American*," xli. 278.
Richardson	* "*Sc. American*," xxxvi. 262.
Hydrant, *Root* . . .	* "*Iron Age*," xx., Oct. 25, p 1.
Rotary, *Root* . . .	* "*Min. & Sc. Press*," xxxvi. 353.
Schmid, Switz.	* "*Engineer*," xlvi. 210.
	* "*Sc. American*," xxxix. 327.
Forging, *Haswell*, Aust.	*Thurston's* "*Vienna Report*," iii. 335.

Grid	* "*Sc. American*," xl. 241.
Gun carriage, *Kaskazoff*	* "*Engineering*," xxiii. 305.
Hoist, marine slip	* "*Sc. American*," xxxvii. 130.
Docks, Br.	* "*Sc. American Sup.*," 1696.
Marillier, Br.	* "*Engineer*," xliv. 350.
Jack, *Dudgeon*	* "*Am. R. R. Jour.*," l. 647.
Compound, *Harrison*	* "*Engineer*," xliii. 21.
Lift, *Cranston*	* "*Min. & Sc. Press*," xxxvi. 305.
Cushing	* "*Man. & Builder*," xii. 198, 232.
River Weaver, Br.	* "*Engineer*," l. 157, 160.
Trocadéro, Fr.	* "*Engineer*," xlvi. 377.
Locomotive, *Leaman*	* "*Sc. American*," xxxvi. 79.
Main	* "*Man. & Builder*," viii. 233.
Mill, sugar cane, *Berry*	* "*Engineering*," xxix. 204.
Mining, California	* "*Engineering*," xxiv. 409, 448, 485.
Bowie	* "*Sc. American Sup.*," 1683.
	* "*Sc. American*," xxxviii. 274.
	"*Sc. American Sup.*," 757.
Distributor	* "*Min. & Sc. Press*," xxxv. 329.
Gravel elevator	* "*Min. & Sc. Press*," xxxiv. 377.
Nozzle	* "*Eng. & Min. Jour.*," xxiv. 169.
Gooseneck	* "*Engineering*," xxiv. 445.
Gravel mining	* "*Min. & Sc. Press*," xxxv. 329.
Hoskin	* "*Min. & Sc. Press*," xxxiv. 267.
"Dictator," *Hoskin*	* "*Engineering*," xxiv. 445.
	"*Engineering*," xxii. 279.
Power Co., Hull, Br.	* "*Engineering*," xxv. 95.
Press, for gunpowder, Br.	* "*Sc. American*," xlii. 134.
Pump	* "*Man. & Builder*," xii. 49.
Lyon	* "*Engineering*," xxv. 190.
Direct-acting, *Taylor*	* "*Engineer*," xlv. 84.
Pump, *Tweddell*, Br.	* "*Engineer*," xlv. 38.
Cotton, *Watson*, Br.	* "*Engineering*," xxiii. 488.
Pumping eng., *Hathorn*	* "*Min. & Sc. Press*," xxxvii. 369.
For mines	* "*Sc. American Sup.*," 1183.
Punch & shears, Toulon	* "*Engineer*," xliv. 455.
Ram (8 Figures)	"*Sc. American Sup.*," 239.
Efficiency	* "*Engineer*," xli. 30
De Calichy	* "*Engineer*," xli. 30.
Easton & Amos	* "*Engineer*," xli. 30.
Fox	* "*Engineer*," xli. 30.
Fyfe	* "*Scientific Amer.*," xli. 262.
Heisse	* "*Sc. American Sup.*," 1262.
Hett	* "*Engineer*," xli. 30.
Hypsydre	* "*Sc. American*," xxxviii. 166.
Millington	* "*Engineer*," xli. 30.
Montgolfier	* "*Engineer*," xli. 30.
Whitehurst	* "*Sc. American*," xxxiv. 226.
Riveter, *Tweddell*, Br.	* "*Engineer*," xliv. 98.
Keel, *Tweddell*, Br.	* "*Engineering*," xxx. 535.
Shears, Toulon arsenal	* "*Engineer*," xli. 208.
Tweddell	* "*Sc. American Sup.*," 352.
Tip, wagon, *Thomson*	* "*Engineering*," xxviii. 204.
Valve, *Dennis*, Br.	* "*Engineering*," xxviii. 13.

Hy-drau′lic Main Dip Reg′u-la′tor. A valve device in gas works for regulating the depth of seal of the dip-pipes in hydraulic mains. In *Isbell's* device an arrangement allows the heavy tar to be withdrawn from the bottom of the main without disturbing the seal. *Smith & Sayre Manufacturing Co.* See DIP-PIPE, Fig. 1660, p. 705, and GAS APPARATUS, p. 944, "*Mech. Dict.*"

Hydraulic main
* "*Manufacturer and Builder*," viii. 233.

Hy-drau′lic Mill. A form of sugar-cane mill in which the megass (*bagasse*) is steamed in a covered chamber and repressed in a second mill.

Sugar-cane mill, *Berry*, Br. * "*Engineering*," xxix. 204.

Hy-drau′lic Mi′ning. A system of placer mining in which auriferous strata are washed down by water jets. See HYDRAULICKING; also HYDRAULIC NOZZLE, and references *passim*.

Hydraulic mining, Cal.	* "*Engineering*," xxiv. 409, 448, 485.
Bowie	* "*Sc. American Sup.*," 1683.
	* "*Sc. American*," xxxviii. 274.
	"*Sc. American Sup.*," 757.
Distributor, gravel mining.	* "*Min. & Sc. Press*," xxxv. 329.
Gravel elevator, *Cranston*.	* "*Min. & Sc. Press*," xxxiv. 377.

See also HYDRAULIC NOZZLE.

Hy-drau′lic Mo′tor. See HYDRAULIC ENGINE, "*Mech. Dict.*," *et supra*.

Hy-drau′lic Noz′zle. The pipe for directing a stream of water on a bank of auriferous gravel in placer mining.

The subject and the method are considered under HYDRAULICKING, *supra*; the flume of Smartville, California, is shown in Fig. 2041, p. 891, "*Mech. Dict.*," and the nozzles at Fig. 2616, p. 1149, *Ibid.*

"Monitor," Craig	* "*Engineering*," xxiv. 445.
Fisher, Knuckle-joint	* "*Engineering*," xxiv. 445.
	* "*Eng. & Min. Jour.*," xxiv. 169.
Gooseneck	* "*Engineering*," xxiv. 445.
Gravel Mining	* "*Min. & Sc. Press*," xxxv. 329.
Hoskin	* "*Min. & Sc. Press*," xxxiv. 269.
Dictator, *Hoskin*	* "*Engineering*," xxiv. 445.

Hy-drau′lic Pile Driv′ing. (*Hydr. Eng.*) A mode of sinking piles in friable soil by means of excavating in advance of the pile by a forcible stream of water. See PILE, *infra*.

Hy-drau′lic Pow′er. See HYDRAULIC MACHINERY.

Hy-drau′lic Press. A press in which water under pressure of pump or elevation is used as a source of power. See p. 1149, "*Mech. Dict.*"

Beet root, Fr.	"*Dep. Agri. Sp. Report*," No 28, Plate XIV.
Lalouette	"*Dep. Agri. Sp. Report*," No. 28, Plate XV. Description on page 138.
Gunpowder, Br.	* "*Engineering*," xxv. 95.
Press pump	* "*Scientific Amer.*," xlii. 134.
Lyon	* "*Man. & Builder*," xii. 49.
Direct acting, *Taylor*	* "*Engineering*," xxv. 190.
Direct action pumps for, *Tweddell*, Br.	* "*Engineer*," xlv. 84.
Cotton press, *Watson*, Br.	* "*Engineer*," xlv. 38.

See also OIL PRESS; STEARINE PRESS; WIRE PRESS; HOT PRESS; also Plates XXIV., XXV., "*Mech. Dict.*"

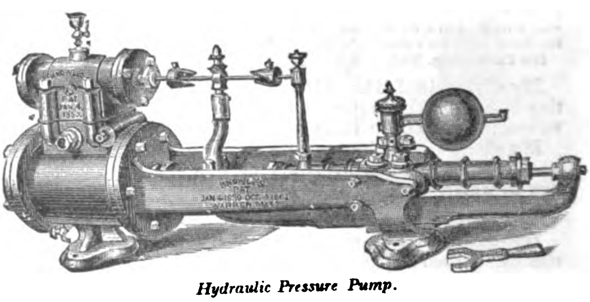
Hy-drau′lic Pres′sure Pump. A pump for working a hydraulic press.

Knowles' pump, shown in Fig. 1415, works direct from the steam cylinder, dispensing with belt, pulley cranks and fly-wheel.

See also figures in Plates XXIV., XXV., "*Mech. Dict.*"

Hy-drau′lic Pump. 1. An engine for serving a line of pipes by which hydraulic power is distributed through a city or works. See account of works at Hull, Br., HYDRAULIC MACHINERY, p. 481.

Fig. 1415.



Hydraulic Pressure Pump.

2. A pump worked by hydraulic power.
3. A pump for serving a hydraulic press. See HYDRAULIC PRESSURE PUMP.

Pumping engine. *Hathorn & Co.*, Br.	* "*Engineering*," xxiii. 488.
Water elevator for mines	* "*Min. & Sc. Press*," xxxvii. 369.

Hy-drau′lic Punch. A punch operated by hydraulic power. See *G*, Plate XXV., opp. p. 1150, "*Mech. Dict.*"

Figs. 1416, 1417 show two forms of rail punches by Dudgeon. Fig. 1416 is for punching holes through the webs of rails, for the passage of the bolts of fish-plates. Fig. 1417 is for punching notches on the edge of the foot flange for the driving of the spike.

Fig 1416.

Rail Web Punch.

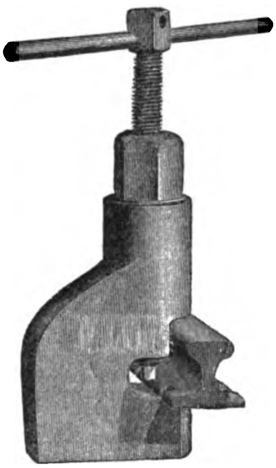
Punch and shears, Toulon, Fr. * "*Sc. Am. Sup.*," 1183.

Hy-drau'lic Rail'way Brake. A form of railway brake in which the rubbers are brought against the wheels by hydraulic power. Barker (Br.).

The brake in its early form was worked by a set of pumps in the guard's van driven by a friction wheel. As now used on the Midland Railway, a steam pump, fitted under the foot-plate of the engine, supplies a pressure which can be varied between 5 lbs. and 360 lbs. on the square inch. The pump starts of itself when the pressure falls below a certain point, and its duty consists in always keeping an accumulator filled, the load on the accumulator being supplied by the pressure in the boiler. The brake blocks are operated by small hydraulic presses.

Barker, Br. * "*Engineer*," xliii. 302.
* "*Sc. Am. Sup.*," 1234.

Fig. 1417.



Rail Foot Punch.

Hy-drau'lic Ram. 1. A water-raising device, * p. 1150, "*Mech. Dict.*"

8 figures	* "*Engineer*," xliv. 455.
Efficiency, etc. . .	"*Scientific American Sup.*," 239.
De Calichy . . .	* "*Engineer*," xli. 30.
Easton & Amos . .	* "*Engineer*," xli. 30.
Fox	* "*Engineer*," xli. 130.
Fyfe	* "*Engineer*," xli. 160.
Heise	* "*Scientific American*," xli. 262.
Hett	* "*Scientific American Sup.*," 1762.
Hypsydre	* "*Engineer*," xli. 30.
Millington . . .	* "*Scientific American*," xxxviii. 166.
Montgolfier . . .	* "*Engineer*," xli. 30.
Whitehurst . . .	* "*Engineer*," xli. 30.

2. The piston of a hydraulic press.

The span of the Rock-island draw-bridge is rotated by two hydraulic rams, each of 10' stroke and 8" diameter of piston. These are placed over the circular girder of the turn-table, one on each side of the span in a vertical position, and are worked by a double-cylinder engine, each cylinder 6" × 8". The force-pumps are four in number, each with 1½" piston. The rams are reciprocal, each being the reservoir for the other, and the office of the pump is to transfer the liquid (water .50, glycerine .50) from one ram to the other. Both the rams are thus under the same pressure at all times, and hold the span in equilibrium, except during the process of turning.

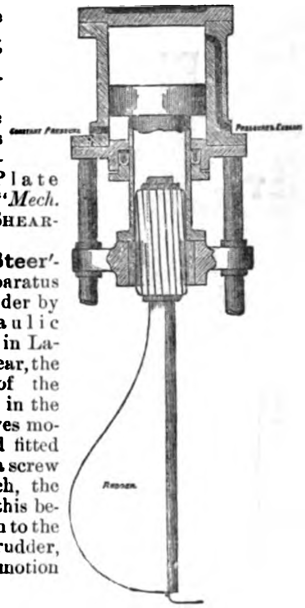
The power of the rams is transferred to the pier by means of a wire rope 1½" diameter, arranged as in an Armstrong crane. See Hydraulic Bridge Operator.

Hy-drau'lic Riv'et-ing Ma-chine. A machine riveter worked by hydraulic power. See Figs. 4351, 4354, p. 1949, "*Mech. Dict.*"
See also Riveting Machine.

Hy-drau'lic Shears. Shears worked by hydraulic power. *O*, Plate XXIV., p. 1157, "*Mech. Dict.*" See also Shearing Machine.

Hy-drau'lic Steer'ing Gear Apparatus for working a rudder by means of hydraulic power. As seen in Lafargue's steering gear, the vertical action of the plunger contained in the power cylinder gives motion to a crosshead fitted with a nut having a screw cut of a quick pitch, the collar working in this being firmly keyed on to the upper end of the rudder, gives the circular motion required.

Fig. 1418.



Lafargue's Hydraulic Steering Gear.

* "*Engineer*,"
* "*Sc. Am. Sup.*," 2258.

Hy-drau'lic Tip. A device for discharging coal wagons.

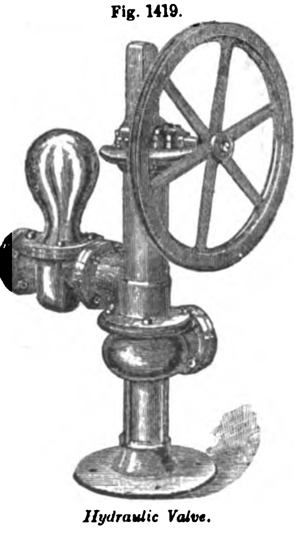
The invention of D. Thomson, of London. A vertical skeleton frame is provided with arrangements for lifting and tipping the wagons. A single hydraulic cylinder is used, the tipping being done by a chain attached to the end of the rising platform, that end of the platform being detained during the latter portion of the hoisting movement.

Thomson, Br. . . . . * "*Engineering*," xxviii. 204.

See also Hydraulic Dump.

Hy-drau'lic Valve. The valve for controlling the flow of water to and from the cylinder in hydraulic elevators; starting, stopping, and holding the car at the different floors. A wire shipping cable runs inside the hatchway from top to bottom, passing around the wheel on the valve stem, for opening or closing the valve, and the cable is under control of the attendant in the cage or on the platform. The valve is moved by pinion and rack and discharges below.

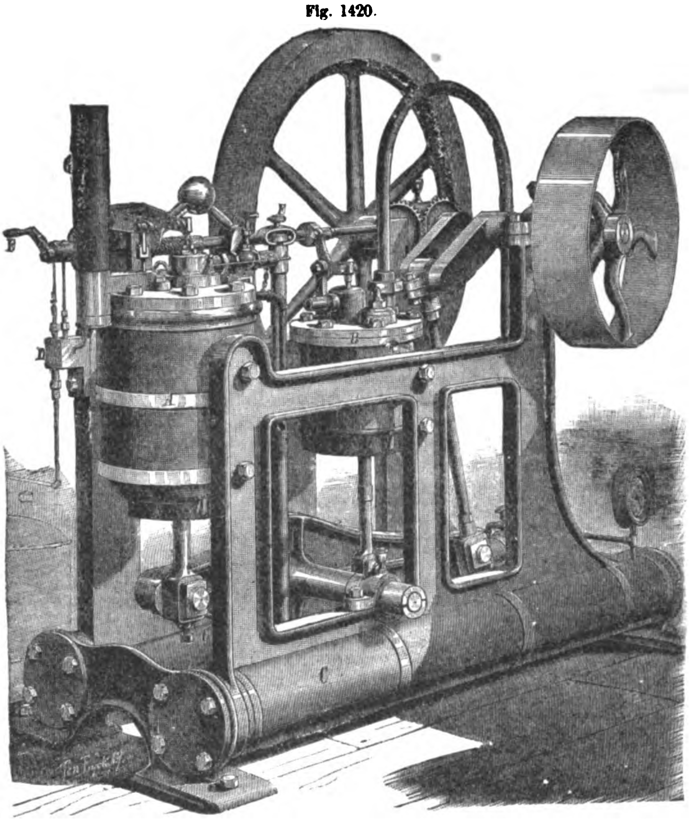
Fig. 1419.



Hydraulic Valve.

Dennis, Br. . . . . . * "*Engineering*," xxviii. 18.

Fig. 1420.



Hydro-carbon Engine.

Hy'dro-ac-cu'mu-la'tor. See ACCUMULATOR, HYDRAULIC ACCUMULATOR, *supra*.

Hy'dro-car'bon En'gine. An engine in which mixed petroleum and air are burned to furnish power by the expansion due to combustion.

Fig. 1420 shows Brayton's single-acting hydro-carbon engine. *A* is the working cylinder of the engine, which is jacketed by a water cylinder. *B* is an air-pump actuated by the working cylinder, and employed to compress air into the two reservoirs *C C*, constituting the base of the frame. *D* is a pump, which supplies the petroleum or other suitable fuel, as fast as it is needed for combustion. The double-acting engine is furnished with a beam, the column carrying the beam center being employed as the reservoir for water. The air-pump is also double-acting, and is placed over the motive or working cylinder; the latter having a diameter of 10″ and 15″ stroke. The engine is constructed to stand a pressure of 100 lbs. on the square inch, and to make 200 revolutions per minute. The oil reservoir is formed in the frame supporting the crank shaft; but if the use of a reservoir of oil is objected to, the oil pump can draw its supply through a pipe from an oil tank placed at any convenient distance. One volume of crude oil can be burnt with 25 volumes of highly compressed air.

The action of the engine is as follows: The oil pump feeds a few drops of liquid fuel through a small tube into an annular chamber containing felt; here the petroleum encounters a supply of compressed air by which it is vaporized, the mingled air and vapor are forced in proper proportion into the working cylinder, where the combustion takes place, communication with the annular chamber being cut off and the products of combustion being left to work expansively, driving the working piston downward; towards the end of the stroke the compressed air supply to the working cylinder is cut off, thus extinguishing the combustion therein; the opening of the exhaust valve permits egress to the products of combustion, and the stroke is completed. An independent jet of hydro-carbon, burning continuously in a suitable chamber, lights the hydro-carbon in the working cylinder at the commencement of each stroke. The supplies of air and oil are adjustable, thus giving to the engines all the advantages of a variable cut off, and effecting an important saving in fuel when the engine is not required to work up to its full capacity. Ordinarily but one of the compressed air reservoirs *C C* is employed, the other being kept charged in order to allow of the immediate starting of the engine at any time.

The engine is made in sizes for small factories, for yachts, and launches: 3 to 10 horse power.

In the small horizontal petroleum engine of Julius Hock, of Vienna, the oil is pumped into one end of a cylinder, mixed with air, and then exploded, the piston is driven outward and returns by the momentum of the flywheel, forcing the gas out of an exhaust valve in the backward stroke. One end of the cylinder is open, like the Otto gas-engine.

Brayton.
* "*Engineer*," xli. 485.
* "*Engineering*," xxiii. 124.
* "*Sc. Amer. Sup.*," 916.
* "*Sc. Amer.*," xxxiv. 303; xxxvi. 15.
* "*Sc. Am. Sup.*," 529, 530.
Thomson, Sterne & Co., Br.
* "*Engineering*," xxvi. 46.
* "*Engineer*," xlvi. 42.

Hy'dro-car'bon Fur'nace. See PETROLEUM FUANACE.

Hy'dro-car'bon Oil. United States Revenue designations.

Lubricants: Semi-fluid oils of a tarry consistence at ordinary temperatures.
Paraffine oils: Fluid hydro-carbon oils below 36° *Beaume*.
Kerosene: Fluid hydro-carbon from 36° to 59° *Beaumé*.
Benzine, from petroleum / *Benzole*, from coal } from 59° to 70° *Beaumé*.
Gasoline: From 70° to 80° *Beaumé*.
Hydro-carbon oils above 80° *Beaumé* volatilize in ordinary conditions of the atmosphere.
See PETROLEUM.

Hy'dro-cele Ap'pa-ra'tus. (*Surgical.*) Instruments for puncturing, syringing, or compressing the scrotum.

Pages 46, 47, Part III., *Tiemann's "Armamentarium Chirurgicum."*

Hy'dro-dy-na-mom'e-ter. An instrument employed to measure the velocity at any point of a liquid current. It determines directly the pressure exerted by the liquid against an obstacle to the current. This pressure is equilibrated by the torsion of a metallic rod. A graduated circle is used to measure the amplitude of the torsion.

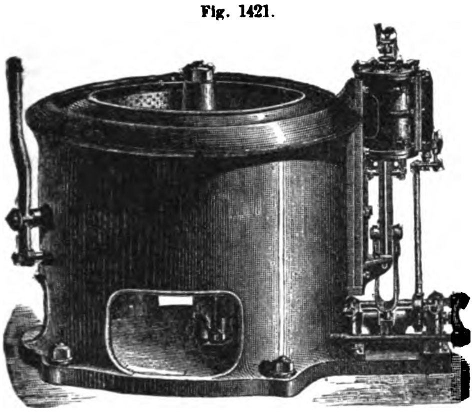
The account of *M. de Perrodil's* hydro-dynamometer,* translated from the "*Annales des Ponts et Chaussées*," in "*Van Nostrand's Eng. Magazine*," xvii., p. 481.

Hy'dro Ex-tract'or. Another name for a wringing or drying machine; the term especially belonging to the centrifugal dryer, known also as a centrifugal machine, sugar dryer, honey extractor, etc. See under the various heads in "*Mech. Dict.*," *et supra et infra*.

The instance shown in Fig. 1421 is one made by *Pierron & Dehaître*, Paris, in which a small and compact reciprocating steam-engine attached to the side of the shell operates the cage through the medium of shafts and bevel-gear. A similar arrangement is made by *Uhlinger*, of Philadelphia.

* "*Scientific American Supplement*" . . . . 2792.

Fig. 1421.



Hydro Extractor

Hy'dro-gen Gas Ap'pa-ra'tus. For the production of hydrogen gas for aëronautic purposes.

Wet process, *Giffard* . . . . * "*Man. & Builder*," x. 36.
* "*Sc. Am.*," xxxviii. 104.
Super-heated steam, naphtha, and lime process, *Tessié du Motay* * "*Sc. Am. Sup.*," 3831.

Hy'dro-hem'o-stat. (*Surgical.*) A bag through which cold water is passed, and which is pressed against a surface to arrest hemorrhage.

Gouley's hydro-hemostat for arresting hemorrhage after lithotomy, is shown in Fig. 157 *c*, Part III., *Tiemann's* "*Armamentarium Chirurgicum*."

Hy-dro-mère'. An *artificial mother*, or *hoverer*, heated by hot water, and designed for young chickens received from the incubator.

Hy-dro-mo'tor. An application of steam to pumping water, ejected at the stern as a mode of propulsion.

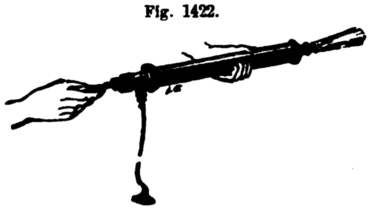
Hydro-propulsion was adopted by Rumsey, of Virginia. See p. 2322, "*Mech. Dict.*" The subject is considered under HYDRAULIC PROPELLER, p. 1150, *Ibid.*

* "*Scientific American*" . . . . . . xli. 228.

Hy-dro-nette'. A portable force-pump for sprinkling gardens, flowers, and vines in conservatories, etc.

A syringe. See also AQUAPULT.

Fig. 1422.



Hydronette.

Hy'dro-pneu-mat'ic Ac-cu'mu-la'tor. An apparatus in which compressed air is made the reservoir of power; especially adapted for using in connection with hydrostatic presses and lifts. See ACCUMULATOR.

Hy'dro-pneu-mat'ic Gun. One in which the recoil is used to compress a volume of air, which, being subsequently brought to act upon the gun, shall raise it to the firing position.

The invention of Capt. Jas. B. Eads. Independently invented or adopted by Major Moncrieff. See description, pp. 506 *et seq.*, "*Ordnance Report*," 1877, and Plates XXXIX., XL.

Moncrieff's system. Described and illustrated in Barnard & Wright's report on "*Fabricating of Iron for Defensive Purposes*," Engineer Department, U. S. A., 1871.

Hy'dro-py-rom'e-ter. One in which the temperature is ascertained by exposing to the action of the heat which is to be measured a definite weight of some metal, as platinum, steel, copper, etc., and then quenching the same in a known weight of water, and noting the rise in temperature of the latter.

The plan was first adopted by Clement Desormes & Schwartz for the measurement of heat in furnaces; then by Regnault in the determinations of the specific heat of various substances, and by Dr. Siemens in experiments upon the varying electrical conductivity of telegraph wire under different degrees of temperature.

Byström's (Swedish) hydro-pyrometer, "*Ordnance Report*," 1878, Appendix R, 8, Plates IV., V., and p. 375.

Hy'dro-rhe'o-stat. An apparatus to vary the intensity of the electric current by passing it through water.

Fig. 360, Part I., *Tiemann's* "*Armam. Chirurgicum.*"

Hy'dro-stat. (*Electricity.*) Water stopper. The cell cover, which prevents the spilling or slopping of the exciting fluids, and which makes the battery portable, and enables the operator to convey it from place to place safely, without removing the liquid.

Hy'dro-stat'ic Joint. A leaden joint for mains, calked by hydrostatic pressure. A circular groove inside the bell of the main is occupied by a ring of lead. A threaded hole is made on the exterior, leading into the groove. Tar is poured in around the ring and force applied, which drives the lead into every crack. The hole is then fitted with a screw plug.

* "*Scientific American Supplement*" . . . . 1725.

Hy'dro-stat'ic Reg'u-la'tor. 1. The hydrostatic regulator, as applied by M. Cheret to the arming press (*balancier*) of the French mint, is described in *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," i., art. "*Balancier*," Fig. 189 *bis*.

2. An apparatus for controlling the water pressure in the mains and pipes of water-works in the Holly system of water supply.

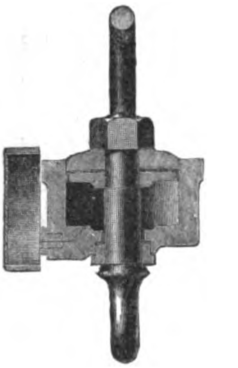
The hydrostatic regulator is provided with a piston, placed within an upright cylinder, and having a rod extending upward which is connected to a cross-bar, having heavy weights, which by means of suitable contrivances bear down upon the piston with a force that increases as the piston rises. A small pipe connects the water mains with the cylinder below the piston, and any change in the water pressure (which would be increased or diminished by opening or closing service-cocks) at once communicates motion to the piston, and the force below the piston is always met by an equal resisting force from the increasing weight. By means of simple appliances, the changes in the position of the piston are utilized to operate on the steam-valves of the engine (or the gates of a water-wheel, if works are run by water-power), and change the point at which steam is cut off in the cylinders of the engine, thereby increasing or decreasing the power of the engines, the speed of the pumps, and the quantity of water supplied. Thus it will be seen that if the piston moves either higher or lower in the cylinder than the point at which it may have been set to maintain the desired pressure, it will automatically bring the speed of the engine to the rate required to supply the demands for water, and permit the pressure to vary only within the limits needed — two or three pounds — to reverse the action of the cut-off moving mechanism of the regulator.

"*Scientific American Supplement*" . . . . 2220.

Hy'dro-stat'ic Weigh'ing Ma-chine'. An apparatus for ascertaining the weight of an object *in transitu*, during the operation of hoisting. Figs. 1423–1425.

The upper loop is placed over the hook of the crane chain, and the object slung to the ring beneath. To the upper loop is attached the cylinder,

Fig. 1423.



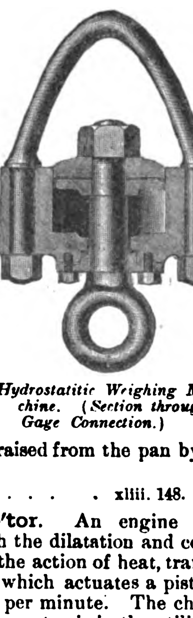
Hydrostatic Weighing Machine. (Section through Suspending Strap.)

Fig. 1424.

Hydrostatic Weighing Machine. (Front View.)

and to the ring the piston moving in the cylinder and tightly packed therein. The space in the cylinder is filled with castor-oil. When a weight is suspended from the ring, the piston presses on the oil, which passes by a channel to the gage which indicates the weight, in tons and pounds.

Fig. 1425.



Hydrostatitic Weighing Machine. (Section through Gage Connection.)

Hy′dro-the-ra-peu′-tic Ap′pa-ra′tus. A shower-bath. In the form invented by Bozerain, of Paris, it is a compact folding arrangement. It may all be contained in a pan with a lid, and when erected for use, has a stem fastened to the slatted floor, and holding a reservoir and a perforated ring for discharging upon the shoulders, the water being raised from the pan by a hand-pump.

* "*Scientific American*"	. xliii. 148.

Hy′dro-ther′mal Mo′tor. An engine invented by Tomassi, in which the dilatation and condensation of oil, caused by the action of heat, transmits motion to mechanism which actuates a piston at the rate of 100 strokes per minute. The chief proposed application of this motor is in the utilization of the heat of the exhaust of steam engines, something after the manner proposed for the bisulphide of carbon and ammonia machines. — "*Les Mondes*," "*Scientific American*," xxxiv. 89.

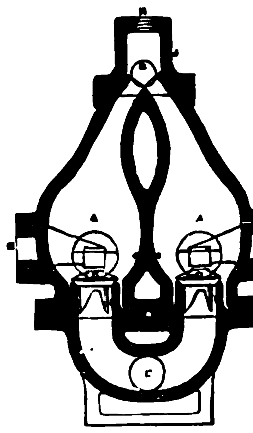
Hy′dro-tri-met′ric Pu′ri-fier. A name given by M. Le Tellier to his apparatus for removing the hardness from water by throwing down the lime, which is afterwards intercepted by filtration through charcoal.

A jet of lime-water is made to mingle with the stream from the supply-pipe, and the precipitated lime is afterwards arrested by filtration. See "*Proceedings of Soc. of Engineers*" (Br.), March 4, 1878, in a paper by J. W. Pearse, reported in "*Van Nostrand's Eng. Mag.*," xviii., p. 472.

See also FEED-WATER HEATER AND PURIFIER, Figs. 1006-1011, pp. 328, 329, *supra*; also LIME CATCHER, *infra*.

Hy′dro-tro′-phe. The English name of an apparatus for raising water by means of condensing steam in chambers, similar in principle to the *pulsometer*, *aquometer*, etc.

Fig. 1426.



Hydrotrophe.

Steam is admitted to the chambers alternately. The condensation of steam causes the chamber to fill from a source below. Steam admitted above the water forces it to any reasonable height; so on alternately of the chambers.

A revival of the so-called steam-engine of Captain Savary. Fig. 5657, p. 2387, "*Mech. Dict.*"

Hodgkin, Neuhaus, & Co.	. * "*Engineering*," xxiv. 27, 88.

Hy-grom′e-ter. A measurer of moisture. See instances and descriptions, Fig. 2628, p. 1159, "*Mech. Dict.*"

	"*Scientific Amer.*," xxxviii. 227.
	* "*Scientific American Sup.*," 212.
Hackenberg	* "*Scientific Amer.*," xxxvi. 36.
Hair, *Koppe*, Zurich .	"*Scientific American Sup.*," 1974.
Hervé Mangon . . .	*Laboulaye*, i., Fig. 5, cap. "*Agriculteur.*"
	Laboulaye, ii.. "*Hygrometre.*"
Simple	* "*Scientific American Sup.*," 2469.
Wagner	* "*Scientific American Sup.*," 808.
Hygroscope, natural .	* "*Scientific American*," xxxvi. 67

Hy′gro-scope. (*Gunpowder.*) An air-tight box in which powder is confined, subjected to a damp atmosphere at uniform temperature for 12 hours, in order to test its capacity for absorbing moisture.

See "*Ordnance Report*," 1879, Appendix I., Plate X. *b*, and description, p. 116.

I.

Ice. Refer to: —

Ice boat, possible velocity	"*Van Nostrand's Mag.*," xxi. 514.
Tower	"*Scientific American*," xli. 288.
St. Lawrence . . .	"*Iron Age*," xviii., Nov. 16, p. 15.
"Whiff"	* "*Sc. American Sup.*," 996, 1107.
"Icicle"	* "*Sc. American Sup.*," 967; * 12.
	"*Scientific American*," xxxvi. 152.
Ice blasting	"*Scientific American Sup.*," 917.
Ice breaker, *Creasey* .	* "*Scientific American*," xli. 58.
	* "*Iron Age*," xxv., April 1, p. 13.
Ice-cream beater, *Wise* .	* "*Scientific Amer.*," xxxviii. 102.
Ice-cream freezer, *Dexter*	* "*Scientific American*," xxxvi. 6.
Ice creeper, *Austin* . .	* "*Scientific American*," xl. 118.
Ice house, cheap . . .	* "*Sc. Amer. Sup.*," 1570; * 1851.
Ice house and cold room	* "*Scientific American Sup.*," 989.
Ice plow, railway.	
Augamar	* "*Scientific American*," xliii. 387.
Ice tongs, *Euler* . . .	* "*Scientific American*," xxxvii. 38.

See also ICE MACHINES.

Ice Bag. (*Surgical.*) A means for cold application specially made for the spine, the eye, etc. Ice broken in pieces is put into a caoutchouc bag of the proper size and shape.

Head-dress, ice water .	"*Scientific American*," xxxv. 342.
Ice hat, medical . . .	"*Scientific American*," xxxix. 345.

Ice Bal'ance. A spring balance registering to 200 or to 400 pounds, by 5's.

Ice Cap. An ice bag for the head. See Ice Bag.

Ice Car. (*Railway.*) 1. One with double sides, floor, ends, and roof; the interstices filled with saw-dust or other non-conductor to prevent the ice from melting.

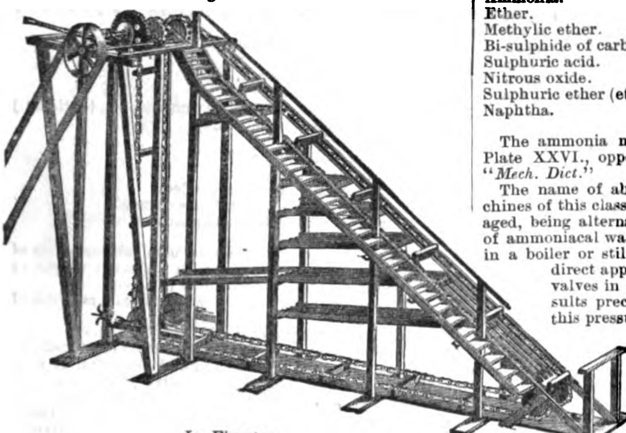
2. See also Ice Locomotive, Fig. 2624, p. 1163, "*Mech. Dict.*"

Ice Chop'per. (*Fishing.*) A tool used in chopping ice for packing fish or bait.

Ice Hook. See Ice Tongs, *g, j, k*, Fig. 2658, p. 1171, "*Mech. Dict.*"

Ice El'e-va-tor. Fig. 1427 is an inclined plane for endless chain elevator.

Fig. 1427.



Ice Elevator.

It is so placed that its foot is in the water of the ice-pond and its several chutes connect with the stories of the ice-house, or successive elevations of the ice stored therein. An endless chain provided with slats runs over pulleys at the angles of the triangular frame; the foot, vertex, and at the angle of the right-angled triangle. The inclined planes consist of a series of gratings, filling its various panels, and the block of ice caught by one of the slats on the continuously moving chain, slips up the grating as far as the latter extends, which may be to any required distance according to the elevation acquired by the stored ice at any given time. On attaining this elevation, which, in the illustration, has been assumed to be at the second chute, say 20′ from the base, the grating having been removed, the block, no longer supported on its slippery track, passes between the inclined beams on to the chute, which, being inclined, conducts it to the ice-house.

Another form of inclined plane ice elevator is shown in Fig. 2641, p. 1163, "*Mech. Dict.*" See also Ice Screw, *infra*. See also Ice Elevator Chain, Figs. 956, 957, p. 309, *supra*.

Ice Ma-chine'. All artificial refrigeration proceeds upon the general principle of compressing a gas, removing from it when in this compressed state the heat generated by compression, by means of running water, and then permitting the reëxpansion of the compressed gas in a series of pipes or chambers so disposed as to abstract heat from the water to be frozen.

Three cubic feet of atmospheric air at the normal pressure of 15 lbs. per square inch and a temperature of 75° F., being compressed into an iron vessel containing one cubic foot, will show a temperature say of 225° F. Being cooled as above, until its temperature is 75°, and then permitted to expand, the result will be say 3 cubic feet of air at 25°.

Various gases are substituted for air as being more powerful refrigerating agents.

Such gases as can be liquefied by pressure possess manifest advantages for this purpose. Perhaps the most convenient agent known is ammonia.

Machines may conveniently be divided into two classes: —

Absorption machines; in which gas (ammonia) is set free from its watery solution by heat, is condensed, refrigerated, worked, and then reäbsorbed by the water.

Compression machines; in which the gasses are forced to make the circuit by means of pumps.

The absorption machines are those of

Tellier	*Boyle.*	*Stanly-Reece.*
Carré.	*Reece.*	*Mignon & Rouart.*
Rankin.	*Krupp.*	*Kropff.*

The following materials have been used in compression machines for the manufacture of ice: —

Ammonia.	Anhydrous sulphuric oxide.
Ether.	Chymogene (petroleum ether).
Methylic ether.	Atmospheric air.
Bi-sulphide of carbon.	Gasoline.
Sulphuric acid.	Carbonic acid.
Nitrous oxide.	Alcohol.
Sulphuric ether (ethylic).	Ethylo-sulphurous dioxide.
Naphtha.	Rhigoline.

The ammonia machine of Ferdinand Carré is shown in Plate XXVI., opposite p. 1164, and described on p. 1165, "*Mech. Dict.*"

The name of absorption machine has been given to machines of this class from the manner in which the gas is managed, being alternately distilled and reabsorbed. A charge of ammoniacal water or aqua-ammonia having been placed in a boiler or still, the gas is driven from the water by the direct application of heat; the gas being retained by valves in a receiver or series of pipes, pressure results precisely as in a steam boiler. While under this pressure, running water passes around the receiver or pipes, and the temperature of the gas is sufficiently reduced, so that it liquefies under the pressure which is derived directly from the still. This liquefied gas, after expanding in a chamber or in a series of pipes, for the purpose of reproducing refrigeration by absorbing heat from substances surrounding the pipes, is then reabsorbed by the water which originally held it in solution.

In these machines mechanical force is dispensed with, excepting in the slight power required to pump the water back into the still pipes, after it has reabsorbed the ammoniacal gas.

Plate XXIII. shows a small Carré ice machine of domestic size in which an ammonia solution serves indefinitely. It requires for operation nothing but fire and water, and, as soon as one block of ice is congealed it is ready to commence another. It is specially intended for ices, caraffes, sorbets, etc., but has its uses also in the laboratory.

In the Rankin Ice Machine, shown in Plate XXIII., the distillation of ammonia is effected by passing the aqua-ammonia through a series of 6″ or 8″ pipes, and finally taking the weak water from the lowest pipe, that is, the last one of the series of small still pipes. The number of these pipes varies from 8 to 18, according to the capacity of the machine. The ammonia passes from each still pipe at the rear end at the same time that the water passes from the front end to the next pipe below. A small pump forces the exhausted water back from the absorber into the still pipes. The absorbers are made of 8″ or 4″ pipe, jacketed for the cooling water to pass the reverse way of the heat. The same arrangement is applied in the construction of the condensers, equalisers, and cooling coils, so that the hottest meets the hottest and the cooler the cooler, in all the interchanges of the machine. Steam-pipes inserted in the still pipes is the preferable mode of heating.

In the Rankin machine the parts are numbered as follows: —

1. Still front.
2. Boiler.
3. Water pump.
4. Ammonia pump.
5. Still pipes
6. Weak water receiver.
7. Stand pipe.
8. Equalizer.
9. Gas receiver.
10. Strong water receiver.
11. Pipe from absorber to strong water receiver.
12. Gas expansion pipes.
13. Pipe to cooling coil.
14, 15. Pressure gages.

16. Header.
17 Pump suction.
18. Gas conductor to condenser.
19. Gas conductor from condenser to gas receiver.

The apparatus of Mignon & Rouart, Paris, is also on the Carré principle.

Pictet reduces temperature by expansion of anhydrous sulphurous oxide. The liquid, contained in a refrigerator, is vaporized under the ordinary atmospheric pressure by a double-acting pump, furnished with conducting pipes, and which compresses it under a maximum of three atmospheres after circulation into a condenser, where it is liquefied anew to be brought back to the refrigerator. The heat produced by liquefaction is absorbed in the condenser. The circulation of a solution of magnesium chloride, between and around ice-molds, is effected by the motion of a helix, which revolves constantly in the bath. The heat of the tropics and that of the arctic regions are found contiguous to each other in the conducting pipes of the pump.

The machine of M. Pictet, shown in perspective and section in Plate XXIII., uses anhydrous sulphurous acid. In the use of this, there is the advantage that at 80° Fah. its tension does not exceed four atmospheres, while it may be liquefied at 25°, and its tension then is only equal to the pressure of the atmosphere. It has no action upon metals when kept free from water; and in order to obtain it in a perfectly anhydrous condition, M. Pictet prepares it by the action of heat on a mixture of oil of vitriol and sulphur, the gas being dried by oil of vitriol. The condensing and refrigerating apparatus consists of tubular vessels similar to those employed with other liquids, such as ether.

A machine capable of producing 550 pounds of ice per hour is thus described: —

"A cylindrical tubular copper boiler has a length of 2 meters and a diameter of 35 centimeters; 150 tubes of 15 millimeters traverse its entire length, and are soldered by their extremities to the two ends. This first boiler is the refrigerator. It is placed horizontally in a large sheet-iron vat, which contains 100 tanks of 20 liters each. An incongealable liquid, salted water, is constantly circulating in the interior of the refrigerator by means of a helix. This liquid is re-cooled to about — 7° C. in a normal course, and it licks on its return the sides of the tanks which contain the water to be frozen.

"In the space reserved between the tubes of the refrigerator, the sulphurous acid liquid is volatilized, and its vapors are drawn up by an aspirating force-pump, which compresses them without the condenser. This condenser is a tubular boiler, the same as the refrigerator: only a current of ordinary water passes constantly into the interior of the tubes to carry off the heat produced by the change of the gaseous into the liquid state of the sulphurous acid, and by the work of compression. A tube furnished with a gage-tap, adjusted by the hand once for all, permits the liquefied sulphurous acid to return into the refrigerator to be subjected anew to volatilization.

"Sulphurous acid has the exceptionally advantageous property of being an excellent lubricant, so that the metallic piston which works in the cylinder of the compressing pump requires no greasing. Thus the introduction of foreign matter into the apparatus becomes entirely impossible.

"The work necessary to manufacture 250 kilograms of ice per hour is at the most seven horse power. A cold of 7° C. in the bath is amply sufficient to obtain in the tanks a rapid and in every way economical congelation. The cost of production is about 10 francs per ton of ice." — "*Nature*."

The perspective view represents a machine on a small scale. A larger apparatus is shown in "*Scientific American*," * xxxvii. 336.

Beneath is a diagrammatic view of the Pictet machine. At *A* is the compression pump, the valves of which are so arranged that at one stroke the gaseous oxide is aspirated through the tube *B*, and on the return it is compressed through the tube *C*. Tube *B* connects with the refrigerator *D*; tube *C* with the condenser *E*. The oxide is introduced at the plug lock *F*, and is drawn by the pump in the direction of the arrow into the copper tubular refrigerator *D*, the liquid filling the space between the tubes. Here vaporization and consequent production of intense cold takes place, and the temperature of the non-congealable mixture of glycerine and water which surrounds the refrigerator is so far reduced that water placed in the metal boxes *H*, immersed in the tank, becomes rapidly frozen. The propeller wheel, shown on the right, determines a current of the glycerine solution through the tubes, and thus hastens the refrigeration. The vapor of the oxide is drawn out of the refrigerator, as already noted, by the pump, carried through the latter, and forced into the space between the tubes of the condenser *E*. Through the tubes a cold stream of water is constantly pumped, which determines the condensation of the vapors, and the reliquefied oxide passes into the admission pipe and once more enters into circulation as already described.

Mignon & Rouart, Paris, use in the domestic machine the solution of ammonia, requiring but the addition of water and heat, alternately. In their larger machine a pump is added.

Sulzer Frères (*Linde*), Winterthur, Switz., operate by the evaporation and recondensation of ammonia, produced by the action of a double-acting suction and force pump.

Siddeley & Co. (Br.) use sulphuric ether. This ether is vaporized in a partial vacuum, and absorbing heat from brine during its vaporization, the vapor thus produced is subsequently condensed and liquefied, to be again vaporized, and so on. The water-vessels are exposed in the brine bath. The excess of heat in recondensation of the ether is carried off by contact of surface exposed to a flow of water.

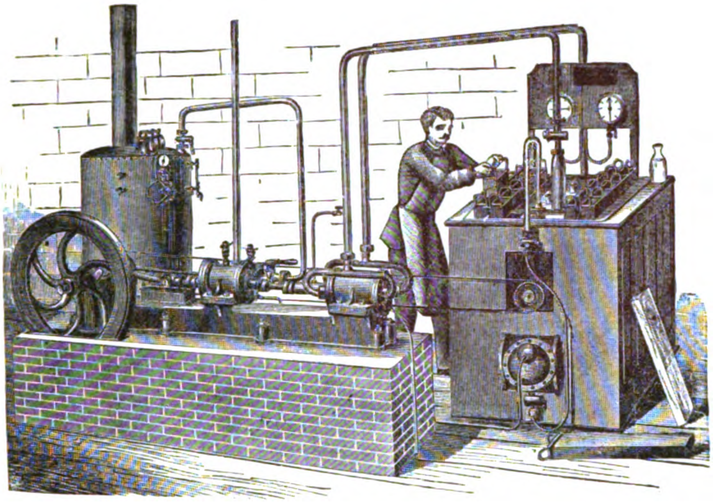
Harrison, in his original apparatus, used ether.
Prof. Twining used sulphuric ether.
Liebe (Br.) used sulphuric ether.
Tellier, methylic ether.
Prof. Paersh, chymogene (petroleum ether) and carbon bi-sulphide.
Prof. Vander Weyde, chymogene.
Prof. Lowe, carbonic acid.
Prof. Seely, liquefied sulphurous acid.
du Motay & Rossi employ ethylo-sulphurous dioxide obtained from ordinary ether by saturating the latter with sulphurous gas.
du Motay & Beckwith, ethylo-sulphurous dioxide.
Boyle, ammonia.
Atlas Engine Co. (Br.), ether.
Duvallon & Lloyd, ether.
Holden, ether, methylic ether, chymogene, etc. (optional.)
Linde (*Sulzer Frères*), ammonia.
Kropff, ammonia.
Edmond Carré, sulphuric acid.
Johnston & Whitelaw, ammonia.
Kirk, air condensed and then expanded.
Winhausen, air condensed and then expanded.
Gorrie, air condensed and then expanded.
Vincent, methyl-chloride.
Toselli's machine for domestic uses, uses sub-carbonate of sodium or nitrate of ammonium, with an equal weight of water, in the interstices between tubes in a nest.

Glacière *Delpy* employs hydro-chloric acid and sulphate of soda.

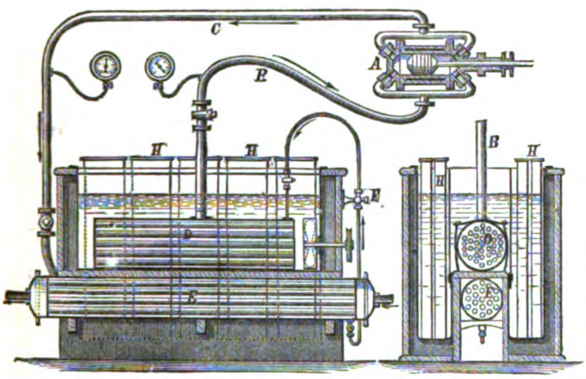
Mansfield uses a deliquescent salt.

The principles involved in the various orders of procedure: vaporization, radiation, liquefaction, and reduction of pressure, have been considered on pp. 1164-1169, "*Mech. Dict.*"

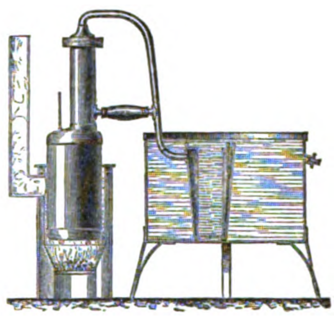
See machines in . . "*Chem. News*," Jan. to Sept., 1876.
"*Sc. American Sup.*," 1348, * 1440.
"*Scientific American*," xliii. 277.
Ammonia . . . . "*Scientific American*," xl. 405.
Atlas Engine Co., Br. * "*Engineering*," xxviii. 13.
"*Technologiste*," xli. 714.
Boyle . . . . . * "*Scientific American*," xlii. 246.
Carré, Edmond . . * "*Mech. Dict.*," p. 1164, Plate XXVI.
Carré, Ferdinand . * "*Mech. Dict.*," p. 1164, Plate XXVI.
* *Laboulaye's* "*Dict.*," iv., ed. 1877.
Cap. "*Production du froid*," Figs. 3707, 3708 *bis*.
du Motay & Beckwith * "*Scientific American*," xlii. 118.
du Motay & Rossi . * "*Engineer*," l. 144.
* "*Scientific American Sup.*," 3794.
"*Scientific American*," xliii. 277.
Duvallon & Lloyd, Br. * "*Scientific American*," xxxviii. 387.
Gesner . . . . . * "*Mining & Sc. Press*," xxxvi. 65.
Gorrie . . . . . * "*Mech. Dict.*," p. 1169.
Harrison . . . . . "*Mech. Dict.*," p. 1166.
Holden . . . . . * "*Scientific American*," xxxvii. 96; xxxviii. 159, 162; xl. 166; xlii. 322.
* "*Manufacturer & Builder*," ix. 198.
Johnston & Whitelaw "*Mech. Dict.*," p. 1167.
Kirk . . . . . . "*Mech. Dict.*," p. 1168.
Kropff . . . . . * "*Manufacturer & Builder*," xii. 201.
Paper by Ledoux.
"*Annales des Mines*" * "*Van Nostr. Mag.*," xxi. 89, 177, 314.
Linde, Ger. . . . . * "*Scientific American Sup.*," 2718.
* "*Engineer*," l. 211.
Lowe . . . . . . "*Mech. Dict.*," p. 1169.
Lugo & McPherson . "*Mech. Dict.*," p. 1169.
Manchester (Br.) Ice Co. See *Siddeley & Mackay*.
Portable, *Mansfield* . * "*Mining & Sc. Press*," xxxvii. 184.
Pictet . . . . . . * "*Scientific American Sup.*," 425.
* "*Sc. Am.*," xxxvii. 335; xxxiv. 403.
* "*Manuf. & Builder*," x. 100.
* "*Mining & Sc. Press*," xxxvi. 321.
Reece . . . . . . "*Mech. Dict.*," p. 1167.
Seely . . . . . . "*Mech. Dict.*," p. 1167.
Siebe . . . . . . "*Mech. Dict.*," p. 1167.
Siddeley & Mackay, Br. * "*Engineering*," xxiii. 481.
"*Iron Age*," xxii., Sept. 19, p. 24.
* "*Sc. American Sup.*," 1159, * 1439.
Skating Rink, London "*Scientific American Sup.*," 550.
Tellier . . . . . . "*Mech. Dict.*," p. 1167.
Toselli . . . . . * "*Scientific American Sup.*," 507.
Twining . . . . . "*Mech. Dict.*," p. 1167.



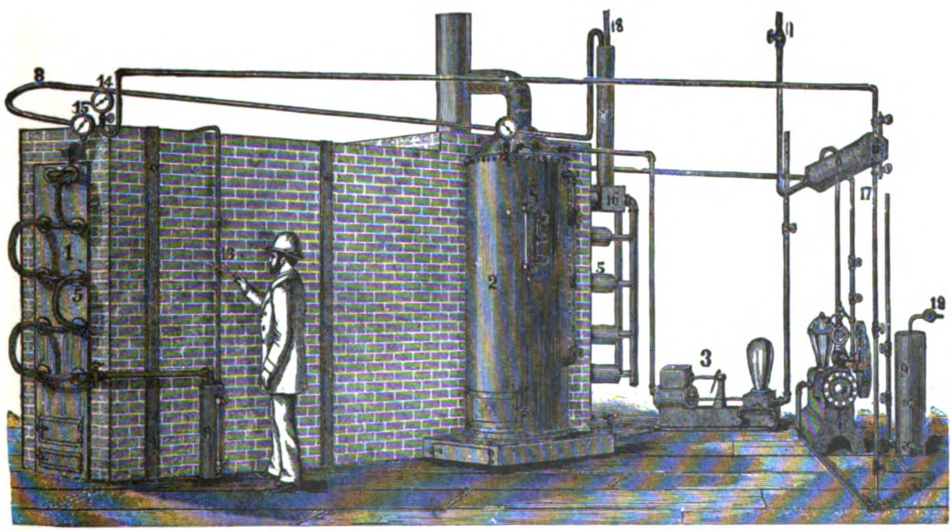
Pictet Ice Machine.



Pictet Ice Machine (Sections).



F Carré Small Ice Machine.



Rankin Ice Machine.

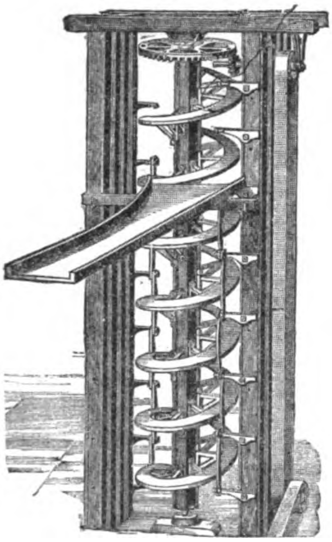
 See page 488.

Tuttle & Lugo . . . "*Mech. Dict.*," p. 1169.
Van der Weyde . . . "*Sc. American*," xxxiv. 177, 228.
"*Mech. Dict.*," p. 1167.
Methylchl. *Vincent*, Fr. * "*Scientific American*," xli. 123.
West . . . . * "*Mining & Sc. Press*," xxxvii. 337.
Windhausen . . . . * "*Mech. Dict.*," p. 1168, Fig. 2406.
See *LeDoux's* "*Ice-making Machines.*" (From the French.)

Ice Mold. A metallic case in which cream or custard is frozen so as to acquire a certain shape, which it retains for a while when deposited upon a dish.

Ice Screw. A machine for elevating ice from the pond to the ice-house, or from one level

Fig. 1428.



Ice Screw.

to another. The block of ice rests against vertical bars, and, as the screw revolves, is pushed up, rising vertically till it reaches the level where it is wanted. Here the block is no longer detained by the vertical bars, and slips off on to the chute which has been disposed to receive it and conduct it to the window of the ice-house.

Ich′thy-o-col′la. The preferable name for isinglass.

Classification by *Danilewski* in "*Technologiste*," xli. 515.

LIST OF UNITED STATES PATENTS.

Jan., 1834, *Norwood et al.*, Sounds are cut, digested, run into strips and dried.
2,474 *Paulsen*, Boiling under pressure.
5,978 *Rowe*, Rollers cooled by circulation of water.
29,596 *Hunter*, Glue from whale-blubber scraps.
40,933 *Herreshoff*, Menhaden fish-water as a dye.
53,686 *Lewis et al.*, Purifying the materials by boiling.
59,331 *Steart*, A "pure" bath of digested fish in treating fiber.
78,016 *Robinson*, Gelatine from fish-heads.
106,212 *Rowe*, Cooling rollers in isinglass manufacture.
134.690 *Manning*, Cooling rollers in isinglass manufacture.
148,317 *Müller*, Sturgeon sounds; solution saltpeter followed by sulphur fumes.
149,165 *Stanwood*, Alcohol and isinglass.
167,123 *Rogers*, Fish-skins scaled, de-salted, digested.
177,764 *Stanwood*, Fish-skins soaked, dried, digested, dried.
219,667 *Alsing*, Albumen from fish spawn.

Il-lu′mi-na′ted Sign. The number-signs of houses in Paris are in numerous cases illuminated by the following contrivance: —

"It consists of a hollow triangular prism 9″ long, two of whose sides are formed of panes of blue glass, on which the number of the house is picked out in white. This prism-shaped lamp-glass rests against the front of the house, so that the two sides with the numbers on them can be plainly seen by the passers-by. In the interior of the prism is a gas jet, fed by a pipe from the house." — "*Telegraphic Journal.*"

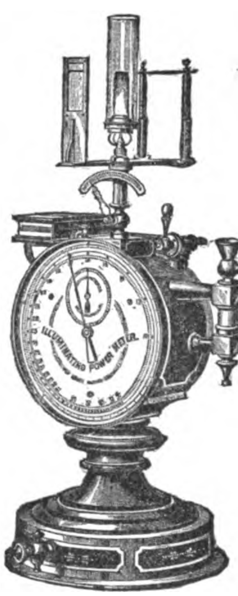
Phosphorescent signs and dials have been used to some extent. See DIAL, p. 254, *supra*, where are several recipes, and numerous references.

See also DIAL, *Morton*, "*Scientific American*," xl. 180, 232.

Il-lu′mi-na′ting Pow′er Me′ter. (*Gas.*) An instrument, by Sugg, of London, designed as a ready means to ascertain the exact illuminating value of gas, in terms of sperm candle values; it can be used in the office or any desired place, as it does not require a darkened room.

After adjusting the height of flame to 3″, the correct reading of any test can be made by an observation of one minute. It occupies a space of about one foot square, and consists of an experimental meter and clock. The dial of the meter is 12″ diameter, its outer circle being divided into spaces of varied lengths, each representing one candle, these spaces being subdivided into tenths of candles. Above the center of dial is a circle having 60 divisions, each representing one second of time, *i. e.*, one minute the whole revolution. A long hand traverses the outer circle and a shorter one the small one. On the side of the meter is a water-box with glass, showing true water-line, and on the top is a governor, three-way cock, pedestal, a quadrant with 45 equal divisions, an argand burner with chimney, and a sighting frame to enable the operator to adjust the flame to exactly 3″. To operate the instrument, start the clock, then adjust the height of flame to 3″, when the gas is passing through the meter, stop the hand at 16 by turning the cock so that the gas passes to the burner without going through the meter, then wait till the clock-hand moves to 60, at this instant turn the gas through the meter and let it pass through till the clock-hand again reaches 60, at this instant turn off the gas from the meter, and the long hand (or pointer) will indicate the quality of gas.

Fig. 1429.



Illuminating Power Meter

Il-lu′mi-na′ting Tile. One with glass bull's eyes for sidewalks over cellars and areas, or pavement over basements.

Il-lu′mi-na′tion.

The following is a London test of the illuminating value of the materials named: —

Material.	Value. 24 cents equal 1 shilling.	Duration of 1 cent's worth in one sperm candle values.
		h. m.
Standard sperm candles, per lb. .	$0.48	1 7
Best wax candle, per lb.	.48	1 6
Sperm oil in moderator, per gal. .	2.28	1 12
Belmont sperm candle, per lb. . .	.30	1 27
Stella or Burmese wax, per lb. . .	.30	1 37
Petroline candle, per lb.	.36	2 15
Composite candle, No. 1, per lb. .	.22	2 5
Composite candle, No. 3, per lb. .	.16	2 45
Common dip candles, per lb. . .	.12	2 52
Almond oil, in moderator, per gal.	2.22	3 –
Colza, per gal.	1.20	4 37
Paraffine oil, in lamp, per gal. . .	.72	9 35
Common London gas, per 1,000′ .	.90	26 –

It may be noted that the price of gas, 90 cents per 1,000′′ is scarcely more than one third of the exorbitant prices usual in the United States.

Il-lu′mi-na′tor. 1. (*Surgical.*) *a.* A lamp with lens used as a means of directing a strong light, in examination by the laryngoscope, ophthalmoscope, speculum, etc. Pages 78, 79, Part II., and Fig. 545, Part III., *Tiemann's "Armamentarium Chirurgicum."*

b. An instrument for illuminating an internal cavity by means of incandescent platinum in a glass envelope.

3. A glazed opening; such as floor-light, deck-light, side-light, bull's-eye, etc., which see.

4. (*Microscope.*) A special attachment for throwing light upon an object under view. See list under ILLUMINATOR, * 2660, p. 1171, "*Mech. Dict.*"

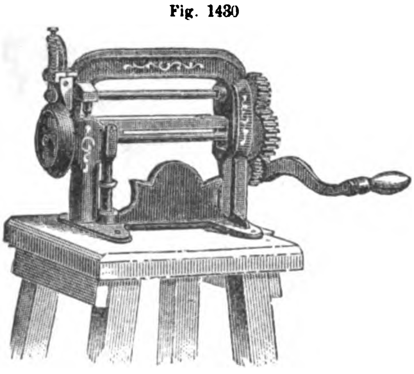
Im-pe′ri-al Silk Serge. (*Fabric.*) A silk and wool French goods.

Im′preg-na′tion. (*Mining.*) Metallic deposits having undefined limits and form.

Im-pres′sion Ma-chine′. (*Cartridge.*) A machine for making an impression in the head of the cup, which is done by a horizontal die pressing it into a pattern, so that, when vented, the holes will not be on the top but on the side of the impression.

Im-pres′sion Stitch Ma-chine′. (*Leather.*) A machine for crimping the upper edge of welts of a boot or shoe to give it the appearance of sewed work.

Fig. 1430

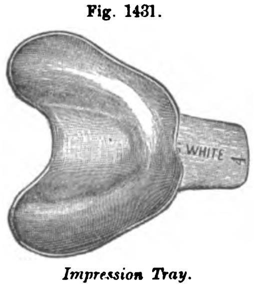


Impression Stitch Machine.

The machine shown in Fig. 1430 makes a stitch impression of any desired width or size.

Im-pres′sion Tray. A tray of Britannia metal to hold the gypsum in taking impressions of the mouth for the making of dentures.

Fig. 1431.



Impression Tray.

They are made of various sizes, and specifically for upper and lower jaws. They are light enough to allow of alteration by pliers or mallet to suit peculiar formations of the maxillary.

Incan-des′cent Light. (*Electricity.*) A form of electric light as distinct from the *voltaic-arc* light. In the *incandescent* light a strip of carbon or platinum is heated to whiteness, *in vacuo*, or in a rarefied atmosphere of an inert gas, nitrogen, for instance.

In the voltaic-arc light, the current leaps the space between two pencils of carbon.

"The incandescent systems are far less numerous than those which employ the voltaic arc, and hence their classification is less complex. They are divided into

"1. Incandescent lamps with combustion.

"2. Lamps purely incandescent.

"The former are represented by Reynier's, Weidermann's (Napolio's modification), Joel's, and Tommasi's apparatus. All of these consist of a carbon rod resting lightly on a lump of carbon or an irregularly-shaped piece of metal, thus producing imperfect contact.

"Pure incandescence is represented in four systems: those of Edison, Maxim, Swan, and Lane-Fox. In all of these we have incandescence of carbon, and this carbon consists of a very fine thread placed *in vacuo* or in a highly rarefied atmosphere of some inert gas.

"The nature of the current is a matter of indifference with incandescent lamps; they work with either continuous or with alternating currents. Those lamps in which there is incandescence with combustion require a great *volume* of current, and rise in *tension*, while those with pure incandescence require small *volume*, and usually rise in *quantity*.

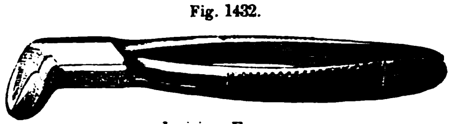
"To pure incandescence we must also refer Jablochkoff's, Kavlin's, Trouvé's platinum wire polyscopes and Geissler's tubes; but properly speaking these are not electric-light apparatus at all, but only objects to be used for study or for experiment." — "*Electrician.*"

Inch. The "miner's *inch*" is the amount of water that will flow in 24 hours through a hole 1′′ square with 6′′ pressure — about 2,000 cubic feet.

In effective hydraulic mining there should be at least 1,500 inches, each one of which will move from 3 to 5 cubic yards of gravel per day. See statement by Mr. Thomas, reported in "*Scientific American,*" xl. 314.

In-ci′sing For′ceps. (*Dental.*) An instrument for separating, cutting between teeth, splitting and excising salient prongs or parts.

Fig. 1432.



Incising Forceps.

In-ci′sor For′ceps. (*Dental.*) An instrument with narrow single prongs for extraction of the incisors.

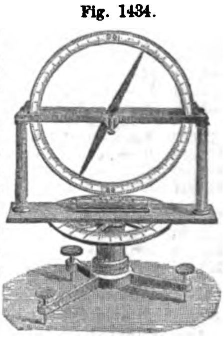
Fig. 1433.

Incisor Forceps.

In′cli-na′tion Com′pass. A magnetic needle with vertical circle to indicate the *inclination* or *dip*, one of the three elements of magnetic force registered at the observatories. The invention of *Norman*, of London.

See DIPPING NEEDLE, Fig. 1659, p. 705, "*Mech. Dict.*" The illustration, Fig. 1434, shows the instrument with a leveling stand and horizontal circle with magnetic needle.

Fig. 1434.



Inclination Compass.

In-clined′ Plane. An artificial slope for ascent of vehicles or objects; the term in its most important signification concerns railway grades. Many of them, traversed by locomotives, are very bold; some are only surmounted by means of stationary engines and cables.

The subject is treated on pp. 1174–1177, "*Mech. Dict.,*" references being made to the inclined planes of

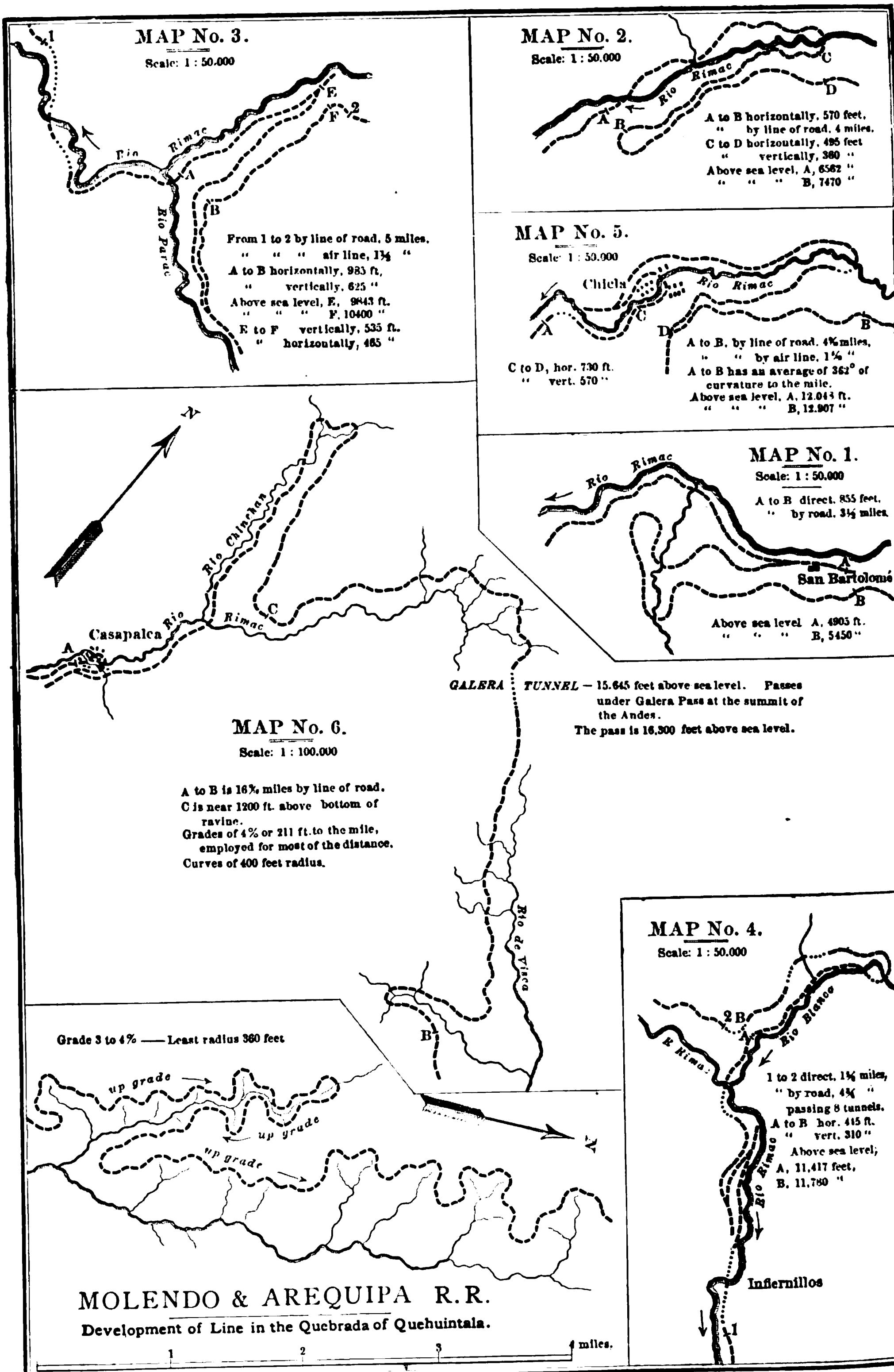


PLATE XXIV. DEVELOPMENTS OF INCLINED PLANES ON PERUVIAN RAILWAYS. *See page* 491.

Reduced from the Surveys in the Office of Señor Henry Meiggs, Lima.

Mount Cenis.	Morris and Essex Canal, N. J.
Holidaysburgh (former) route of Pennsylvania Railway.	Callao, Lima, and Oroya Railway, South America.
Portage, Pennsylvania canal.	Furka pass, Switz.
Mahanoy, Pennsylvania.	Konkan, Bombay.
Mount Washington.	Righi, Switz.

The publication of some engineering data of the Callao, Lima, and Oroya Railway, South America, (Fig. 2664, p. 1175, "*Mech. Dict.*") coming to the notice of Mr. Henry Meiggs, of Lima, Peru, Mr. Jno. McGee of his staff was so obliging as to send careful reductions of the maps of the most interesting developments of the road, which have been reproduced in Plate XXIV. These have all been completed and are numbered in the order the localities are reached in going from the sea.

The descriptions are printed in the panels with each map. In regard to the summit development, No. 6, it may be said that a 60-ton engine takes 60 tons, net load, over the road at 12 miles per hour with ease.

Near the beginning of p. 1176, "*Mech. Dict.*," it was stated that "the longest inclined plane on an artificial road is said to be that from Lima to Callao, which is about 6 miles, and has a descent of 511′, or about 1 in 60." It must now be added from information furnished by Mr. McGee that "the Oroya railway has an average incline for 75 miles of about 1 in 30."

The map of a development on the railway from Molendo to Arequipa, Peru, shown also in Plate XXIV., exhibits the approach to the pampa of Islay, which has a general level of 4,000′ to 5,000′ above the level of the sea.

The subject of inclined planes ascending by cogged gear on locomotive is considered incidentally under INCLINED PLANE, "*Mech. Dict.*"; also RACK RAIL, p. 1852, *Ibid.* Righi Railway, * Fig. 4124, p. 1862, *Ibid.*, and various systems cursorily mentioned on p. 1861, *Ibid.*

The following high grades in Switzerland are mentioned in the journals: —

"A road recently opened up Mt. Uetliberg, Switzerland, overlooks, at a height of 1,300′, Lake Zurich. The total length is 5¼ miles. The lowest grade is 232′ per mile, but 59 per cent. of the whole exceeding 264′ per mile. The curves are 500′ and 450′ radius, the latter coinciding with a grade of 327′. The track is standard gage, and the rails, of iron, weigh 60 lbs. There are three tank locomotives of the Krauss pattern, with six drivers coupled, each 38″ diameter, and with a wheel base of 6′ 8″. They weigh 41,800 lbs. empty, and in service, from 52,800 to 55,000 lbs. The heating surface is 770′ square, diameter of piston 12½″, stroke 21½″. At the first ascent the engine pushed up three cars with gross load of 30 tons, at from 8 to 10½ miles per hour, with steam pressure of 170 lbs. The descent is made with compressed air, by means of an apparatus used on the engines of the Righi road; speed 15½ to 18½ miles per hour.

"Another Swiss mountain road, the Righi Kulm and Lake of Zug, is 7 miles long; 6 miles are worked with a peculiar cogged wheel arrangement, by which grades of 1,056′ per mile are surmounted; radii of the curves, which are uniform, 600′."

PENNSYLVANIA IRON REGION.

Planes.	Total Length of Planes.	Height of Head above Tide.	Height of Foot above Tide.	Total Elevation.	Length of Main Rope required.	Diameter of Main Rope.	Weight per Foot.
	Ft.	*Ft.*	*Ft.*	*Ft.*	*Ft.*	*In.*	*Lbs.*
Mahanoy	2,410	1,478.42	1,124.70	353.72	2,900	2¼	8½
Gordon, 1	4,650	1,519.00	1,200.50	318.50	5,105	2¼	8½
Gordon, 2	4,755	1,206.00	802.00	404.00	5,225	2¼	8½
Big Mine Run. .	1,245	1,274.8	1,013.8	20.65	1,550	2	–

The Mahanoy has steel wire rope 2¼″ diameter with independent steel wire rope center. The others 2¼″ diameter iron wire rope (Big Mine 2″) with independent iron wire rope center.

A new locomotive for use on Ithaca Hill, N. Y., is thus described: —

"The incline has five tracks, of which the outer two are of the usual width, used in the ordinary manner. When the engine starts up the hill it rests upon a pair of rails just within the usual track and upon a set of double-flanged small driving-wheels which are upon the same axles with the big drivers, they being only about 30″ in diameter; this inside track is raised about 15 to 18″ above the outer one, and so high that the big drivers do not touch the track at all; the engine rests now upon the small drivers, and is independent of the outer ones; then in the center of the track is placed a wide cogged rail, which meshes into the cog-wheel, which is between these small drivers, directly under the center of the locomotive. By applying power to the big drivers, in the ordinary way, the power is applied to the cogged-wheel, which does the climbing. The cogs are about 3″ from tip to tip, and the wheel is 8″ wide."

CINCINNATI INCLINED PLANES.

	Mount Auburn.	Price's Incline, Mill Creek.
Vertical height . . .	275 feet.	346 feet.
Length of track . . .	840 feet.	758 feet.
Angle of incline . . .	°	24°.
Wire rope	1⅜″ diameter.	1¼ inch.
Wire rope weight. . .	–	39 tons.
Drum	9′ diameter	9 feet.
Actual strain on rope .	–	6 tons.
Number of winds . .	27	
Time in winding . . .	1 to 1½ minutes.	1′ 12″ to 1′ 15″
Engines	2, double act.	Same.
stroke	24″	
diameter	12″	
Made by John Cooper	Company, Mount	Vernon, Ohio.

The inclined plane of the Jeffersonville, Madison, and Indianapolis Railway at its landing on the Ohio River, has an ascent of 300′ in a mile, or 1 in 17. Wire rope is used.

When a locomotive ascends a grade and then winds up the train to its own level, either of two means may be employed. In each, a rope and winding drum is employed.

1. The winding drum is attached to the engine, which is detached from the train at the foot of the incline, attaches the rope to the forward car, and mounts the incline alone, is anchored to the rails, and then draws the car up after it. It may be anchored part of the way up, draw the cars to itself, the cars be anchored at this point, and then the engine ascend and repeat.

2. The winding drum is at the summit; the engine ascends and so places itself that its driving-wheels are over other wheels of the winding drum. The engine being anchored, its wheels in motion wind the drum, and draw upon the rope.

In each case the train is let *down* the grade by a brake on the drum.

The locomotive of Henry Handiside, of Bristol, Br., is constructed for this purpose. It has a gripping lock which holds the rails, and a drum beneath, operated by another cylinder, for winding the wire cable which connects to the front coach of the train. The locomotive ascends a piece, paying out the cable; then locks itself and hauls up the cars. These are then locked, and the locomotive makes another ascent and repeats. On a level, the locomotive acts in the ordinary manner: shown in Paris, in 1878.

COMPARISON OF DIFFERENT METHODS OF DESIGNATING GRADES.

Engineer	English.	American R. R.
.5 in 100	1 in 200	26.4 feet per mile.
1 in 100	1 in 100	52.8 feet per mile.
1.5 in 100	1 in 66 2-3	79.2 feet per mile.
2 in 100	1 in 50	105.6 feet per mile.
2.5 in 100	1 in 40	132 feet per mile.
3 in 100	1 in 33 1-3	158.4 feet per mile.
3.5 in 100	1 in 28 4-7	184.8 feet per mile.
4 in 100	1 in 25	211.2 feet per mile.
4.5 in 100	1 in 22 2-9	237.6 feet per mile.
5 in 100	1 in 20	264 feet per mile.
5.5 in 100	1 in 18 2-11	290.4 feet per mile.
6 in 100	1 in 16 2-3	316.8 feet per mile.
6.5 in 100	1 in 15 5-13	343.2 feet per mile.
7 in 100	1 in 14 2-7	369.6 feet per mile.

Refer to: — Bessemer Ill. .	* "*Engineering*," xxi. 462.
Bhor, India	"*Sc. American Sup.*," 919.
Callao, Lima & Oroya Ry. .	* "*Eng'ing*," xxviii. 46, 104.
Cincinnati	"*Sc. American Sup.*," 1906.
Tramway, fortress of Glats, Silesia	* "*Engineer*," xliv. 462.

Grand Combe mines, Fr. . . * "*Engineering*," xxvii. 86.
Hyd. hauling machine for
Hayward, Tyler & Co. . . * "*Engineering*," xxiii. 362.
Pittsburg Passenger Ry. . . * "*Scientific Am.*," xliii. 175.
Winding engine, Gordon . . * "*Engineer*," xliii. 77.
Safety trucks, Mahanoy . . * "*Engineer*," xliii. 78.
Woottens, patent . . . . No. 57,423, Aug. 21, 1866.

Table showing the proportions between an engine's maximum load on grades up to 350 feet per mile, and its maximum load on level, the latter being 100 per cent.

Grades.	Per cent.	Grades.	Per cent.
0	100	130	11.6
5	82.8	140	10.6
10	68.1	150	9.8
20	50	160	9.2
30	39.3	170	8.6
40	32.3	180	8
50	27.3	190	7.5
60	23.5	200	7.1
70	20.7	225	6.1
80	18.3	250	5.3
90	16.4	275	4.7
100	14.9	300	4.2
110	13.6	350	3.3
120	12.4		

In-clined' Plane Car. (*Railway.*) One for ascending inclined planes; the support of the bed being so arranged that the bed shall be level when the car is on the incline. The Righi, Mt. Washington, and others afford examples. See INCLINED PLANE, "*Mech. Dict.*," *et supra*. RAILWAY, "*Mech. Dict.*," pp. 1061, 1062, and references *passim*.

In-clined' Press. One of which the bed and die are inclined, for convenience of insertion of the blanks. Cutting, drawing, and stamping presses are sometimes thus built, and sometimes are adjustable so as to have either level or inclined table.

In-cline' Drift. (*Mining.*) An inclined passage under ground; still known as a *level*, but having an inclination to carry off water, or following the dip of a strata.

In'com-bus'ti-ble Wood, etc.

See FIREPROOFING, p. 339, *supra*, for preparations for

Wood.	Canvas.
Theatrical scenery.	Cordage.
Fabrics.	Straw.
Cloth.	Paper.

In-con'stant Bat'te-ry. (*Electricity.*) A single fluid battery is usually termed *inconstant*, to distinguish it from a two-fluid battery.

In-cor'po-ra'ting Mill. (*Gunpowder.*) A mill on the Chilian principle; two-edge wheels revolving in an annular pan. The materials are ground in water; say 1 gallon to the batch of 50 pounds from the mixing-mill.

See "*Ordnance Report*," 1879, Appendix I., Plate II., Fig. 5, and description on pp. 99–101.

For gunpowder, Br. . . . . . * "*Engineering*," xxv. 37.

In-crust'ed Work. (*Fine Art Metal-working.*) Relief work in metal: from the *crustæ* of the Romans; small ornaments in relief attached to vessels. Distinct from *repoussé*, in which the relief is by beating out the metal.

When the figures were large they were removable and called *emblemata;* like instances seen in *Swami* work, of the Madras Presidency.

India shows many varieties of the work, as silver incrusted on brown copper, copper on brass, tracery, diapering, designs in one metal on another; engraved, chased, or stained by oxidation: tin soldered on brass and incised through in floriated patterns, the ground being in part filled with lac, somewhat like *niello*.

The modern French incrusted bronze, is a copper or bronze with gold and silver ornamentation. The objects are first painted in water colors, the principal ingredient of which is white lead. When several articles are to receive the same drawing, it may be printed in the same manner as in porcelain painting. The places which remain unpainted are varnished. The article is then laid in dilute nitric acid, which dissolves the color and bites the metal on the painted places to the required depth. After washing the article, it is placed in a silver or gold bath, where the free surfaces are electrotyped in silver or gold. The varnish is then removed, and the whole surface is polished so that the gilded and silvered parts are not unduly prominent. The article can then be bronzed. A fine effect is produced with black bronze by sulphuret of copper in the spaces between the gold and silver.

In-cu-ba'tor. An apparatus for the artificial hatching of eggs.

The Egyptian egg-hatching ovens, and the apparatus of M. Bonnemain, of France, are shown and described in the "*Mech. Dict.*," p. 1178.

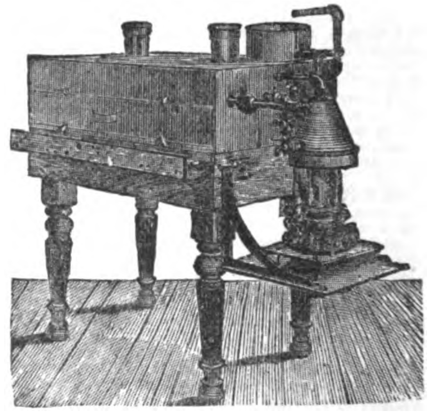
Several late apparatus may be noticed.

Probably each of the following patents has added something to the present approximately successful result.—

Axford.	*Dennis.*
Baker.	*Meyer.*
Day.	*Halsted.*
Cantello.	*Higgins.*
Carbonnier	*Graves.*
Corbett.	*Samuels.*
Weston.	*Thick.*

Fig. 1435 shows the "Reliance" incubator. A steatite radiator is placed over the egg-drawer and heated by hot water pipes imbedded in the steatite. The quantity of water is but

Fig. 1435



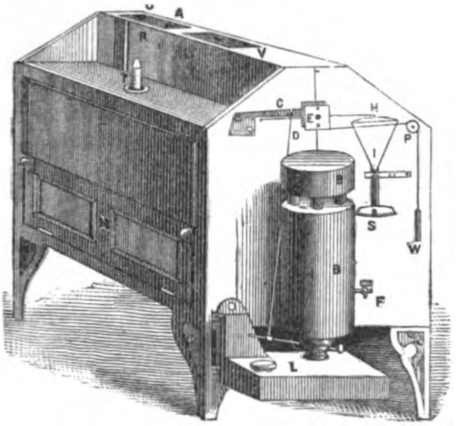
"*Reliance*" *Incubator.*

6 quarts for a 300 egg machine. The egg-drawers are separate, each has its ventilator, and receives moisture from an evaporating pan which gives an atmosphere approximating the condition of the natural nest: heat above, and cool, moist air beneath the eggs. The "Florence" oil-stove is used and the burner is so arranged as to obviate the need for other regulator or thermostat.

Halsted's "Centennial" incubator is shown in Fig. 1436, has a boiler, *B*, from which hot water passes to the tank, over which is the reservoir *R* with a glass water-gage. At *O* is the vent for air in filling, and at *F* the faucet for discharge of water when emptying. *V* is the ventilating flue opening into the egg chamber, the glazed door of which is at *N*. The egg drawer is of parallel bars just near enough together to keep the eggs from falling between them. A thermostatic bar in the chamber projects at *S* and operates the foot of the escape lever at *I*, the upper part of which is a spring wire with a narrow opening at *H*. *E* is a reel around which is wound a cord which passes over the pulley *P*, and is attached to the weight *W*. This reel carries four projecting arms, in pairs, the opposite ones of equal length, and a little shorter than the other pair. The ends of these are bent at right angles, so as to catch upon the curved wire section of the escape-lever *I*. This reel is firmly fastened to a shaft passing through to the ventilator flue, and there attached to the ventilator. On the back of this reel-plate are pins which raise or depress the lamp-lever *C*; this is connected with the lamp-trip by the connecting rod *D*.

The thermostatic bar is set or regulated by a set-screw in the opposite end of the machine. When regulated, the thermostatic bar, affected by the heat, acts upon the lever *I*, bringing the opening *H* over one of the ends of the arms, the force of the weight causes it to pass through and the next arm to catch, thus opening the ventilator and allowing the hot air to escape, and turning down the lamp. When the

Fig. 1436.

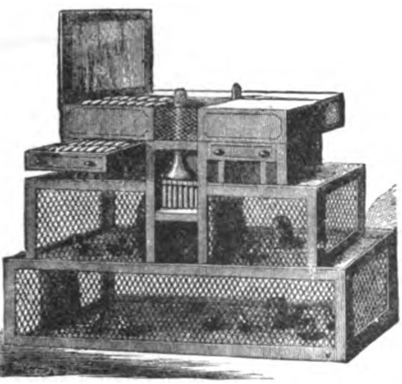


Halsted's Incubator.

drawer has cooled down one or two degrees, the reverse action of the thermostat again releases the end of the arm, and the ventilator closes and the flame is turned up. This is repeated automatically until the weight runs down.

Fig. 1437 shows the *Thick* incubator, which has a water reservoir of 10 gallons, heated by kerosene lamp. Air-carrying pipes pass through the heated water, and carry warm air to

Fig. 1437.



Thick's Incubator. (Br.)

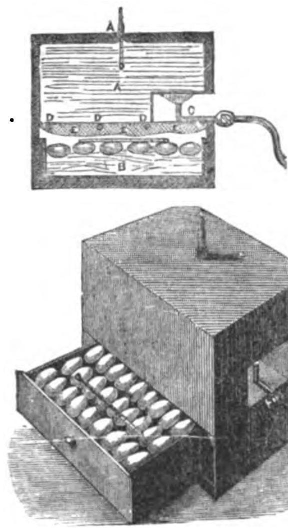
all parts of the hatching apparatus; hot-water boxes form part of the reservoir, under which the chicks, when hatched, are placed to receive the heat necessary for their health. The boxes are covered with a lamb skin, or a "wool mother," the cool, graveled flooring affords for the feet of the chickens a surface similar to natural conditions.

50 eggs are placed in each drawer. The heat of the water reservoir is about 120° Fah., which keeps the eggs at about 103°. The eggs are turned daily and left exposed for 15 minutes, and their relative positions in the drawers changed.

In *Voitellier's* apparatus, shown at the French Exposition of 1878, the heat of the reservoir is kept up by occasional renewals of hot water, and steam is occasionally allowed to escape to keep the atmosphere moist around the eggs.

An improvement on the incubator of *Carbonnier* (Fr.) is shown in Fig. 1438. The apparatus consists of a box, with a zinc case *A* filled with hot water fixed in the top, and underneath a drawer, *B*, to put the eggs in, and in which is spread a quantity of hay, so as to line the bottom of the drawer completely. *C* is a small gas burner sufficient to keep the temperature of the water at 110° Fah., for the eggs

Fig. 1438.

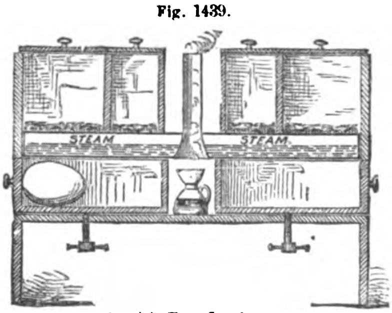


Carbonnier's Incubator.

to become warmed to a temperature of 105° or 104°, to show which a thermometer is laid on the top of the eggs The upper *A* is a pipe for supplying the basin with water and to receive the thermometer, which is immersed in the fluid, and shows the temperature. *D D* are three iron rods fixed in from back to front of the box as a support for the zinc case. *E* is a layer of sawdust, suspended by a piece of muslin (or some such thin material) fastened by a few tacks to the inner side of the box, through which the heat passes. The drawer is opened once or twice every day to turn the eggs, during the incubation of 21 days.

The "Leviathan" incubator, used in Africa in the artificial hatching of ostrich eggs, was exhibited in the Cape of Good Hope section at the Centennial Exhibition. The apparatus consists of a middle steam chamber of metal, which is kept constantly hot by a lamp or furnace beneath. Below this are drawers in which the eggs are first placed, and these, by means of the screws shown below, may be raised until the eggs are brought almost in contact with the warm surface above. In these receptacles the eggs are kept for two weeks at a temperature of 102° Fah. They are then removed and placed in the inner pair of compartments, shown above, for another fortnight, at a temperature of 100°. At the end of this period the eggs are carefully extracted, and a small hole is chipped in each shell at the point opposite the chick's head. They are next replaced and kept in the same compartments for two weeks longer at 98°, when the hatching takes place, and the young birds are placed in the outer upper receptacles, and there remain for two days. The compartments above have bottoms of lamb's wool, which come in contact with the steam chamber below.

Fig. 1439.



Ostrich Egg Incubator.

The egg is about 7″ in length, and the hatched chick about 18″ in height. The chick is fed on rice, and when it reaches the age of seven days is worth $50 in gold. Nearly 20,000 birds, it is said, have been hatched at the Cape of Good Hope by apparatus of this description. The machine is frequently made of sufficient size to hold 115 eggs at a time.

Day's machines are made for 220 and 320 eggs respectively. They are warmed by coal or gas, and the heat is regulated by a thermostat of two unequally expanding metals. This regulates the flame or the draft, as the case may be. An alarm is rung if a given heat be exceeded.

Halsted's "Acme" incubator is entirely of metal, is self-regulating as to heat, and has trays in which the eggs are simultaneously turned, without handling. It is a hot-air machine without boiler or tank. A copper drum is heated by oil lamp, and the warm air radiates from the drum, passing upward through the hot-air chamber where the evaporating trough divides the current and charges it with moisture. A plate deflects the air over the eggs in the drawers. A cool, moist air is retained beneath the eggs. The regulator is a thermostatic bar.

Axford's incubator has a lamp near the floor; circulation from above among the eggs, and exit downward; an electric thermostat and a turn-table holding the trays of eggs; and a special egg-turning arrangement.

Myer's "Perfection" Incubator is heated by the ordinary house-stove.

The *Corbett* incubator is placed on a pile of fermenting horse-manure, and more manure piled round if necessary. It is a cylindrical box with trays, each of which has a tier of eggs. The cover is removed and the trays lifted daily and the eggs turned. The apparatus subsequently acts as an artificial mother.

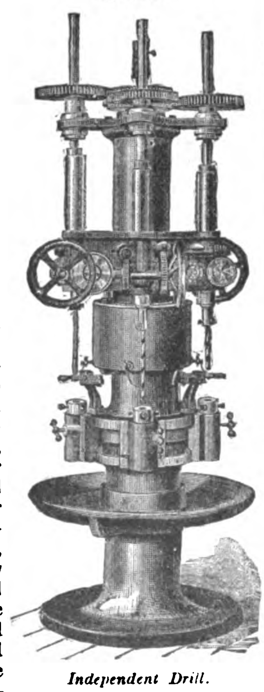
See also: —	* "*Scientific American Sup.*," 849.
Carbonnier, Fr.	* "*Scientific Amer.*," xxxiv. 213.
French	*Laboulaye's* "*Dictionnaire des Arts*," *etc.*, iii. "*Regulateur.*"
Ostrich, *Douglass*	* "*Min. & Sc. Press*," xxxvii. 57. * "*Sc. Amer.*," xxxiv. 226; xxxv. 297; xxxviii. 294, 295.
Ostrich farming	"*Scientific American Sup.*," 884.
Thermostat for	"*Manufacturer & Builder*," xii. 95.

In'de-pen'dent Air Pump. One having no mechanical connection with the main engine: as distinct from a *connected* air-pump, which is a moving part of the engine. Being a steam-pump, operated independently, a vacuum can be formed for the engine before the latter is started, and the speed regulated according to the temperature of the injection water and the requirements of the engine.

In'de-pen'dent Car Wheel. One running free on the axle; as distinguished from the usual railway car wheel, which is chilled or keyed fast to the axle.

One form of independent car wheel, in which the two wheels are not essentially fast together, so that they can move independently in turning curves, is the *Miltimore* wheel, Fig. 532, p. 163, *supra*. See also CAR-AXLE, pp. 458, 459, "*Mech. Dict.*," and AXLE, pp. 198–201, *Ibid*.

Fig. 1440.



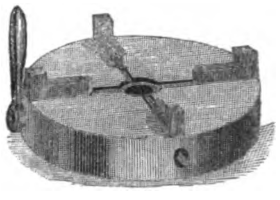
Independent Drill.

In'de-pen'dent Drill. A machine tool intended for work requiring four drills to finish a hole. Each spindle has independent automatic feed, so that one operator can attend to several machines. The four drills may be respectively a *starting* drill, *through* drill, *enlarging* drill, and *finishing* drill or *reamer*. The piece to be drilled is secured in a holder, indexed perfectly under the drills and finished before removing from its fastening. (*Pratt & Whitney.*)

In'de-pen'dent Jaw Chuck. A chuck in which each jaw is separately adjustable; as distinguished from the *universal*, in which the jaws move in concert. Fig. 1441. See also LATHE CHUCK, *infra*.

In'de-pen'dent Truck. (*Railway.*) One of the 4 or 6-wheeled trucks beneath a railway car on the American system. The car rests on the center pins of the trucks, which can therefore follow the track, swiveling by their own motion while the body of the car takes the position of a chord.

Fig. 1441.



Independent Jaw Chuck.

In the European practice the pairs of wheels are independent and their boxes work in hangers or pedestals on the main sill of the car frame. See Fig. 4126, p. 1863, "*Mech. Dict.*"

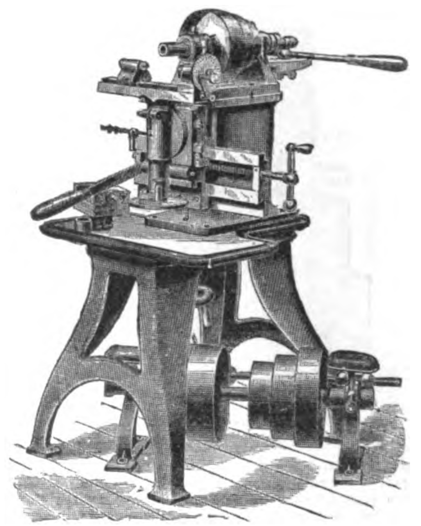
In'de-pen'dent Wheel. A term sometimes applied to a car wheel which runs free on its axle, in contradistinction to the customary wheel, which is chilled, or otherwise tightly fastened to its axle, in the usual railway practice where the wheels are rigidly attached to the respective ends of the axle.

See also a compromise arrangement in which the axle is divided, and each part carries its own wheel, Fig. 532, p. 163, *supra*.

In'dex Mill'ing Ma-chine'. A machine tool adapted to cutting rotary cutters in all varieties, spur and bevel gears, etc.

It receives ordinary work up to 6″ diameter, but will cut spur or bevel gears much larger. The index-plate is attached to the bottom of a hollow spindle having a graduated disk.

Fig. 1442.



Index Milling Machine.

The spindle is pivoted to a vertical slide, and with its attachments, as vise or centers, may be moved to and secured at any angle in a vertical plane of 180°, or 90° on either side of an upright position. This slide, carrying the index, spindle, etc., has a perpendicular traverse of 2″. The upward and downward movement of the main slide, to which the vertical is attached, is 6″, and its side traverse 12″. The centers are shown in the engraving as attached to the index-spindle. They will receive work 3½″ diameter and 8½″ in length. The cone spindle is of steel, and slides in a cast-iron sheath or shell, which runs in cast-iron boxes lined with babbitt-metal. The horizontal movement of the cone-spindle and the vertical movement of the slides is made by adjustable hand-levers, and limited by check-nuts. (*Pratt & Whitney.*)

In'dex. The following scheme for the filing away of valuable suggestions or data, of a miscellaneous description, or appertaining to any study, science, or what not, was devised some time since by Mr. M. T. C. Gould.

The scheme is for a book of 602 pp. The position of the slip or item is determined by its initial letter and next succeeding vowel, for instances: —

Cyrus, *C. y.*, pp. 145, 146.
Steam, *S. e.*, pp. 462–477.

INDEX RERUM.

Chapter.	Section.	Begins at page.	Occupies pages.	Chapter.	Section.	Begins at page.	Occupies pages.	Chapter.	Section.	Begins at page.	Occupies pages.	Chapter.	Section.	Begins at page.	Occupies pages.
34	*a*	1	6	18	*a*	229	6	32	*a*	319	16	38	*a*	510	8
	e	7	8		*e*	235	4		*e*	335	2		*e*	518	4
A	*i*	15	10	G	*i*	239	4	M	*i*	337	4	T	*i*	522	6
	o	25	6		*o*	243	2		*o*	341	8		*o*	528	14
	u	31	2		*u*	245	1		*u*	349	1		*u*	542	4
	y	33	2		*y*	246	1		*y*	350	1		*y*	546	2
44	*a*	35	12	22	*a*	247	6	16	*a*	351	2	6	*a*	548	2
	e	47	10		*e*	253	4		*e*	353	4		*e*	550	2
B	*i*	57	4	H	*i*	257	4	N	*i*	357	4	U	*i*	552	$\frac{1}{2}$
	o	61	10		*o*	261	6		*o*	361	4		*o*	552	$\frac{1}{2}$
	u	71	6		*u*	267	1		*u*	365	1		*u*	553	$\frac{1}{2}$
	y	77	2		*y*	268	1		*y*	366	1		*y*	553	$\frac{1}{2}$
68	*a*	79	24	11	*a*	269	2	11	*a*	367	2	11	*a*	554	6
	e	103	6		*e*	271	4		*e*	369	4		*e*	560	1
C	*i*	109	6	I	*i*	275	2	O	*i*	373	2	V	*i*	561	1
	o	115	24		*o*	277	1		*o*	375	1		*o*	562	1
	u	139	6		*u*	278	1		*u*	376	1		*u*	563	1
	y	145	2		*y*	279	1		*y*	377	1		*y*	564	1
26	*a*	147	6	10	*a*	280	2	44	*a*	378	14	28	*a*	565	6
	e	153	6		*e*	282	1		*e*	392	10		*e*	571	4
D	*i*	159	4	J	*i*	283	1	P	*i*	402	8	W	*i*	577	10
	o	163	4		*o*	284	4		*o*	410	6		*o*	587	4
	u	167	4		*u*	288	1		*u*	416	4		*u*	591	1
	y	170	2		*y*	289	1		*y*	420	2		*y*	592	1
28	*a*	173	10	11	*a*	290	2	28	*a*	422	4	2	*a*	593	$\frac{1}{3}$
	e	183	8		*e*	292	4		*e*	426	6		*e*	593	$\frac{1}{3}$
E	*i*	191	6	K	*i*	296	2	R	*i*	432	4	X	*i*	593	$\frac{1}{3}$
	o	197	2		*o*	298	1		*o*	436	10		*o*	594	$\frac{1}{3}$
	u	199	1		*u*	299	1		*u*	446	2		*u*	594	$\frac{1}{3}$
	y	200	1		*y*	300	1		*y*	448	2		*y*	594	$\frac{1}{3}$
20	*a*	201	4	18	*a*	301	4	60	*a*	450	12	2	*a*	595	$\frac{1}{3}$
	e	205	6		*e*	305	4		*e*	462	16		*e*	595	$\frac{1}{3}$
F	*i*	211	6	L	*i*	309	4	S	*i*	478	20	Y	*i*	595	$\frac{1}{3}$
	o	217	10		*o*	313	4		*o*	498	10		*o*	596	$\frac{1}{3}$
	u	227	1		*u*	317	1		*u*	508	1		*u*	596	$\frac{1}{3}$
	y	228	1		*y*	318	1		*y*	509	1		*y*	596	$\frac{1}{3}$
								Q	*u*	597	4	Z	*a-y*	601–2	2

In'dex Plate. For gear cutting machines. The face has a number of circles each with a certain number of holes so that any required number of teeth may be made on a wheel, the circle being divisible by that number.

SIZES OF BROWN & SHARPE'S INDEX PLATES FOR GEAR CUTTING MACHINES.

Diameter of Plate.	Number of Circles.	Number of Holes in Smallest Circle.	Number of Holes in Largest Circle.	Whole Number of Holes.	Divides all Numbers to.	Divides all Even Numbers to.
12 in.	25	52	100	1,900	50	100
16 in.	38	76	150	4,294	75	150
20 in.	50	102	200	7,550	100	200
24 in.	63	126	250	11,844	125	250
28 in.	75	152	300	16,960	150	300
32 in.	90	182	360	24,390	180	360

In'dex Wheel. 1. A graduated plate marked in circles of holes, for spacing in the cutting of gears. See INDEX PLATE; INDEX MILLING MACHINE.

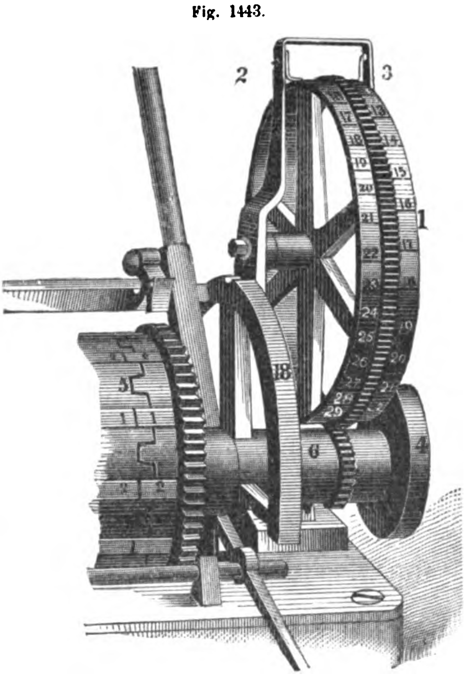
2. A graduated wheel in an instrument for dividing or measuring angles, or in some forms of calculating instruments.

An index wheel in the set works of a saw-mill is shown in Fig. 1442.
1 is the index wheel.
2 and 3, pointers.
4, coupling to which the set rod for working the knees is connected.
6, cog for working the index wheel.
18, support for the index wheel.

The object of the device is to tell at any time the exact number of inches in any log on the carriage, between the knees and the saw. Also, to tell how much slab must be taken off the first cut, in order to have the lumber in the remainder of the log all come out of the required thickness.

In'di-a Ink. The best India ink is still made in China, although its quality has deteriorated since glue made of buffalo instead of stag's horn has

Fig. 1443.



Index Wheel for Saw-logs.

been employed as the vehicle for the lampblack. Its first invention is reported to have been between A. D. 220–419. — "*Scientific American*," xxxvi. 26.

In'di-a Rub'ber. See CAOUTCHOUC.

In'di-a Rub'ber Spring. 1. (*Railway.*) A block of caoutchouc, usually cylindrical, and used in connection with steel springs, either as truck springs or for buffers and draw-springs. See Figs. 1142–1144, pp. 482, 483, "*Mech. Dict.*"

2. (*Carriage.*) A spring used in connection with the ordinary elliptic springs in the running gear, or as a bumper spring between the bolster and bed of a wagon.

3. A strap of rubber used for a return motion in many species of light machinery.

In'di-ca'tor. A marker of phenomena; time, place, number, distance, recurrent position or presence, etc.

There are many instruments cited as GRAPHS, METERS, SCOPES, etc. (see said titles in "*Mech. Dict.*"), which are indicators; such as, to cite one class of limited area, a *Gas Indicator*, of which *Fire-damp Alarm*, *Grisoumeter*, *Carburometer*, are specific titles.

See list of MEASURING, CALCULATING, AND INDICATING INSTRUMENTS, *infra*.

A list of speed, course, grade, and distance indicators and recorders is given on p. 282, *supra*.

Steam, electric, and other indicators are shown on pp. 1180, 1181, "*Mech. Dict.*," and the same work contains in their alphabetical places notices of the following indicators: —

Door.	Shoal.	Stream.
Leak.	Speed.	Street.
Leeway.	Station.	Weather.

See also: —

Channel depth, *Echebarn & Durgos*, Brazil	* "*Scientific American Sup.*," 1522.
Diagrams, *Martin*	* "*Railroad Gazette*," viii. 55.
Eye-piece of microscope	* Fig. 997, p. 323, *supra*.
Gas	* "*Scientific American Sup.*," 1615.
Guiding pulley for. *Stanek*, Aus.	* "*Engineering*," xxv. 65.
Motion, *Bowsher*	* "*American Miller*," iv. 30.
Station	"*Scientific American Sup.*," 865.
Steam, detent for. *Darke*, Br.	* "*Engineer*," xli. 69.
Steam engine, *Thompson*	* "*Scientific Amer.*," xxxv. 278.

In'di-rect' Point'ing Ap'pa-ra'tus. (*Ordnance.*) The piece being once suitably adjusted by means of direct observations, the graduation of certain plates is observed, and subsequently the piece being marked, the piece is adjusted according to the graduations. See POLEMOSCOPE.

See cut and description of the Prussian apparatus used in the sieges of the war 1870, 1871, at Strasbourg and elsewhere. "*Revue d'Artillerie*," iii. 2, and translated in "*Ordnance Report*," 1878, Appendix L, p. 107.

See also ALTISCOPE, * Fig. 136, p. 69, "*Mech. Dict.*"

In-duced' Cur'rent. (*Electricity.*) A current of electricity generated in a coil of wire by induction.

In-duc'tion Ap'pa-ra'tus. See *infra*, also —

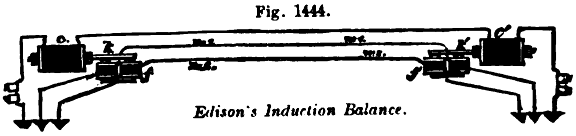
Apparatus { * *Faraday* / * *Forbes* }	"*Scientific Amer. Sup.*," 742.
Balance, *Edison*	* "*Engineer*," xlvii. 284. U. S. Pat. 203,019, Ap. 30, 1878.
Hughes	* "*Engineering*," xxvii. 219, 419, 458.
	* "*Scientific American*," xl. 244.
Coil, *Hopkins*	* "*Scientific Amer. Sup.*," 2548.
Inductorium, *Apps*	* "*Teleg. Journal*," * v. 31, 151.
(Large)	* "*Scientific Amer. Sup.*," 3647.
	* "*Engineering*," xxiii. 303.
Eng.	* "*Scientific Amer. Sup.*," 1173.

In-duc'tion Bal'ance. An instrument for the eradication of induction currents in telegraph lines.

Edison's induction balance, patented in England in 1877, and in the United States in 1878, was designed, in the terms of its specification —

"To compensate, neutralize, and destroy the extraneous or induced currents from contiguous circuits, so that the messages will not be in any manner interfered with by false

Fig. 1444.



Edison's Induction Balance.

currents. The invention consists, in the combination with the telephonic circuit, of an induction coil, connected with the contiguous circuits in such a manner that a reactionary induction is established in the telephonic line of a power corresponding and similar to the primary inductive action, but opposed to the same, so as to neutralize the action of the same."

Fig. 1444 is "a diagram representing one of the forms in which the compensation is effected. The large coils, *c c'*, are included in the telephonic circuit at each end of the line. In the coils are iron cores, surrounded by a primary coil, the ends of which may or may not be connected together, according to the compensation desired.

"The iron core extends outside of the coils some distance. The circuits, No. 1 and No. 2, running in close proximity to the telephone wires, induce a momentary current in it every time the circuits are opened or closed, the strength of which is proportionate to the proximity of the wires to each other and the number of miles that they run side by side. These induced currents are in one direction in closing the circuit, and the opposite direction on opening the circuit. To neutralize the induced current from, say, No. 1 circuit, electro-magnets, *e e'*, are placed at each terminal in the circuit of No. 1.

"These magnets are then adjusted to approach the iron cores, *k k'*, until the induced current thrown into the coils, *c* and *c'*, and telephone line by the action of the magnets, *e* and *e'*, is equal, but opposite to, the induced current from the circuit No. 1 thrown into the telephonic wire by running parallel to it. Thus a perfect compensation is attained.

"If the two lines run parallel for long distances the two ends of the primary coil on *c* and *c'* are connected together, and thus retard the magnetization and demagnetization of the cores, *k k'*, and consequently lengthen the induced currents thrown into *c* and *c'* by the action of *e'* and *e*.

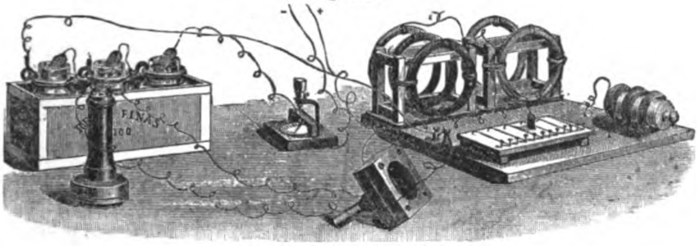
"Having thus compensated for circuit No. 1, the compensation for circuit No. 2 is exactly similar. If the latter circuit does not affect the telephone circuit as strongly as No.

1, the electro-magnets, *f* and *f'*, are placed a greater distance from *k* and *k'*; the latter may be elongated, and compensation attained from many circuits by employing separate magnets in each circuit which affects the telephonic circuit."

Fig. 1445 shows Prof. Hughes' apparatus. It consists of coils of wire, a telephone, a microphone, a three-cell Daniell battery, and a galvanometer, and was constructed by Prof. Hughes, to practically demonstrate his principle of compensation. The subject is carefully described, and the principles of the apparatus well treated in "*Engineering*," March 14, 1879.

"The five rings of insulated iron wire attached to the board — on the right, in the perspective view, Fig. 1445 — represent three lines of telegraph running parallel. The

Fig. 1445.



Hughes' Induction Balance.

two coils of each of the outside pair are joined so as to form one circuit, consisting of one black ring and one white one, each pair representing one line of a certain length, and between them is a single coil representing an intermediate telegraph line of a shorter length; this difference of length was adopted by Professor Hughes in his experimental model in order to represent a somewhat complicated case, and to show that no matter what the relative lengths and distances apart of telegraph lines, their mutual induction may be compensated by suitably constructed and adjusted compensating coils. The compensation portion of the apparatus consists of three rings whose distances apart can be adjusted by sliding in or out the cylinder to which each of the outer coils is attached. On the left front corner of the board is the commutator, consisting of six stiff elastic wires, which can be sprung against twelve brass nails, and the connections are so arranged that the battery circuit may be sent through any one of the lines, with or without the balance in the circuit, and each line can be made either a primary microphone circuit, or a secondary line in connection with a telephone, by simply placing the commutator wires against their proper contact pins. The microphone, and the clock (not shown), which is the source of sound, were, in the professor's experiments, placed in a distant room, and the direction of the currents throughout the whole apparatus was under perfect control by means of the commutator to which we have referred." — "*Engineering*."

In'duc-tom'e-ter. An invention by Dr. O. J. Lodge (England). A modified form of induction balance fitted for electric testing.

"*Engineering*" . . . . * xxx. 134.

In-duc'to-phone (*Electricity.*) A sounding instrument in which vibrations transmitted through the primary are reproduced by a plate and membrane. *Adams.*

"*Telegraphic Journal*" . . . . vi. 30.
"*Journal Society Telegraph Engineers*" . . . . * vi. 476.

In'duc-to'ri-um. The carrier of an induced current. — *Ganot.*

Subject considered,* with notices of Ruhmkorff, Bréguet, Masson, Fizeau, Neef, De la Rive, Verdu, Savart, Moncel: *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," article "*Induction*," tome iv., ed. 1877.

Hopkins . . * *Scientific American Supplement*," 2548.

In-fer'nal Ma-chine'. A name applied to Fieschi's battery of gun barrels with which he attempted to assassinate Louis Philippe.

Thomasson . . * "*Engineer*," xli. 28.
"*Scientific American*," xxxiv. 65.
* "*Scientific American Supplement*," 149.

In'fil-tra'tion. (*Mining.*) The theory that vein filling was introduced as mineral water.

In'fu-so'ri-al Earth. A species of earth, the remains of microscopic animals. It is used as an ingredient in dynamite. See p. 767, "*Mech. Dict.*"

Infusorial earth, uses of, "*Scientific American*," xxxv. 240.

In'grain. As applied to carpets, ingraining is the union, according to the necessity of the pattern, where an interchange of yarn occurs between the *plies* or webs. The more frequently this occurs the better the fabric is *ingrained.*

The ingrain carpet may be *two-ply, three-ply,* etc., according to the number of webs.

In-jec'tion. (*Mining.*) The theory that vein filling was introduced by an igneous fluid and solidified. See IMPREGNATION.

In-ject'ing Syr'inge. (*Microscopy.*) An instrument for injecting the minute arteries of animal tissues with colored chemical substances, thus filling the small blood-vessels and rendering them visible under the microscope.

In-jec'tor. 1. (*Surgical.*) An instrument of the nature of a syringe. The size and shape and the form and proportions of the nozzle vary with the object.

They may be classed as

Bladder.	Rectum.
Embalming.	Uterus.
Hypodermic.	Vagina.

Dr. Parker's injection tubes for the urethra are bulb-pointed, soft rubber, velvet-eyed.

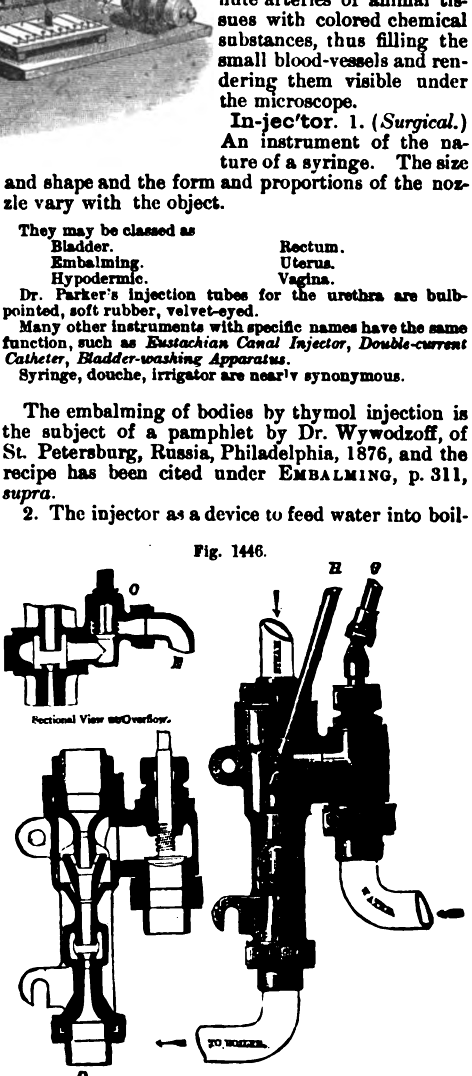
Many other instruments with specific names have the same function, such as *Eustachian Canal Injector, Double-current Catheter, Bladder-washing Apparatus.*

Syringe, douche, irrigator are nearly synonymous.

The embalming of bodies by thymol injection is the subject of a pamphlet by Dr. Wywodzoff, of St. Petersburg, Russia, Philadelphia, 1876, and the recipe has been cited under EMBALMING, p. 311, *supra.*

2. The injector as a device to feed water into boil-

Fig. 1446.



Friedmann Injector.

ers has been described on pp. 1185, 1186, "*Mech. Dict.*" *Giffard's*, and *Seller's* improvement on Giffard, are there shown, Fig. 2679.

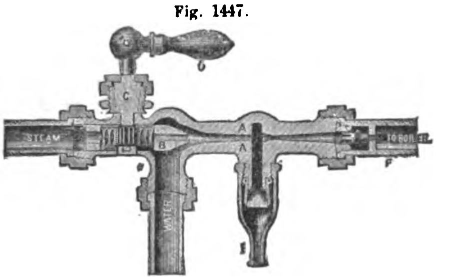
Various modifications and applications of the device are now found.

Fig. 1446 shows the Friedmann (Nathan & Dreyfus) non-lifting injector for locomotives. It is to be placed below the water line and can be used as a heating cock for the tender and water-tank by closing the overflow valve, the handle of which extends into the cab.

H is the handle of the overflow valve, to be used to close the overflow altogether or when the injector is to be used as a heater-cock to heat the water in the tender. *G* is the handle of the water valve; the latter is seen to the right in the sectional view. On the left, in the sectional view, is the intermediate nozzle by which the water supply is conducted in two annular streams to the condensing chamber of the injector when the steam jet is subjected to the action of both at separate points. The result is effective condensation of steam and the transfer of its velocity to the water.

Fig. 1447 is the "Keystone" injector. The form shown is used when the supply water is received from a pressure, such as street main or elevated reservoir. It is placed in a horizontal position, the steam pipe attached to highest part of the boiler, an ordinary globe valve being placed on the steam pipe, and a valve or water cock on the water pipe.

Fig. 1447.

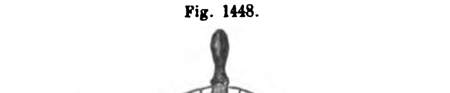


"*Keystone*" *Injector.*

Method of working: Open the steam valve to drive out any condensed steam there may be in the pipe, and close it again. Then open the water cock, then the steam valve, and move the plug *B* slowly forward with the handle *b*, until the water ceases at the overflow. If, while the injector is working, water should escape from the overflow, move the plug forward to reduce the supply of water. If steam escapes, move the plug backward, to give it more water. When the lever *b* is set so the injector works perfectly dry; if you wish to stop feeding, close first the steam valve, then the water cock.

Rue's "Little Giant" injector has an adjustable *combining-tube* moved by a lever. The motion to the left, as exhibited in the cut, Fig. 1448, gives more water, and contrariwise, less. The injector cannot be worked while the combining-tube is closed at either end. The injector lever should be in such position as to allow a sufficient quantity of water to condense the steam when the valve is full open. The combining-tube being open at each end slides in stuffing boxes *C C*, on the left towards the steam supply pipe which projects into the water chamber, and at the other end the tube projects into the discharge chamber to meet the discharge tube which leads to the boiler. The space around the tubes, what may be called the second chamber, has an overflow valve which allows escape of water in the direction of the arrows, when the force of the steam has not sufficient force to cause the water to open the check valve in the boiler supply pipe beyond the discharge plug. When the water has sufficient momentum to open the check valve it causes an indraft at the overflow pipe which closes the valve against the ingress of air.

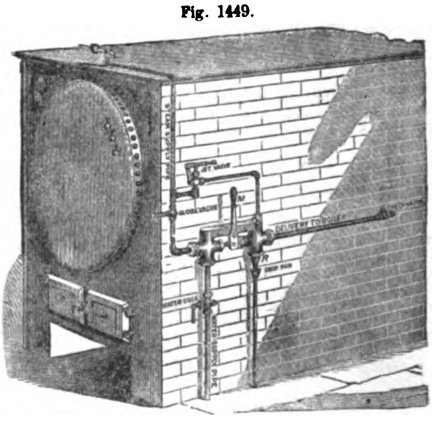
Fig. 1448.



"*Little Giant*" *Injector.*

Fig. 1449 shows the "Little Giant" injector attached to a stationary boiler. The parts are indicated in the cut.

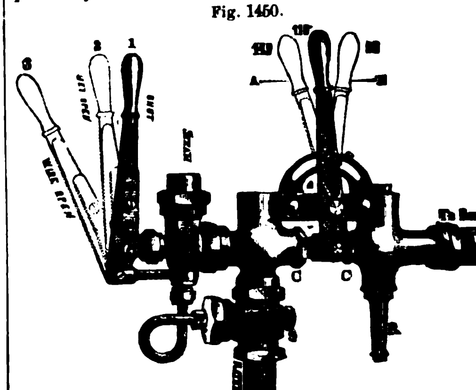
Fig. 1449.



"*Little Giant*" *Injector attached to Stationary Boiler.*

Fig. 1450 shows the arrangement of the *Rue* "Little Giant" injector as applied to locomotives. Directions for operating will sufficiently explain it in connection with what has been previously stated.

Fig. 1450.



Rue Locomotive Injector.

To start the injector: Open lever valve from 1 to 2; when water shows at overflow *R*, open valve to 3 where it must remain while the injector is at work. Regulate water by the combining-valve lever *M*.

To stop the injector, close the valve *A*.

To use as a heater: Close overflow by moving lever *M* to *A*. Then open lever valve on the left to 2 or 3 to admit steam required.

See also INSPIRATOR.

See Austrian	* "*Engineering*," xxvi. 86.
Condenser, *Bulkeley*	* "*Engineer*," xlvii. 332.
Friedmann	* "*Sc. American Sup.*," 655.
	* *Thurston's* "*Vienna Expo. Rept.*," ii. 188.
Hydrants for fire extinction.	
Greathead, Br.	* "*Engineering*," xxviii. 80.
Gresham & Craven (16 Figs.), Br.	* "*Engineer*," xliii. 134.
Gresham & Craven, Br.	* "*Engineer*," xlix. 35.
Hall	* "*Sc. American Sup.*," 2436.
Hart, Engl.	* "*Sc. American Sup.*," 1779.
Steam, *Irwin*	* "*Man. & Builder*," xii. 132.
	"*Iron Age*," xxv., Mar. 25, 1.
Locomotive, *Körting*, Br.	* "*Van Nostr. Mag.*," xvi. 419.
Körting, Engl.	* "*Sc. American Sup.*," 897.
Körting, Br.	* "*Engineering*," xxii. 474.

"Clipper," *Lynde* . . . * "*Scientific Amer.*," xl. 37.
Locomotives, *Mazza*, Italy * "*Engineering*," xxvii. 24.
Hot water for locomotives.
Mazza . . . . "*Iron Age*," xxiii., Feb. 13, p. 9.
Steam, on, *Pocket* . . . . * "*Van Nostrand's Mag.*," xvi. 209 : * 341.
Principles . . . . . . "*Sc. American*," xxxviii. 325.
Sam, Br. . . . . . . * "*Engineer*," xlviii. 462.
Sellers . . . . * "*Railroad Gaz.*," xxi. 323.
* "*Iron Age*," xix., June 7, p. 26.
Steam, *Westley* . . . . * "*Sc. American*," xxxvi. 355.
"Eclipse," *Wilde* . . . * "*Sc. Amer.*," xxxviii. 290.

Chas. E. Emery's report in "*Centennial Exhibition Reports*," vol. vi., Group XX., refers to —

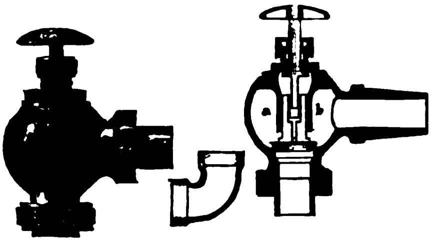
Sellers . . . . * vi. 376.
Friedmann . . . . * vi. 377.
Nathan & Dreyfus . . . . * (ejector).

Treatise on *Giffard's*, *Laboulaye's* "*Dict. des Arts et Manufactures*," article "*Injecteur*," tome iv., ed. 1877.

Leon Ponchet, "*Steam Injectors.*" (From the French.)

In-ject'or Check Valve. The valve in the water supply pipe, between the injector and the

Fig. 1451.



Injector Check Valve.

boiler, rising to admit the water under impulse of the steam jet, and falling to prevent back flow of water.

Ink.

Yellow: A little alum, added to saffron in soft hot water.

For tin or zinc plant labels: Copper, 1; nitric acid, 10; water, 10, subsequently added.

Stencil ink: Shellac, 2; borax, 1; soft water, 10; boil. Add gum arabic, 1; remove from the fire, and stir in lamp-black *ad suf.* Indigo added to tinge.

For tin or zinc: Sulphate of copper, 1; sal ammoniac, 0.5; acetic acid, 2; add lamp-black or vermilion.

Blue: Sulphate of indigo, diluted with water.

To restore faded ink: Brush over with a solution of sulphide of ammonium.

Or: Brush with solution of tannin, remove excess by current of water, and dry at 144° to 177° Fah.

Or: Brush over with solution of sulphocyanide of potassium 1 in 20, and dry in fumes of hot hydrochloric acid. Ferro-cyanide might answer.

To remove ink marks: Moisten with solution of cyanide of potassium, and then solution of oxalic acid. Apply with a camel's-hair brush alternately.

Sympathetic: —

Material.	Treat with.	Result.
Sol. bichr. potas.	Logwood extract.	Black.
Yellow ferrocyan. pot.	Sulph. iron.	Blue.
Yellow ferrocyan. pot.	Sulph. copper.	Red brown.
Salt of arsenic.	Sulph. acid vapor.	Yellow.
Salt of antimony.	Sulph. acid vapor.	Orange.
Nitr. or chl. nickel.	Heat.	Green.
Nitr. or chl. cobalt.	Heat.	Red.
Chl. copper.	Heat.	Blue.

See list also on p. 1187, "*Mech. Dict.*"

Japanese writing inks are very much like Chinese, and manufactured in a similar, though perhaps not quite identical way. The body of the ink is soot, obtained from pine wood or rosin, and lampblack from sesamum oil for the finest sort. This is mixed with liquid glue made of oxskin. This operation is effected in a large round copper bowl, formed by two spherical calottes, placed 1″ apart, so that the space between can be filled up with hot water to prevent the glue from hardening during the time it is mixed by hand with the lampblack. The cakes are formed in wooden molds, and dried between paper and ashes. Camphor, or a peculiar mixture of scents, which comes from China, and a small quantity of carthamine (the red coloring substance of safflower), are added to the best kinds, for improving the color, as well as for scenting the ink. There is a great difference in price as well as in quality between the various kinds of ink, the finest article being rather costly. The most renowned manufactory is in Nara, the old capital of Japan, in the province of Yamato.

Black, Austrian . . . . "*Scientific Amer. Sup.*," 708.
Chromic . . . . "*Sc. American*," xxxv. 298.
Copying . . . . "*Sc. Amer. Sup.*," 708, 1975.
Indelible . . . . "*Sc. American*," xxxiv. 361; xxxv. 52; xxxviii. 96.
Invisible for postal cards . "*Sc. American*," xxxvi. 20.
Logwood . . . . "*Sc. American*," xxxv. 101.
Pencil . . . . "*Sc. American*," xli. 228.
Powder and tablet . . . "*Scientific Amer. Sup.*," 708.
Inkstand, Railway . . . * "*R. R. Gazette*, xxiv. 706.
Sympathetic . . . . . "*Sc. American*," xxxix. 377.
Long list of inks . . . . "*Scientific Amer. Sup.*," 2498.
Ink cartridges and solid ink "*Sc. American*," xxxvii. 112.

A variety of recipes and colors are given in *Laboulaye's* "*Dict. des Arts et Manufactures*," vol. ii., cap. "*Encre.*"

Ink Cup. A vessel hermetically closed, to hold water color or liquid india ink, to preserve it from evaporation and from flies.

Fig. 1452.

India Ink Cup.

The stopper is removed, and the ground ink (or color) is placed in the cup through the tubular neck. Replace the stopper and tube. Pressure on the bladder cover causes the ink to rise in the tube, so as to be within reach of the pen.

Ink'er. The device on a recording instrument which makes the dot or trace.

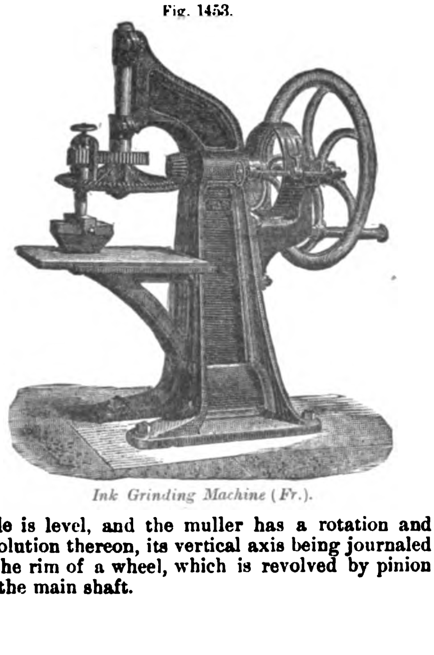
John inking disk, for telegraphic instrument, English, 1856.

Devos inker . . . . * "*Telegraphic Journal*," vi. 28.

Ink E-ra'ser. Take chloride of lime 4 ozs., dissolve in 1 quart of soft water. When dissolved, strain, and add a teaspoonful of acetic acid to each ounce of chloride lime-water. Apply to ink with a brush; absorb moisture with blotter, and dry.

Ink Grind'ing Ma-chine'. A machine having muller and table for grinding ink or color. The

Fig. 1453.



Ink Grinding Machine (Fr.).

table is level, and the muller has a rotation and revolution thereon, its vertical axis being journaled in the rim of a wheel, which is revolved by pinion on the main shaft.

Ink'ing Pad. A pad used to ink the faces of post-office canceling and office stamps.

The Yale pad has a metallic cup, a porous ink surface, and a cover to protect it when not in use.

Ink Pen'cil. A pencil giving a black mark which does not fade on exposure to light, and can be reproduced in the copying machine.

"The mass for these pencils is prepared as follows: 10 lbs. of the best logwood are repeatedly boiled in 10 gallons of water, straining each time. The liquid is then evaporated down till it weighs 100 lbs., and is then allowed to boil in a pan of stone-ware or enamel. To the boiling liquid nitrate of oxide of chrome is added in small quantities, until the bronze-colored precipitate formed at first is redissolved with a deep blue coloration. This solution is then evaporated in the water bath down to a sirup, with which is mixed well-kneaded clay in the proportion of 1 part of clay to 3¼ of extract. A little gum tragacanth is also added to obtain a proper consistence.

The nitrate of oxide of chrome is prepared by precipitating a hot solution of chrome alum with a suitable quantity of carbonate of soda. The precipitate is washed till the filtrate is free from sulphuric acid. The precipitate thus obtained is dissolved in pure nitric acid, so as to leave a little still undissolved. Hence the solution contains no free acid, which would give the ink a dirty red color. Oxalic acid and caustic alkalies do not attack the writing. Dilute nitric acid reddens, but does not obliterate the characters." — *Moniteur Scientifique.*

Ink Pow'der.

Aleppo galls	8 lbs.
Copperas	1 lb.
Gum arabic	½ lb.
White sugar	¼ lb.

Powder and mix. 1 pint boiling water to 2 oz. of this mixture makes a good ink.

Ink, Solid. One recipe for solid ink is: —

Honey	8 oz.
Egg	1 yolk.
Extr. galls	1½ pints.
Sugar candy	1 oz.
Gum arabic	3 oz.
Indigo	1 oz.
Decoc. logwood	½ pint.
Lampblack	2 oz.
Willow wood charcoal	2 oz.
Sulphate iron	3 oz.
Blue galls in powder	3 oz.

Another recipe is: —

Catechu	3 drachms.
Extr. hæmatoxylon	1 drachm.
Acetate and hydr. of deutoxide copper	10 grains.
Sulph. alumina and potash	1 scruple.
Gum arabic	1 drachm.
Sulph. of protoxide of iron	1 drachm.
Sulp. indigo, for color.	

Over all pour a decoction of Campeachy wood to form a paste.

Ink'stand. A solid-ink inkstand is one furnished with a block of ink which affords a writing fluid by addition of water. See *supra.*

In-lay'ing. (*Fine Art Metal-work.*) The inlaying of Japanese bronzes with gold, silver, and alloys is called *zogan*, and is principally carried on in the provinces of Kaga and Yechiu. The process by which the inlaid work is effected differs according to the nature of the material on which it is produced.

Cloisonné. The design is hollowed out to a certain depth with a graver or chisel, and the ornamenting metal, silver, gold, etc., generally in the shape of threads, is laid into the hollow spaces and hammered over, should the alloy be soft enough; the edges of these grooves are first slightly driven up, so that when the silver or gold has been laid in, they can be easily hammered down again, so as to prevent the inlaid metal from getting loose.

Or: The surface is merely covered in the required places with a narrow network of lines by means of filing, and the thin gold or silver-leaf fastened on to this rough surface by hammering. This last process is the one used mostly for inlaid iron-work. With *Niello*, instead of the usual black sulphureted silver and copper, a more easily fused alloy is used. Inlaid work of the above kind is made at Kanasawa and Takaoko, where the alloy used for the bronze casting is mostly composed of copper, tin, zinc, and lead.

In the European practice the inlaid enamel work which is performed by Oriental artists with so much skill and patience, and at the same time with such primitive appliances, is now executed by simpler and quicker means. The object to be inlaid is entirely covered with varnish, portions of which are removed by a graver so as to form the design; and thus prepared, it is subjected to the action of a galvanic bath of gold or silver, which deposits the metal in the places laid bare by the graver.

Another method is suggested by M. Morin. After the removal of the varnish, according to the pattern made by the graver, the object is plunged into a solution of cyanide of silver. The salt is deposited on the lines from which the varnish has been removed; the object is heated in a muffle furnace, and the metal appears on the black patina.

Inlaid patterns of gold and silver may be obtained, either of their natural brightness or with a dead surface, the latter being effected by different processes of oxidation; so that, on the same object, by making use of the protecting varnish, designs in gold and silver of various degrees of luster may be combined.

See also "*Manufacturer and Builder*" . . . . xi. 34.

Japanese *repoussé* work consists of small metallic ornaments for swords, tobacco pouches, etc., and larger pieces, such as tea-pots, scent-burners, vases, etc.; the inlaying of this kind of ware is sometimes of extraordinary delicacy and beauty. The dark blue color shown by a great number of smaller pieces is that of the Shakudo, composed of copper and 3 or 4 per cent. of gold.

India excels in inlaying, and has many styles, the names of some of which have been recognized in commerce, arts, or in treatises. The art, which was common in Europe, is said to have been introduced from Persia into India about a century ago.

Bombay inlaid work is used for boxes, desks, and similar articles.

Vizagapatam work is in ivory and stag's horn, and applied to articles similar to the Bombay work. The black etched scroll work on the ivory is in graffito.

Mynpuri work consists of boxes and salvers of a rich brown wood, inlaid with brass wire in geometrical forms and scroll patterns.

Agra work is a mosaic of semi-precious stones, copied in style from the exquisite Taj at Agra by Austin de Bordeaux.

See also Bidiri Work; Kuft Work.

In'ner-hung Brake. (*Railway.*) One in which the brake shoes and beam are hung between the wheels, under the car-bed. In contradistinction to *outer*-hung brake.

In Place. (*Mining.*) A vein or lode inclosed on both sides by fixed and immovable rock.

In'sect De-stroy'er. A means for destroying aphides, slugs, and bugs on roses or other flowers and plants; beetles on potatoes; worms on cotton, and so on.

See Sifter; Duster; Spraying Machine; Fountain Pump; Sprinkler; Beetle-Destroyer.

Comstock's "*Report upon Cotton Insects*," 1879, shows a great number of devices, which are listed under Cotton-worm Destroyer, p. 226, *supra.*

See also decoction tomato stems	"*Sc. American*," xli. 168.
Powder blower, *Marks*	* "*Sc. Am.*," xxxviii. 278.
Grasshopper machine	"*Iron Age*," xix., June 28, p. 11.
Riley	* "*Sc. Amer.*," xxxvii. 169.

In'sect Pin. A delicate, thin pin for impaling entomological specimens.

In-sert'ed Joint. A form of pipe joint in which one member slips in the other, which forms a sleeve. A bell-joint.

In-side'-jaw Chuck. A chuck for holding drills, rods, or pipes. These pass *through* the chuck, the jaws of which have an inside hold instead of, as in a face-chuck, gripping the object by projecting jaws, as in the ordinary lathe chuck.

In-side' Mold'ing Ma-chine'. 1. A wood-planing, molding, or matching machine, the cutters of which are between the bearings of the cutter arbor; in contradistinction to a machine in which the cutter overhangs the frame.

2. A wood molding machine which has cutters protruding upwardly through the table, and adapted to work upon inner molding edges, as those of pic-

ture frames, etc. An edge-molding machine. See Fig. 3200, p. 1468, "*Mech. Dict.*"

In-sol′u-ble Ce-ment′.

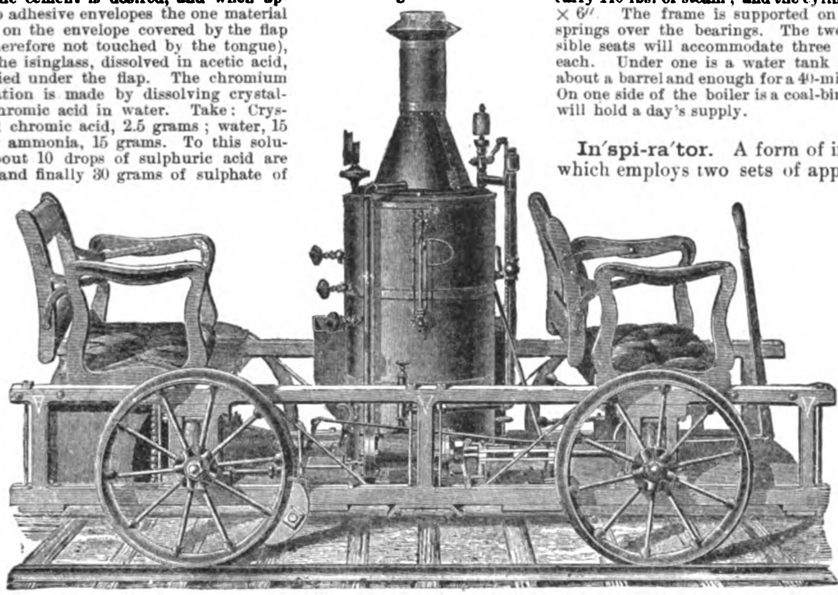
"A chromium preparation and isinglass forms a solid cement, which is not only insoluble in hot and cold water, but even in steam, while neither acids or alkalies have any action upon it. The chromium preparation and the isinglass or gelatine do not come into contact until the moment the cement is desired, and when applied to adhesive envelopes the one material is put on the envelope covered by the flap (and therefore not touched by the tongue), while the isinglass, dissolved in acetic acid, is applied under the flap. The chromium preparation is made by dissolving crystallized chromic acid in water. Take: Crystallized chromic acid, 2.5 grams; water, 15 grams; ammonia, 15 grams. To this solution about 10 drops of sulphuric acid are added, and finally 30 grams of sulphate of ammonia and 4 grams of fine white paper. — "*Dingler's Polytechnisches Journal.*"

In-spec′tion Car. One used by the officers of a railway while inspecting the track.

One made by Mr. Noble is shown in Fig. 1454. The platform extends under the axles and is within 10″ of the rails. The boiler is about 42″ × 18″, intended to carry 140 lbs. of steam; and the cylinder 3½″ × 6″. The frame is supported on rubber springs over the bearings. The two reversible seats will accommodate three persons each. Under one is a water tank holding about a barrel and enough for a 40-miles run On one side of the boiler is a coal-bin which will hold a day's supply.

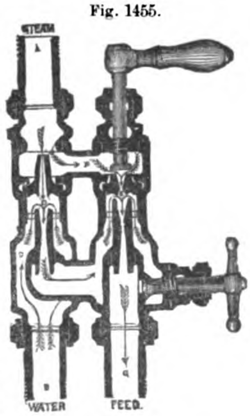
In′spi-ra′tor. A form of injector which employs two sets of apparatus contained each in a separate chamber, but working in combination, the first of which lifts and receives the water in the pump-chambers by the suctional action of a small jet of steam, and then conducts it to the injector or forcing-tubes contained in the second chamber. The water is then transmitted to the boiler by the aid of a second jet of steam, which constitutes the forcing element, and which impinges upon the stream of water as delivered by the pump, and forces it directly into the boiler.

Fig. 1454.



Inspection Car.

Fig. 1455.



Hancock's Inspirator.

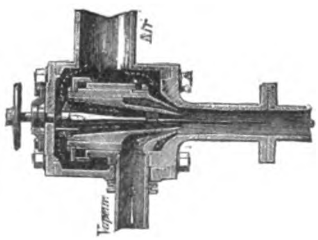
The operation is as follows: Dry steam is admitted to the instrument by opening a valve at the point *A*. The water is drawn up from the well, or other reservoir, in the chamber *B* by the creation, at that point, of a partial vacuum, and rises through the channel *C* to the point *D*, when the jet of steam drives it into *E*, as shown by the line of arrows. The forcing jet of steam is admitted through *F*, and controls the feed-current at *E*, passing to the boiler down the feed-pipe *G*.

See also INJECTOR.

Hancock . . . . * "*Iron Age*," xxv, March 4, p. 17.
* "*Scientific American*," xl. 99.
* "*Mining & Scientific Press*," xxxv. 409

In′suf-fla′tor. 1. A blower feeder for furnaces. It is on the principle of the injector. An annular blast of steam draws in and violently projects a current of air into the furnace. Siemens' insufflator is shown in Fig. 1456. In the petroleum feeders for furnaces the same device is used, concentric currents of petroleum and air being injected by a blast of steam.

Fig. 1456.



Siemens' Insufflator.

2. (*Surgical.*) A powder blower. Named according to the nature or place of application, as *Laryngeal*, *Esophageal*, *Rectal*, *Oral*, etc. A syringe, in effect: may be an *atomizer* or *fumigator*.

See also AUTO-INSUFFLATOR, Fig. 131, p. 57, *supra*.
See also INJECTION SYRINGE, *i*, Fig. 2678, p. 1191, "*Mech. Dict.*"

In′su-la′ted. (*Electricity.*) Protected from contact with other conductors.

In′su-la′tor. A material of extremely small conductivity isolating a wire from the ground, or interposing between an electrified body and other objects.

A piece of wood cut from a tree is a good electrical conductor. Let it be heated and dried, it becomes an insulator. Let

it be baked to charcoal, it becomes a conductor again. Burn it to ashes, and it becomes an insulator once more.

Addition to instances shown on p. 1191, "*Mech. Dict.*"

	* "*Scientific Am. Sup.*," 1628.
Teleg., *Bloomfield*	* "*Sc. American*," xliii. 387.
Cardeaux	* "*Telegraphic Jour.*," vi. 287.
Creighton, Br.	* "*Engineer*," xlix. 107.
Creighton	* "*Teleg. Journal*," vii. 146.
Creighton, Br.	* "*Engineering*," xxix. 120.
European	*Brooks'* "*Vienna Exp. Rep.*," 1873.
Fuller	* "*Teleg. Journal*," vi. 3.
Johnson & Phillips, Engl.	* "*Teleg. Journal*," v. 245.
Lightning-guard, *Oppenheimer*	* "*Teleg. Journal*," vii. 127.

In′te-gra′tor. Invention of J. Amsler-Laffon. The object of the instrument is to find the area, the statical moment, and the moment of inertia of any closed curve, by simply tracing out the curve with a pointer, the machine doing all the rest.

Mechanical, *Amsler-Laffon*, Fr.	* "*Engineering*," xxix 462
	* "*Engineer*," xlix. 252.
	* "*Sc. Amer. Sup.*," 3930.
Integrating machine.	
Sir W. Thomson	* "*Van Nost. Mag.*," xv. 301.
	* "*Engineering*," xxx 561.

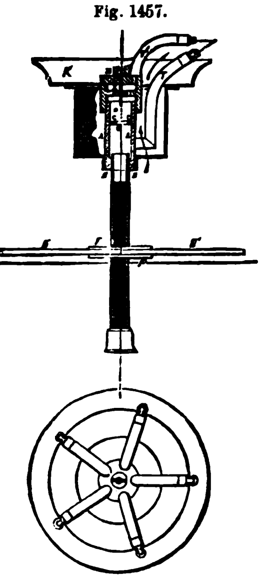
See also HARMONIC ANALYZER, page 438, *supra*.

In-ten′si-ty. (*Electricity.*) Another name for tension; capacity to overcome resistance.

In-ten′sive Gas Burn′er. (Fr. *bec Mallet.*) A late French form of gas burner.

The burners, ordinary batswings, are placed in pairs on the circumference of a circle, so that their tubes of supply represent radii of the circle.

Fig. 1457.



Bec Mallet. (*Section and Plan.*)

In the burner shown in the section and plan in Fig. 1457 there are five pairs, or ten burners. The lower ones are inclined from the horizontal in an upward direction, so that the flames join together into one. The upper row is supplied from a chamber, *X*. The disk crossing the center of the chamber may be raised or lowered by the central screw, thereby giving less or more gas to the upper circle of burners. The chamber has a hollow thread cut in it, and screws up and down on the tube *A A*, so that the distance between the two circles of burners can be regulated. The lower burners are supplied from the tube *A A*. This tube has also a hollow screw cut in it and the main supply tube *H* screws into it. By screwing the supply tube *H* into the tube *AA* the supply of gas to the lower circle of burners is cut off as the end of the tube *H* approaches the diaphragm *C C* perforated with a hole *D*, while the supply to the upper burners is obviously unaffected. Thus the supply to either circle of burners can be increased or diminished or cut off entirely; and either can be lit, to the exclusion of the other. At *L* is represented a basket in wire gauze surmounted by a plate *K*. The air that passes through this is supposed to be somewhat heated, and supplies the flame through the interior of the apparatus, and the shield preserves the flame from currents of cold exterior air.

Fig. 1458 shows the general effect of the Mallet burner in a street lantern.

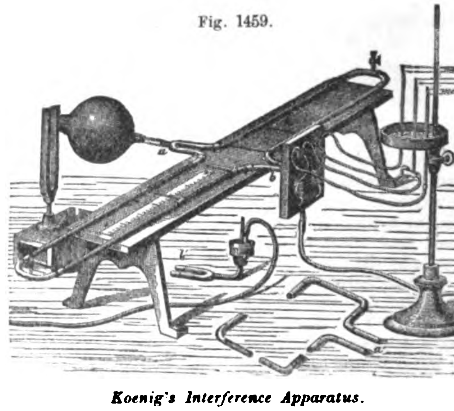
In′ter-fe′rence Ap′pa-ra′tus. An apparatus by M. Koenig for investigating the theory of sound. That shown in Fig. 1459 is for observing the interference of sonorous waves.

The apparatus consists chiefly of two U-shaped tubes, fixed horizontally upon a board, but so arranged that their length may be changed, on the same principle as the trombone with the well-known sliding piece: these allow the tubes to be made of the same length, or different according to any length desired. These tubes connect mutually by both ends; at one connection, *a*, a resonator is attached, serving to intensify the sound of a large tuning-fork, with which it is in unison, and to conduct it through both tubes to the other end *b*. When these tubes have the same length, the waves will arrive equally through both routes; but if we lengthen one of the arms until the difference between them amounts to half a wave-length of the note of the tuning-fork, the waves coming through the two conduits destroy each other at the other end of the tube, and if we allow this to terminate in a small cavity, above which is a manometric capsule, we shall see, on lengthening one of the arms, how the deeply cloven flames in the revolving mirror are gradually changed into bands of light when the difference of half a wave-length is reached, corresponding with the point where the two waves destroy one another by interference.

Fig. 1458.

Intensive Gas-burner.

Fig. 1459.



Koenig's Interference Apparatus.

See "*Manufacturer and Builder*," * viii. 12, and * v. 13, Fig. 3, also numbers for January and July, 1874, in regard to the application of resonators and mirrors in investigating the properties of sound.

See also CURVE INSTRUMENT; ELECTRICAL DIAPASON; FLAME MANOMETER; HARMOGRAPH, *supra*; and PENDULUM INSTRUMENT, *infra*.

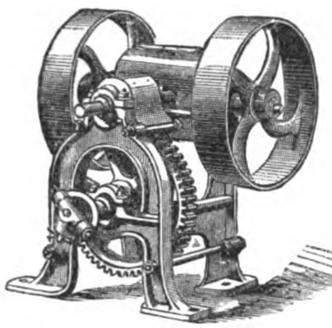
In′ter-me′di-ate Floor. (*Railway.*) A floor consisting of boards placed between the sills and floor-timbers of passenger cars and between the deafening or under floor and the upper or main floor. The purpose of the intermediate floor is to exclude noise and stiffen the floor-timbers. — *Forney*.

In′ter-me′di-ate Mo′tion. A device placed between a horse-power and a machine to be driven, to convert the motion of the tumbling-rod of the former into a band motion for the latter.

The tumbling-rod is coupled to the gimbal shown on the left, and the motion is communicated by master wheel, pinion and bevel wheels (in the case) to the band pulleys. The latter are two in number, to serve separate machines.

Also known as a *jack*; a jack serving 3 machines is shown at *E*, Fig. 2569, p. 1126, "*Mech. Dict.*"

Fig. 1460.



Intermediate Motion.

In'ter-me'di-ate Spin'ning Frame. In the series of spinning frames, consisting of *slubbing*, *intermediate*, *roving*, and *fine roving* frames.

In-ter'nal Gage. A gage for testing internal sizes; holes and other spaces. An internal diameter gage.

The *cylindrical* gage is a favorite form; see Fig. 772 (plain), p. 244, *supra*.
Also Fig. 994 (threaded), p. 322, *Ibid*.

In-ter'nal Pres'sure Gage. Lieut. Metcalfe's internal pressure gage, for testing pressures in exploding ordnance, is described and illustrated in the "*Report of the Chief of Ordnance*," 1877, * 361, and Plate accompanying Appendix 1, *a*. It uses a conical point, and the determination of the pressure is by measuring the surface diameter of its penetration into a copper disk.

In the same volume, p. 374 *et seq.*, and Plates I.-IV., is a description of Lieut.-Col. Benton's dynamometer, used for the same purpose. Also of Rodman's internal pressure gage, p. 387, and Plate V; the Adams circular cutter, p. 388, and Plate VI.; the national armory circular cutters, p. 389, and Plates VII. to X.
See DYNAMOMETER.
See also PIEZOMETER, *infra*; and CRUSHER GAGE, p. 283; CUTTER, p. 239, *supra*.

In-ter'nal Screw Gage. A steel external-thread screw made to an accurate size, for measuring internal-threaded screws.

See EXTERNAL AND INTERNAL GAGES, Figs. 993, 994, p. 322, *supra*.

In'ter-os'se-ous Saw. (*Surgical.*) A fine thin saw for working between bones, as those of the fore-arm, the lower leg, the ribs. — *Lente*.

In'ter-rupt'ed Cur'rent. (*Electricity.*) An intermittent current caused by the rapid action of a rheotome or vibrating armature. The primary and secondary currents are generally interrupted ones, and the galvanic or battery current can also be, if required.

In'ter-rupt'er. (*Electrical.*) An automatic apparatus, used in connection with the chronograph and wire-targets, to ascertain the velocity of flight of projectiles.

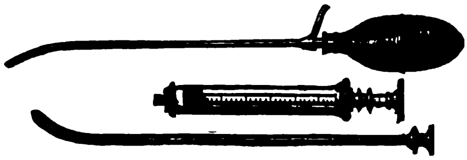
The *Russell* interrupter, used in connection with the *Schultz* chronoscope, is described on pp. 42, 45, and Plate I, "*Ordnance Report*," 1878.

In'tra-u'te-rine Syr'inge. (*Surgical.*) An instrument for injecting the uterine cavity.

The upper one in Fig. 1461 is *Molesworth's*. It consists of an elastic bulb and double canula; the fluid is discharged directly forward, towards the symphysis pubis, without danger of throwing the jet into the Fallopian tubes, and escapes as fast as thrown in, or may be retained as long as desired, and all withdrawn by relaxing the pressure on the bulb; the tube is silver, and the curve easily changed.

The lower one in the figure is *Gautillon's*. It has also the reverse flow, a graduated glass barrel, and a silver tube.
Intra-uterine and uterine electrodes, for introduction through the cervix and for clasping the neck of the uterus respectively, are shown in *Tiemann*, Part 1. page 106.

Fig. 1461.



Intra-uterine Syringe.

In-trench'ing Spade. One carried by troops for making earthworks.

See BURGOYNE, Fig. 77, p. 147, *supra*.
Harrison's, Fig. 2691, p. 1193, "*Mech. Dict.*"
Rice's TROWEL BAYONET, Fig. 6673, p. 263, "*Mech. Dict.*"
The Austrian intrenching spade has a jointed handle.
See also intrenching tool, *Buskett*, * "*Scientific American*," xl. 202.

In-ver'sion Bat'te-ry. (*Electricity.*) One in which the inversion, or upsetting of the battery, throws the exciting liquid against the plate or plates and sets the battery in action.

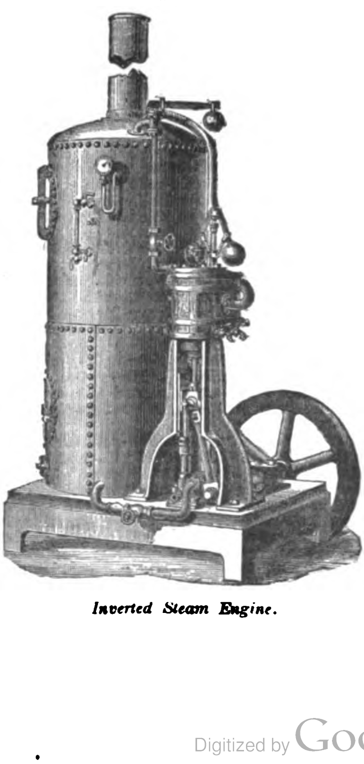
See that of M. Trouvé in connection with his electro-medical apparatus, * "*Telegraphic Journal*," vi. 475.
* "*Niaudet*," American translation, 147.

In-vert'ed Arch Bar. A wrought-iron bar bent into somewhat the form of an inverted arch, and which forms the tension member of a truss of an iron side-frame of a truck. The ends of an inverted arch-bar rest on the journal-boxes, and the arch-bar is on top of it. — *Forney*.

In-vert'ed Steam En'gine. A form of steam-engine useful in yachts and launches, as it allows direct connection to a propeller-shaft which has its bearings on the base-plate.

Several forms are shown in Figs. 2695, 2696, p. 1194, "*Mech. Dict.*" See also *Craig*, Br. * "*Engineer*," l. 3.

Fig. 1462.



Inverted Steam Engine.

In'wall. The lining wall of a smelting furnace; specifically, that part of it which is above the boshes.

I'on. (*Electricity.*) A product of voltaic decomposition.

Ir'i-dec'to-my In'stru-ments. (*Surgical.*) Instruments for operating upon the *iris* of the eye. See IRIDECTOME, p. 1195, "*Mech. Dict.*"

Iridectomy instruments include those for artificial pupil, dislocating the natural pupil, and incision. See KERATOME, p. 1223, "*Mech. Dict.*"

PUPIL, ARTIFICIAL, p. 1835, *Ibid.*

See also for knives, scissors, needles, forceps, sharp and blunt hooks, p. 30, Part II., *Tiemann's* "*Armamentarium Chirurgicum.*"

Ir'i-dec'to-my Scis'sors. (*Surgical.*) For operating upon the iris. See *Althof's*, *d* Fig. 4672, p. 2054, "*Mech. Dict.*"

I-rid'i-a'ted Glass. Glass, the surface of which has acquired opalescence or the iridescence familiar in mother-of-pearl, by exposure for a long period in the ground, or by artificial means for producing the same effect. See IRIDESCENT GLASS.

Iridescent lace, *Helouis*, Fr. . "*Sc. American*," xxxix. 184.

Ir'i-des'cent Glass. The cause of the change in the structure of the ancient glass, — the articles exhumed by General di Cesnola, at Idalium and Golgoi, in Cyprus, being the most brilliant specimens (see p. 973, "*Mech. Dict.*"), — is understood to be the combination of the alkaline components of the glass with carbonic acid, setting free the silicic acid. The alkaline carbonate, being washed away, leaves the surface in a laminated condition, adapted to refract light from a multitude of surfaces, giving the same appearance as the wavy structure of *nacre* or mother-of-pearl. It is said that analysis of some of the di Cesnola glass proves the fact of the changed chemical condition stated.

Specimens from China and Burmah indicate that means are in the possession of these Orientals for producing the rainbow tints, and Clémandot and Frémy have succeeded in producing the iridescence by placing the glass under a pressure of 2 or 3 atmospheres for 6 or 7 hours in a water-bath containing 15 per cent. of hydrochloric acid at a temperature of 248° Fah.

The wondrous beauty of the Cyprian specimens directed special attention to the subject, but it had long been noticed that Etruscan and Roman glass had acquired this property, and specimens in the European museums, in Italy especially, had made the appearance familiar. That the still more ancient glass of Egypt had not manifested the same peculiarity is accounted for by the dryness of the atmosphere of that country, although some Egyptian glass is not destitute of iridescence.

The process of Webb & Son, of England, is as follows: —

Chloride of tin or tin salt is burnt in a furnace, and the hot glass, while on the ponty in the last stage of the course of manufacture, is exposed to the fumes. To give greater depth to the tints, nitrates of bromine and strontium are used in small quantities.

Investigations of the Austrian and Bohemian iridescent glass show that the process there pursued is by heating the glass and causing the deposit of a metallic oxide on its surface by reduction. Bismuth is used, and M. Peligot has detected it by analysis.

Bohemian (lime glass) glass is thought to be the most suitable for this treatment.

Producing colors on glass by fuming vapors, forms the subject of a U. S. Patent to F. S. Shirley, Dec. 18, 1877. It is, however, a European invention, and was shown by Lobméyr, the pioneer in this line, in the Austrian section, at Philadelphia, in 1876.

Articles made with a beautiful iridescent surface are now common in shop windows, globes of this character having their effect enhanced by filling with water. It is perhaps more effective in partial shadow than in full light. Chandeliers and decorative bulbous plates of this kind of glass are extremely brilliant. Black beads, for trimmings of ladies' costumes, are now made as iridescent as peacock coal.

Clémandot's patented process produces beautiful effects. The main feature of the process is the application of acids to the glass, under a pressure of from two to five or more atmospheres. Water containing 15 per cent. of hydrochloric acid is used to bring out rainbow tints like mother-of-pearl; and artificial gems of various sorts have thus been manufactured. The glass prepared by these processes is quite as iridescent as that which antiquaries so much value, the pressure and the acids hastening a result that the ordinary agencies of the atmosphere would take centuries to produce.

To remove the tendency of window glass to show iridescent colors, it may be plunged as it is taken from the *leer* into a bath of water, with 2% of hydrochloric acid.

"*Iron Age*"	xxii., July 4, p. 20; xxvi., Aug. 26, p. 15.
"*Eng. & Mining Journal*" .	xxv. 99; xxvii. 44.
"*Mining & Scientific Press*"	xxxviii. 402.
"*Scientific American*". . .	xliii. 198; xxxvi. 211; xxxviii. 23, 184; xxix. 6, 368; *Clémandot*, xliii., 198.
"*Am. Manuf. & Iron World*"	xxiv., Jan. 8, p. 11.
"*Telegraphic Journal*" . .	*Clémandot*," vi. 67.
"*Engineer*"	xlv. 45.
"*Scientific American Sup.*" .	* 1882, 1900.
"*English Mechanic*" . . .	xxvi. 172.

I'ris-a'ted Wire, etc. An invention of Nobile, improved by Becquerel and M. Hélouis, of France, in which metallic threads, lace, and ribbons are *irisated* by means of binoxide of lead, producing delicate fibers of binoxide in concentric rings, with varied colors, like those of soap bubbles.

Nobile used electro-chemical means. Becquerel devoted time to its elucidation, and substituted a solution of oxide of lead in potassa or soda.

M. Hélouis has succeeded in irisating ribbons, threads, and bands, objects in some cases of such tenuity as to have a length of 32,800 feet to the pound.

I'ris-a'tion. Conferring the tints of nacre.

To produce rainbow tints on metals: Dissolve 3 parts hyposulphite of soda in 30 of water and mix in 1 of sugar of lead. The mixture is precipitated on being heated to 70° or 80° Réaumur, depositing sulphuret of lead. In the presence of any metal this deposit is made upon it. According to the thickness of the deposited layer various iridescent colors appear on the surface of the metal. To produce this coloration uniformly the object should be heated throughout.

Hélouis	"*Technologiste*," xli. 444.
Of glass	"*Technologiste*," xxxviii. 378.
Frémy & Clémandot .	"*Technologiste*," xl. 68, 117.
Paper by *Lockert* . .	"*Scientific American Sup.*," 1882.

I'ron. The history and divisions of the subject are given on pp. 1195–1206, "*Mech. Dict.*" See also lists under FURNACE, p. 926, *Ibid.*; and METALLURGY, pp. 1424, 1425, *Ibid.*

See also references: —

Art work	"*Iron Age*," xvii., May 11, p. 18.
Assaying, *Bruno Kerl* .	* "*Scientific Amer. Sup.*," 252, 340.
Bridge, *Kuilenberg*, Holl.	* "*Scientific American*," xliii. 387.
Building	"*Van Nostrand's Mag.*," xvi. 470.
"*Building News*" .	"*Iron Age*," May 8, p. 7; May 10, p. 8.
	"*Scientific American Sup.*," 1123.
Cutter, "Old Colony" .	* "*Iron Age*," xix., Feb. 1, p. 1.
Fence pickets	* "*Iron Age*," May 3, p. 11.
Fortifications.	
Sheerness, Br. . . .	"*Iron Age*," xix., Mar. 29, p. 23.
House, Manchester, Br.	"*Scientific American Sup.*," 1969
Ingot press, *Jones*, Br. .	* "*Engineer*," l. 101.
Inlaying with pearl . .	"*Iron Age*," xxv., Feb. 12, p. 5.
Japanese	"*Scientific American*," xxxiv. 358.
Microscopical exm. . .	* "*Scientific American Sup.*," 2620.
Nail works, Sable.	
Zuy & Co.	* "*Iron Age*," xix., April 5, p. 1.
Pavement, Paris . . .	"*Scientific American*," xxxiv. 242.
Ships, American . . .	"*Scientific American*," xxxvi. 278.
Steel and iron, *Siemens*	"*Scientific Am. Sup.*," 1112, 1121.
Holley & Smith . . .	"*Scientific American Sup.*," 1184.
Steel and iron, advances,	
Akerman, Switz. . .	"*Van Nostrand's Mag.*," xix. 459.
Work, ornamental . .	"*Iron Age*," xix., May 10, p. 1.
Works, Creusôrt plan .	* "*Engineering*," xxvi. 275.

I'ron A-mal'gam. Sideraphthite: composed of 65 parts iron, 23 nickel, 4 tungsten, 5 aluminum, 5 copper.

It resists sulphureted hydrogen, is not attacked by vegetable acids, and only slightly by mineral acids. It is useful as a substitute for standard silver, while it can be produced at a cost not exceeding that of German silver. For alloys which have to be silver-plated to prevent oxidation, the inoxidizable iron, as the above is called, is stated to be a successful substitute.

Ir'on Bar'row. A wrought-iron wheel barrow for moving iron in pig, sheets, or bars.

I'ron Ce-ment'.

Dried and powdered brick earth	4
Peroxide manganese	1
Fine iron filings (free from rust)	2
Common salt	0.5
Borax	0.5

Mix, grind, and make into a paste with water. Apply when freshly made. Warm, and then expose to a nearly white heat.

Another: Sifted peroxide of manganese 1
Triturated zinc 1

Rub up into a pasty condition with common water glass. Apply while freshly made.

See also recipes, p. 182, *supra;* and pp. 507-509, "*Mech. Dict.*"

I'ron Clad. The Italian iron-clads are at present the most formidable.

"The new twin-screw double-turret vessel 'Dandolo,' belonging to the Royal Italian navy, excepting in the omission of the internal torpedo deck, resembles the sister ship 'Duilio' in her general arrangement, but has considerably surpassed her in speed. The 'Dandolo' was built at the royal naval arsenal at Spezzia, under the supervision of Director Borghi, at whose suggestion the whole of the bow plating is worked flush, instead of the plates overlapping as usual. The length of the vessel is 337′ 8″, the breadth 62′ 3¼″; the mean draft at the trials with armament on board was 28′ 9″, giving a total displacement of 11,225 tons. The battery is heavily armored, and is placed in the middle of the vessel; the two turrets rise above the weather-deck, and are placed diagonally in the battery, so as to enable all four guns to be fired fore and aft. The armor of the turrets is impenetrable to all except the heaviest modern artillery. Each turret contains two 100-ton Armstrong guns, made at Elswick, having a bore 17.72″, throwing a shot 2,018 pounds, with a maximum of 511 pounds of powder, the ordinary charge being 355 pounds. The turrets and guns are moved and worked by a complete system of hydraulic gear, made at Elswick. The loading is also done by the same means, the rammers being below the weather-deck, and arranged to enter the gun when the muzzles are depressed for the purpose. Between the turrets is situated the mast, which really assumes the function of a look-out tower, as there are no sails.

"The 'Dandolo' carries four large steam launches and eight other boats, all hung upon hinged davits which are worked from the steam capstan, and which will hoist them right on board. The 'Dandolo' is propelled by twin screws worked by two independent pairs of engines, which were contracted for to indicate a maximum power of 7,500 horses. These engines, together with the pumping and blowing engines, were constructed by Messrs. Maudslay Sons & Field, of London. Each set of engines is placed in a separate water-tight compartment, one at each side of the vessel; instead of being side by side, they are situated one in advance of the other, the alternate spaces being occupied by the magazines, which are placed immediately below the turrets. Each pair of engines has one high-pressure cylinder, 64″ in diameter, and one low-pressure, 120″ in diameter, with a stroke of 4′. Steam of 65 pounds pressure is supplied by 8 large oval and double-ended boilers, having 32 furnaces in all. Four boilers are placed forward of the engines, and the other 4 aft; but each pair of boilers is contained in a separate water-tight compartment. The chimneys, which are ample in size and height, are built of 1″ plate from the main deck to the flying deck above the turrets, so as to enable them to withstand the great shock produced by the discharge of the guns.

"The 'Dandolo' ran to Genoa and back without stopping, in 6 hours and 28 minutes, with a mean indicated horse-power of nearly 7,200, and a maximum of 7,415 horses, and the speed obtained was 15¼ knots, with a consumption of 51¼ tons of coal. On the measured knot trial a speed of 15.55 knots was obtained with 8,050 horse-power. No steam blast was used on any of the trials. The engines worked with perfect regularity throughout, giving a maximum number of revolutions of 74 per minute, the pitch of the screw being 23′ 6″." — *London "Times."*

See the following references: —

"Abyssinia," Br. . . . * *Barnard & Wright's "Rept. U. S. Engineers,"* 1871.
"Alexandra" . . . . * "*Scientific Am.,*" xxxvi. 258, 261.
"*Iron Age,*" xix., March 8, p. 1.
Australian, "Cerberus" * "*Scientific American,*" xxxiv. 143.
Austrian . . . . . . * "*Engineer,*" xli. 243.
* "*Scientific American Sup.,*" 379.
"Cerberus," Br. . . . * *Barnard & Wright, "U. S. Engineer's Report,"* 1871.
Circular, Russian . . "*Iron Age,*" xvii., March 23, p. 7.
"*Engineering,*" xxi. 112, 284, 299, 307.
Circular, Russian . . "*Scientific American Sup.,*" 1487.
Cyclads . . . . . . page 241 *supra.*
* "*Engineer,*" xli. 75, 93, 244.
"Devastation" . . . * *Barnard & Wright's "Rept. U. S. Engineers,"* 1871.
"Dreadnaught," Br. . * "*Scientific Am. Sup.,*" 959, 2012.
"Duilio," Italian . . "*Engineer,*" xli. 359.
* "*Engineer,*" xlvi. 78.
"*Iron Age,*" xvii., June 1, p. 1.
* "*Engineer,*" xliii. 162.
"*Van Nostrand's Mag.,*" xxii. 487.
* "*Scientific American,*" xxxvi. 57.
"Foo-so," Japanese . . * "*Engineering,*" xxiv. 371.
"Hamidieh," Turkish . * "*Scientific American,*" xxxvi. 370.
"Huascar," Peru . . * "*Engineering,*" xxviii. 455.
"Huascar," after conflict * "*Engineer,*" xlviii. 439.
"Independencia," Braz. * "*Scientific American Sup.,*" 1861.
* "*Engineering,*" xxv. 107, 110.
"Inflexible," Br. . . * "*Engineer,*" xlv. 195.
"*Iron Age,*" xvii., June 1, p. 1.
"*Scientific American Sup.,*" 1936.
"Italia" . . . . . * "*Scientific American Sup.,*" 4089.
"Li-Ki," Japanese . . "*Scientific American,*" xxxix. 5.
"Magdala," . . . . * *Barnard & Wright's "Rept. U. S. Engineers,"* 1871.
"Memdouhiye," Turkish * "*Engineer,*" xliii. 65.
Monitor, the first, *Welles* "*Iron Age,*" xix., April 12, p. 3.
Navies of the world. Table "*Iron Age,*" xix., June 28, p. 14.
"Nelson," Br. . . . * "*Engineering,*" xxii. 434.
"*Scientific American Sup.,*" 804.
"Novgorod," engines of * "*Engineering,*" xxi. 275.
"Payki Shereef," Turk. * "*Scientific Amer.,*" xxxviii. 119.
Peruvian . . . . . * "*Engineering,*" xxviii. 12.
"Polyphemus," Br. . . "*Iron Age,*" xxiv., Aug. 28, p. 3.
"*Scientific American,*" xli. 306.
"Redoubtable," Fr. . "*Scientific American Sup.,*" 660.
Swedish gunboat . . . * *Barnard & Wright's "Rept. U. S. Engineers,"* 1871, Plate XXIII., p. 120.
"Téméraire" . . . . "*Engineer,*" xli. 359.
"Thunderer," . . . . * *Barnard & Wright's "Rept. U. S Engineers,"* 1871.
"Vanguard," sunken . "*Scientific American Sup.,*" 1088.
"Vasco de Gama," Port. "*Engineering,*" xxii. 17.
"*Scientific American Sup.,*" 570.

See ARMOR PLATING, Figs. 337-358, and Plate IV., "*Mech. Dict.,*" pp. 150-155; also ARMOR PLATE, p. 47, *supra.*

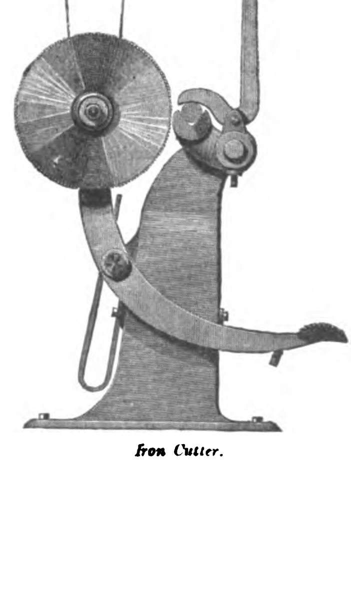
See also comparison of iron clads, Fig. 2708, p. 1202, "*Mech. Dict.;*" also *Clark's* U. S. Patents, No. 231,899.

I'ron Cut'ter. 1. A machine for cutting iron in bar or sheet. See SHEARS, Figs. 4929-4934, pp. 2136, 2137, "*Mech. Dict.*"

2. A circular saw for cutting hot iron.

A number of the supporting brackets are fitted on a rod, 3′ to 4′ long, so arranged as to be set up in the position shown, or dropped down out of the way, as the length of the iron being cut may require. Adjustable gages for determining the length of the pieces cut are provided on the opposite side of the machine from the one shown in the engra-

Fig. 1463.



Iron Cutter.

ving. The belt coming down from a shaft above becomes slightly tightened as the saw is pressed forward to the iron, and loosened again when the saw returns to the position shown. The purpose of this arrangement is to avoid unnecessary strain upon the saw spindle when the machine is not in use, and to permit it to run continuously, a matter of convenience when a number of workmen use the same machine, as it saves stopping and starting each time a piece is to be cut. — *Richards.*

See also IRON SAW.

I'ron-ing Ma-chine'. **A machine for pressing clothes, fabrics, or hats, to smooth and polish the surface.**

Sanson's machine, Fig. 1464, is a pressing machine for tailors' use. By means of the swivel frame moving on friction roller, the iron can be moved in any direction. The lifting and depressing is parallel and evenly distributed over the surface of the board. The pressure is by treadle which is counterbalanced, and is adjustable up to 1,000 pounds. The machine has wide and narrow pressing boards, for optional use. The iron is moved by hand, and heated by gas from a flexible tube.

Fig. 1464.

Sanson's Pressing Machine.

Thurston's polishing machine for a laundry obtains the pressure by a spiral spring communicating with the iron by means of universal joints and levers. The table is stationary, and the pressure of the iron can be regulated by a lever to suit the work.

Walker's machine for tailors' use has an iron swiveled at the end of a double-jointed arm, free to turn about a vertical shaft, and raised or lowered by a spring and foot-lever. The iron is moved by hand and has an inserted iron heater.

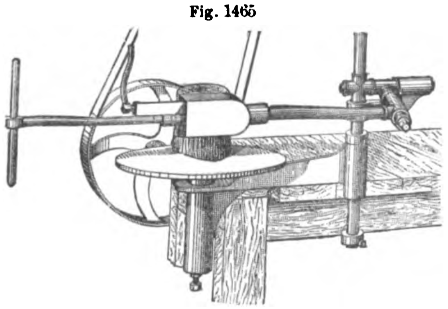
In the *Storrs* presser, the goose may be turned in any direction at the end of an arm, connected by a pivoted link with the upper end of a ⊃-shaped arm supported on a horizontal bearing. The pressure is by a foot-lever; the iron is heated by an inserted hot plate and is moved by hand.

In *Leopold's* ironing and polishing machine the article is laid upon a horizontally reciprocating and automatically reversible board. The iron is heated by steam, and has a short, rapid reciprocating movement by means of a short vertical shaft, rotated from a horizontal shaft held in an arm adapted to be vibrated horizontally. The iron support has a ball-joint and a handle which is grasped by the operator, and is moved over the material on the bed while being reciprocated mechanically.

Tyler's machine has a small polishing iron with a concavity in its upper surface, and is pressed down on the material by means of an adjustable spring on a hinged arm, pivoted at the outer end of a swinging frame. The table is adjustable.

Fig. 1465 is *Osterheld & Eickemeyer's* machine for ironing the sides, crowns, and tips of wool hats. An iron frame is secured on the edge of the finishing-bench; on it is a revolving table which supports the block on which the hat is drawn. The iron is heated by a Bunsen gas-burner fed by a flexible tube, and the lever which connects the iron with the joint is a wrought-iron pipe, and serves as a leader to the upright pipe and forms a chimney which produces sufficient draft to carry off all the gases and prevent the formation of soot and the soiling of the hats.

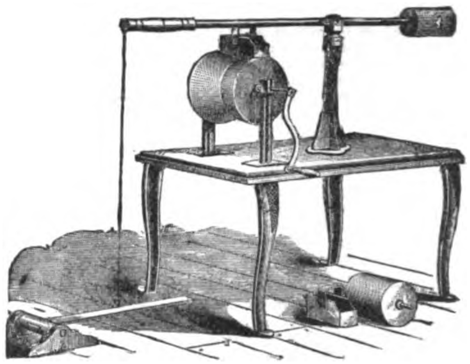
Fig. 1465



Hat-ironing Machine.

Fig. 1466 is a block ironing machine. The iron is of a shape to suit the object which is blocked, and the object is rotated beneath the counterbalanced lever which carries the iron. The pressure is by means of a treadle.

Fig. 1466.



Block Ironing Machine.

I'ron-ing Stove. A stove specially adapted for heating smoothing irons.

Fig. 1467 is a French *fourneau à repasser*, a cast-iron stove, adapted for 7 irons.

Fig. 1467.

French Ironing Stove.

I'ron-ing Ta'ble. A table specially adapted for use in ironing clothes.

Gilbert's table is capable of being folded, and when extended, affords a long board for use in ironing dresses, shirts, and trousers, which may be conveniently slipped on to it. (See Fig. 1468.)

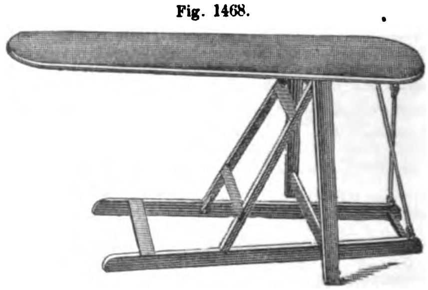
Fig. 1469 shows a French steam-heated table for pressing pantaloons or coats. It is a hollow iron arm projecting from the wall, and having the necessary pipe connections for steam and condensed water respectively. See also LAUNDRY.

Hogin . * "*Sc. Amer.*," xl. 194.

I'ron Pla'ting.

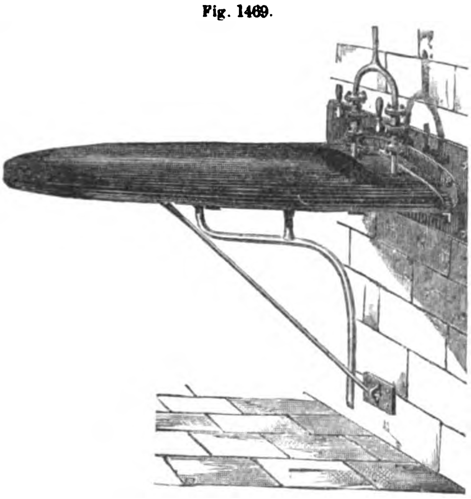
For coating copper plates with iron: Ten parts of ferrocyanide of potassium and 20 parts of tartrate of soda are dissolved in 220 parts of distilled water, adding a solution of three parts of sulphate of iron in 50 parts of water. Caustic soda solu-

Fig. 1468.



Ironing Table.

Fig. 1469.



French Steam Table for Pressing Coats and Trowsers.

tion is poured into the mixture until the Prussian blue formed is redissolved. — *Prof. Bottger.*

I'ron Pre-serv'ing Pro'cess. Barff's process consists in subjecting the surface of the iron to the action of super-heated steam at a high temperature. The result is the production upon the surface of the iron of a hard, smooth, and durable skin of black oxide of iron, which prevents rust, and is claimed to be more effective than any paint, lacquer, rubber, or other compound or process heretofore known.

Iron articles to be treated by this new process are first cleaned with dilute sulphuric acid, and afterward with bran water. They are then placed within a muffle, the temperature of which is 500° or 600° Fah.; dry superheated steam at a temperature of 1,000° Fah. is admitted, atmospheric air being carefully excluded. The formation of the black oxide skin rapidly takes place.

I'ron Pro'cess. Siemens' direct process briefly stated —

" Consists in smelting successive charges of ore in a rotary puddling furnace. A charge of about 20 cwt. of crushed ore mixed with the proper fluxing material is placed in the rotating puddler. When, by the flame from a regenerative furnace, it has been brought to a red heat, from 500 to 600 pounds of small coal is added and the speed of the puddler is increased. The reduction of the ore to the metallic state proceeds rapidly, the carbonic oxide evolved is burned within the chamber, and very little gas from the gas-producers is required. When the reduction is complete the puddler is stopped, and the fluid slag is drawn off. The puddler is then rotated rapidly; the iron is collected into two or three metallic balls, which are withdrawn and treated in the usual way. About two hours are required for a charge, and assuming that 1,000 pounds of iron are got out to each charge, the furnace would produce about 5 tons of puddled bar per diem. It is claimed to be feasible to push the operation so far within the rotator as to produce cast-steel. Mr. Siemens claims and undertakes to demonstrate that by this process a very great saving of fuel is effected. For the lining of the rotary puddler, after numerous trials, he has found a mixture of calcined bauxite powder with clay and graphite to be the best. Three per cent. of clay and six per cent. of graphite give the best results as binding materials. Bauxite is a ferruginous clay, containing from one to four per cent. of silica. The graphite, under the intense heat, reduces the oxide of iron in the bauxite to the metallic state. Linings so made have been found to be very durable, far more so than the best fire-brick." — *Blake.*

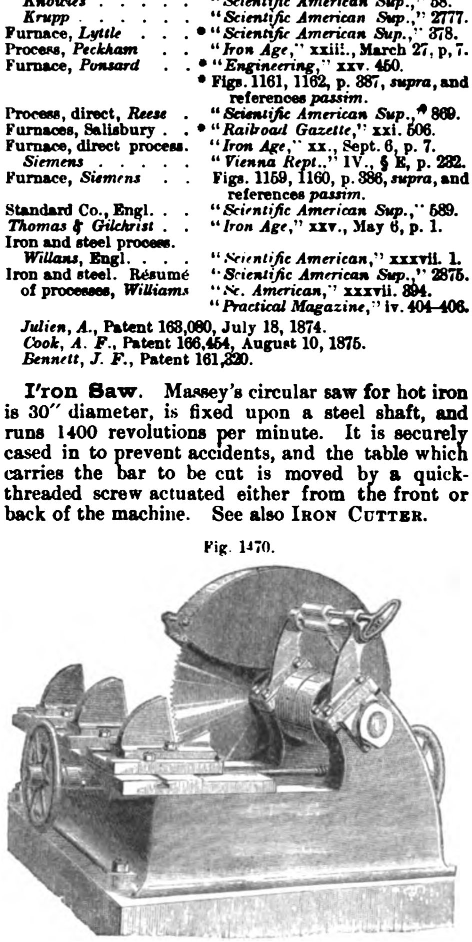
See also, —

Protection, *Barff* . . .	* "*Engineering*," xxviii. 441.
Bower, Barff . . .	"*Scientific American Sup.*," 2001.
Barff	"*Manufacturer & Builder*," x. 54.
	"*Min. & Sc. Press*," xxxviii. 315.
Process, *Bell*	"*Scientific American Sup.*," 517.
	"*Van Nostrand's Mag.*," xvi. 281.
Processes and products,	
On, *Bessemer* . . .	"*Van Nostrand's Mag.*," xvii. 75.
Furnace, *Bicheroux* . .	* "*Eng. & Min. Jour.*," xxi. 55.
Process, sponge, *Blair* .	"*Scientific American*," xxxix. 68.
	"*Scientific American Sup.*," 1992.
	"*Scientific American Sup.*," 1991.
Direct, Brady's Bend,	"*Van Nostrand's Mag.*," xxi. 260.
Pa.	"*Iron Age*," xxii., Sept. 26, p. 14.
Casson-Bicheroux . .	* "*Iron Age*," xxv., May 6, p. 1.
Du Puy	"*Engineering*," xxv. 54.
	"*Scientific American Sup.*," 2495.
	"*Iron Age*," xxii, Oct. 3, p. 5.
Preserving, *Dodé* . . .	"*Scientific American*," xl. 320.
Works, Domnerfoet, Swe.	"*Iron Age*," xxv., Feb. 19, p. 1.
Process, *Ellerhausen* . .	"*Iron Age*," xxiii., Feb. 13, p. 15.
Gilchrist	"*Iron Age*," xxiv., July 3, p. 11.
Henderson	"*Iron Age*," xviii., Sept. 7, p. 18.
Jacobi, Bohemia . .	"*Iron Age*," xvii., March 2, p. 1.
Knowles	"*Scientific American Sup.*," 58.
Krupp	"*Scientific American Sup.*," 2777.
Furnace, *Lyttle* . . .	* "*Scientific American Sup.*," 378.
Process, *Peckham* . .	"*Iron Age*," xxiii., March 27, p. 7.
Furnace, *Ponsard* . .	* "*Engineering*," xxv. 450.
	* Figs. 1161, 1162, p. 387, *supra*, and references *passim*.
Process, direct, *Reese* .	"*Scientific American Sup.*," 869.
Furnaces, Salisbury . .	* "*Railroad Gazette*," xxi. 506.
Furnace, direct process.	"*Iron Age*," xx., Sept. 6, p. 7.
Siemens	"*Vienna Rept.*," IV., § E, p. 232.
Furnace, *Siemens* . .	Figs. 1159, 1160, p. 386, *supra*, and references *passim*.
Standard Co., Engl. . .	"*Scientific American Sup.*," 589.
Thomas & Gilchrist . .	"*Iron Age*," xxv., May 6, p. 1.
Iron and steel process.	
Willans, Engl. . . .	"*Scientific American*," xxxvii. 1.
Iron and steel. Résumé	"*Scientific American Sup.*," 2875.
of processes, *Williams*	"*Sc. American*," xxxvii. 394.
	"*Practical Magazine*," iv. 404-406.

Julien, A., Patent 163,080, July 18, 1874.
Cook, A. F., Patent 166,454, August 10, 1875.
Bennett, J. F., Patent 161,320.

I'ron Saw. Massey's circular saw for hot iron is 30″ diameter, is fixed upon a steel shaft, and runs 1400 revolutions per minute. It is securely cased in to prevent accidents, and the table which carries the bar to be cut is moved by a quick-threaded screw actuated either from the front or back of the machine. See also IRON CUTTER.

Fig. 1470.



Circular Saw for Hot Iron.

I'ron Scale. A special heavy weighing scales with a bed of iron bars, used in weighing merchant iron, pig or castings.

I'ron Shears. Cutters, either hand or machine, for iron. See SHEARS, Figs. 4929-4934, pp. 2136, 2137, "*Mech. Dict.*"

See also IRON CUTTER; IRON SAW, *supra*.
Brown & Curtiss . * "*Iron Age*," xix., June 21, p. 1.

I'ron Steel. Metal composed partly of steel and partly of iron. In the process of manufacture a thin sheet of iron is introduced between the surfaces to be united.

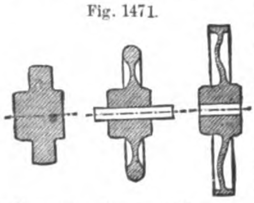
A mold for casting is divided into two compartments by a transverse metal plate, and the two metals previously refined are poured each into its compartment. The iron plate serves at the same time to prevent their mixing and to facilitate their union by becoming partly fused. — *Asbeck, Osthaus & Eicken*, Hagen, Westphalia.

I'ron Strapped Block. (*Nautical.*) One having a loop or band of iron, as contradistinguished from the rope band or strap, formerly exclusively and yet much employed.

I'ron-stone China. (*Ceramics.*) A variety of stone-ware.

I'ron Wheel. Iron wheels are customary with railway and street cars, some kinds of agricultural implements, parts of machines, etc. They are usually cast, composite wrought and cast, and more seldom all of wrought iron.

Fig. 1471.



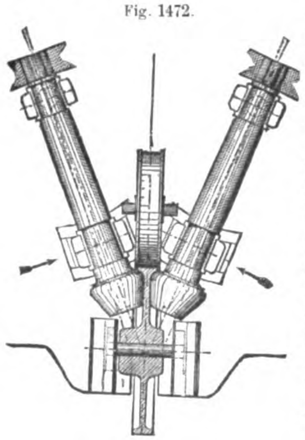
Successive Stages of Wrought Wheel.

A plan for rolling wrought-iron wheels in a single piece has been invented in Belgium.

The iron first receives the shape shown at the left hand, in Fig. 1471. Secondly that of the wheel to the right of it. Up to this point it may be an ordinary compression forging. A hole is then bored and a rod fitted in.

The right hand one of the three exhibits a section of the finished wheel. The machine by which the last transformation is made, is shown in Fig. 1472.

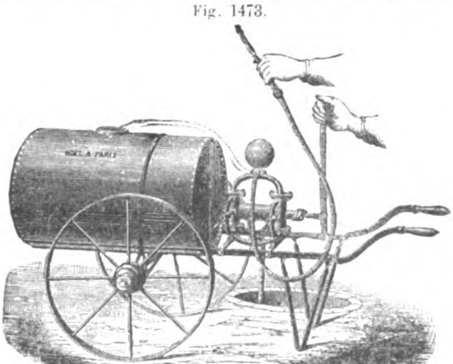
Fig. 1472.



Wheel-making Rolls.

It consists of two conical rolls, each mounted on a separate shaft, which is rotated by means of conical gearing, and which is placed in such bearings that the conical rolls at their extremity can be approached by moving them, as indicated by the arrows. The wheel to be finished rests with its axle in two bearings, and it is then exposed to the action of the conical rolls, which compress the material so that its diameter increases. In order to make allowance for this, the position of the bearings of the wheel are adjustable. The circumference of the wheel is worked by a cylindrical roll. The figure shows the rolling mill as required for finishing the shape of a wheel having the section exhibited. If another shape be required, the surface of the roll is turned accordingly. — *E. von Tarlo in "Annalen für Gewerbe und Bauwesen."*

Fig. 1473.



French Irrigation Barrel.

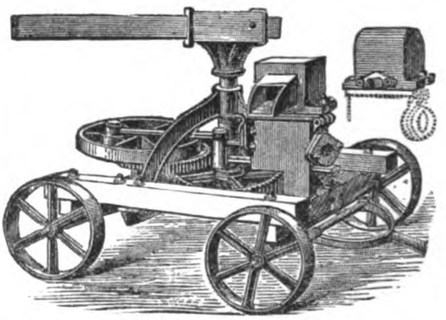
Ir'ri-ga'tion Bar'rel. A cask mounted on wheels and having an attached hand-pump for watering a garden or conservatory plants.

Fig. 1473 shows a French form in which the tonneau is in sheet iron and the pump is adapted to fill the vessel from a well or cistern and to discharge the contents of the vessel, as the case may require.

Ir'ri-ga'tion Pump. A pump for raising water for irrigation of growing crops.

Several forms are shown under various titles, such as the *Noria*, *Mental*, *Shadoof* of Oriental countries. See "*Mech. Dict.*" under these titles and references *passim*. See also list on p. 1827, *Ibid.*, and numerous examples on pp. 1825–1832, *ibid.*

Fig. 1474.



Cattle-power Pump for India.

A mounted cattle-power, a modern form of the Noria (see Fig. 3334, p. 1533, "*Mech. Dict.*") is shown in Fig. 1474, as made for the irrigation works in India.

See Irrigation in Ceylon.

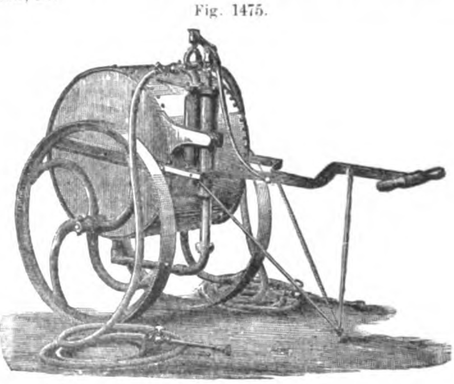
Byrne	"*Van Nostr. Mag.*," xxiii. 197.
Works, Ceylon . . .	"*Van Nostr. Mag.*," xviii. 52.
Southern India . .	"*Van Nostr. Mag.*," xviii. 159.
Paper on, *Davidson* . .	"*Min. & Sc. Press*," xxxiv. 166.
Works in Germany.	
"*Builder*,"	"*Van Nostr. Mag.*," xx. 262.
Irrigator, *Taylor* . . .	* "*Scientific American*," xxxv. 338.

Ir'ri-ga'tor. 1. (*Surgical.*) A douche. A means of applying a profuse washing to a part; rectum, vagina, uterus, etc. See Syringe, Injector, Douche, etc.

2. A watering-cart for growing crops.

In the form shown in Fig. 1475 it is a barrel mounted on wheels, and having a pump which acts as a suction-pump for supply, and a force-pump for discharge. — *Coleman & Morton*, Br.

Fig. 1475.



Irrigator.

I'sin-glass. Fish glue. *Colle de poisson.* See ICHTHYOCOLLA.

An interesting Japanese product is the *Kanten*, or vegetable isinglass, prepared from the *Gelidium corneum*. The seaweed called *Tengusa* is carefully washed and afterward boiled, so as to form a gluish decoction, which is strained off and put into square boxes. When cooled, it forms a stiff jelly, which can easily be divided into squares of a foot in dimension. The manner in which the surplus water is removed is ingenious and worthy of notice. The jelly prisms are exposed in the open air during a cold night, and allowed to freeze. During the day the sun melts the water, which runs off, leaving behind what one might term the skeleton of a white horny substance, which is extremely light, and easily dissolved in hot water; when cooled, it again forms a stiff jelly. This article, which is already to a certain extent known in Europe, can be applied to many uses, viz., for cooking purposes, for making bonbons and jellies, for clarifying liquids, as a substitute for animal isinglass, for making molds used by the plaster-of-paris workers, for hardening the same material; in short, as a substitute for all kinds of gelatines, over which it has the advantage of producing a firmer jelly. In Europe it is sold under the name of *Agar-agar*.

Another sea-weed, much used for industrial purposes, is the Fu, resembling the Caragheen moss, and applied to similar uses, such as, for instance, the sizing of the warp of silk goods. See also HAITHAO.

Is'tle Ma-chine'. A machine for preparing fiber from the leaves of the *lechugilla*, a Mexican *agave*. This fiber is used in the manufacture of hammocks, sacks, ropes, nets, cotton bagging, wagon-sheets, carpets, etc.

The machine (Welke's patent, No. 171,708) is a substitute for the slow and primitive process of hand-scraping.

The invention consists of devices by which the leaves are drawn by rollers through scraping-knives, which are made to yield to the thickness of the leaves. The leaves are placed between the scrapers up to a gage-piece, and then carried with the scrapers toward the feeding-rollers. Sliding and reciprocating scraper-jaws are operated by transmitting mechanism, by the forward motion of the scraper-frame, for scraping off the ends of the leaves which are conveyed to a receiving-platform, and dropped by the same to a receptacle below.

The word *istle* is Mexican, Spanish *pita*, the *Agave Americana*. Admirable specimens of the fiber were shown at the Centennial Exhibition, in Agricultural Hall. The fibers of a species of East India banana yield *Manilla*. The *cochorus capsularius* and *C. olitorius* yield the jute of commerce; the leaves of the *Phormium tenax*, New Zealand flax, yield an excellent fiber; the East Indian *Ramie*, *Bahmeria nivea*, one of the urticaceæ, has a stem, the inner bark of which yields a very useful fiber, used from time immemorial in China, and imported into Europe to mix with silk. *Tampico* is another fiber, the mechanical treatment of which offers the same problem. On the materials above stated, see RAMIE.

I'vo-rine Min'e-rale. A substitute by M. Roger, of Paris, for horn and ivory. It can be made to take various colors, and especially dark hues. By pressing the warm mass into forms, various useful articles, such as umbrella and cane handles, door-knobs, ink and pen-holders, buttons, etc., etc., are produced. — "*D. Industrie Zeitung.*," xix. 387.

I'vo-ry, Ar'ti-fi'cial. Various recipes are given on p. 1207, "*Mech. Dict.*," and a list of 22 patents.

Any white composition of a given mechanical consistence may pass for an artificial ivory, — white celluloid, for instance. See CELLULOID, pp. 180, 181, *supra*, where is given a list of 120 patents of celluloid, pyroxyline, xylodine, and allied compounds, and also a list of references.

See also the following under their alphabetical heads, *supra*. Hints may be taken from them, recollecting that the specialty *ivory* is a mere question of the color of the composition: —

Bonesilate.	Cellulose.	Ebony, artificial.
Bois-durci.	Coral, artificial.	Hemacite.
Boullnikon.	Ebonite.	

The question of color even is not all-important, as the practice is to stain ivory for various purposes, — billiard balls, for instance.

A general statement may be suggestive. Use, combined in suitable proportions, amber, Canada balsam, the Australian gum-kowrie, potato flour or fecula; and with these substances, or any of them, combine meerschaum, paper pulp, calcined bones, fluorate of gypsum or silicium, sulphide or sulphurets of mercury (vermilion), or of other metals, chlorides or carbonates of zinc, or other metals, sulphate of baryta, alkaline preparations, asbestos, fluxed or fritted colors, or finely powdered pumice-stone, sulphur, india-rubber, or similar gums.

See also PYROXYLINE, pp. 1839, 1840, "*Mech. Dict.*," where numerous patents and recipes are listed and described. To these may be added: —

Recipes: Papier-maché and gelatine; for billiard balls, moldings, and architectural decoration: add zinc white or other color. — *Dupré*, Paris. "*La Nature.*"

Ivory dust, 16, boiled in water to a jelly; add shellac, 16, dissolved in alcohol, and oxide of zinc, 1. Pour into forms, dry in the air, subject to high pressure; may be cut, sawed, or turned. — *Cohen*, London.

Calcined magnesia and caoutchouc; heated and pressed.

Cellulose, glue size, and alum water; press into molds; saturate with melted stearine and white wax; polish with a brush. More exactly —

No. 1.	No. 2.	No. 3.
Glue, 100	Alum, 100	Cellulose, 50
Water, 1,000	Water, 1,000	Water, 3,500

Take 75 of No. 1, 200 of No. 2, 200 of No. 3, and add 250 finely ground gypsum, and 100 water. Mix, fill into greased molds. Drain off superfluous water, and allow to solidify. Wash in hot water, dry, soak in equal parts of wax and stearine. Brush to develop luster. — *Harras*, Boehlen, Ger.

Refer to: "*Sc. Amer.*"	xxxvi. 147; xxxvii. 258.
"*Scientific Amer. Sup.*"	1041, 2536.
"*Iron Age*"	xviii., Sept. 1, p. 15: xix., Apr. 19, p. 1; xxiii., Mar. 20, p. 1.
"*Eng. & Min. Journal.*"	xxiii. 171; xxvii. 338.
"*Manuf. & Builder*,"	ix. 192; viii. 192.
"*Telegraphic Journal*"	vi. 284.
Also: Uses of ivory	"*Scientific American Sup.*," 2360.
Vegetable ivory, *Costes*	"*Technologiste*," xli. 823.

I'vo-ry Bleach'ing.

Clean the ivory by boiling it with a paste composed of burned pumice-stone and water. After cleansing place the article under a glass vessel, and expose it to the sun's rays until it assumes its original whiteness. The ivory should be kept moist with water while bleaching.

Mix a thin lime paste and heat over a moderate fire. Place the ivory in this paste, and leave it until it bleaches white, after which remove the paste, dry, and polish.

The ivory articles are placed in a solution containing 11¼ ozs. carbonate of soda in crystals and 45¾ ozs. of water, and allowed to remain in solution for two days. The articles are then removed from the solution, well washed in pure water, and then smeared for five or six days in a solution composed of 17 ozs. of sulphite of soda and 45¼ ozs. of water. At the end of five or six days there should be added to the solution containing the articles an ounce of hydrochloric acid diluted with 5¼ ozs. of water. The vessel containing the liquid should then be covered and left standing for from 24 to 26 hours, after which the ivory may be taken out, washed in clean water, and dried. — *Dr. Artus.*

I'vo-ry Dye'ing.

Black: Steep the article in a weak solution of nitrate of silver, and expose it to the light; or, boil the ivory first in a solution of logwood, and then steep it in a solution of sulphate of iron.

Red: Steep in an infusion of cochineal in liquid ammonia; the articles are first soaked in a water slightly acidulated with nitric or acetic acid.

Blue: Steep in a solution of indigo in sulphuric acid which has been diluted and neutralized with chalk or potash.

Green: Use a solution of verdigris in vinegar.

Yellow: Use a bath of chromate of potash, and afterward a boiling solution of acetate of lead.

Purple: Use a neutral solution of chloride of gold, and then expose to the light.

I'vo-ry Paste. (*Ceramics.*) The material of which ivory porcelain is made. The term *ivory* refers to the peculiar dull luster, made by depolishing the vitreous glaze.

I'vo-ry Por'ce-lain. (*Ceramics.*) A porcelain the vitreous surface of which has been depolished to remove the glaze, leaving the dull luster of ivory.

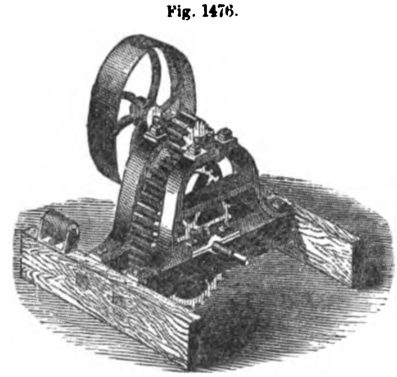
I'vo-ry Sil'ver-ing. Immerse in a weak solution of chloride of silver until of a deep yellow color; then take out and dip in water, after which expose to the sun's rays until black. On rubbing, the black surface will change to a silver.

J.

Jack. (*Add.*) 12. (*Leather.*) A machine to which may be fitted a steel, glass, or *lignum vitæ* slicker, a scouring-stone, or pebbling roller, according as the leather is to be slicked, smoothed, polished, stoned, or pebbled.

13. An intermediate motion, between a horse-

Fig. 1476.



Jack.

power and the machine to be driven. It converts the relatively slow motion of the tumbling-rod of the horse-power into a rapid pulley-motion, the latter communicating by belt to the thrasher, straw-cutter, mill, or what not.

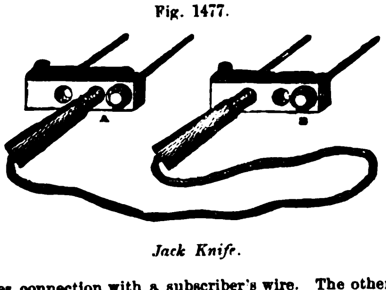
See also INTERMEDIATE MOTION.

Jack'et-ed Gun. (*Ordnance.*) One strengthened by bands fitted or shrunk on to the tube proper. It is now a common mode of making ordnance; a good instance may be seen in the *Broadwell* gun, * "*Engineering*," xxi. 16. Also the Armstrong gun, Fig. 527, p. 160, *supra*.

Jack'-knife. (*Electricity.*) A form of commutator used in telephone central stations. It is a square piece of brass fixed to an upright board by means of two bolts.

The cut shows two of such commutators. The left-hand bolt in each fastens the brass block, and at the same time

Fig. 1477.



Jack Knife.

makes connection with a subscriber's wire. The other bolt is in connection with the indicator wire, but is insulated from the jack-knife, and has a small, erect pin, likewise insulated, upon which the flat spring rests. The jack-knife is then at rest; the line in communication with the indicator, the other end of the latter being in the earth.

When the subscriber sends a current, the indicator notifies the central. The jack-knife has two holes, and the operator puts a pin in hole No. 2 at *A*, connecting by a wire with the telephone.

The pin raises a peg on the spring, and, consequently, breaks the contact between the mass of the jack-knife and the indicator. The simple introduction of the pin does two things: it detaches the indicator from the line, and attaches it to the telephone. The employee then receives his instructions from the subscriber. To connect the two jack-knives of the subscribers, right and left, a flexible metallic cord terminating in two pins is used. These pins are inserted in holes 1 and 2, as seen in Fig. 1477. If one of the indicators is wanted to be in derivation, the corresponding pin is inserted in hole to the left, the spring is not raised, and the mass of the jack-knife, which forms part of the line of correspondence, is connected with the indicator and the earth.

Jack Lamp. (*Sporting.*) One for still-hunting, *weequashing* or fire-fishing, and general camp use. It is sometimes carried on the hat or helmet, but is preferably supported by standard from the belt, so as to give freedom of motion to the head in peering and sighting. It burns kerosene without a chimney.

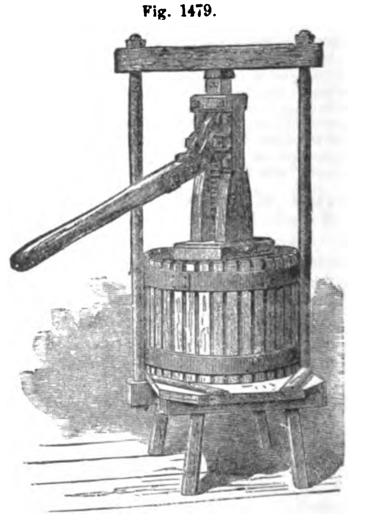
Fig. 1478.

Jack Lamp.

Jack Press. One in which a common lifting-jack arrangement is the means of applying the force. Fig. 1479 shows the ordinary lever-jack thus adapted to a wine, cider, or lard press.

Jack Screw. (*Add.*) 2. (*Dentistry.*) A small extensible instrument used in regulating the teeth;

Fig. 1479.



Jack Press.

to erect them or twist them into symmetrical order. (See Fig. 1480.)

Lifting-jack, telescopic, *Ball* . . . * "*Sc. Amer.*," xlii. 213.

Jac-quard'. See following notices:—

Barker's punching machine for Jacquard cards, noticed in "*Chambers' Journal*," "*Scientific American*," xxxiv. 183.

Double-shedding harness.

Ainley, Eng. . . . * "*Scientific American*," xxxvii. 258.

Jag'ger Spring. (*Vehicle.*) A spring beneath a seat and resting by its ends upon blocks or cleats, in the bed or body of the vehicle.

Fig. 1480.

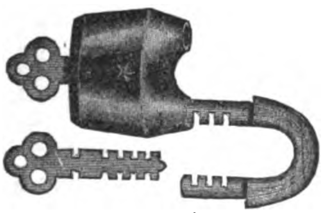
Dental Jack Screws.

Jail Lock. A form of lock used in securing shackles or hasps to staples. Sometimes called a Scandinavian lock, or Scandinavian padlock.

It is unlocked by a flat key, which loosens both branches of the shackle, so that they pull out, or, as in the case shown in Fig. 1481, one becomes free, and then the shackle rotates on the one which remains connected.

Page . . . . . * "*Iron Age*," xxi., January 8, p. 1.

Fig. 1481.



Jail Lock.

Jan'ney Coup'ler. (*Railway.*) A draw-bar arranged to couple cars automatically, and invented by Janney. See CAR COUPLER.

Ja'nus-faced Lock. One having duplicate faces, so as to go upon a right or a left hand door, the key entering at either side indifferently.

Ja-pan'. A kind of varnish, differing in its constituents according to the purpose required of the article treated with it, or of the nature of the process by which the article is manufactured. See LACQUER.

Baking Japans . . "*Iron Age*," xix., March 29, p. 15.

Jap'an-ese Bron'zes. These works of art are made by a process akin to those described on pp. 500 and 1462, "*Mech. Dict.*"

The models are made in wax; and in that material everything, down to the smallest feather of a bird's wing or the hair of a spider, is elaborated with scrupulous care. The wax model is then painted all over with a coating of extremely fine sand, held together by a fire-proof mucilage. The first coat is laid on with extreme care, so as to fill every tiny interstice. So with all following coats, which may number hundreds, until sometimes six months are consumed in the work of painting a cumulative mold three or four inches thick. When the latter is rendered sufficiently strong, the wax model inside is melted and removed. The bronze is then poured in, and the whole object completed in a single casting. The mold is subsequently removed with care only second to that employed in its construction, leaving the bronze without a crease or flaw. From this process emerged the magnificent incense bearer which stood at the entrance of the Japanese section at the Centennial Exhibition, 1876. It represents a vessel elevated upon worn sea rocks, inhabited by a dragon and surmounted by an eagle and flanked by flocks of birds. The price was $4,500, and it was purchased for the London South Kensington Museum.

"Statues of all sizes, bells, vases, water-basins, candlesticks, incense-burners, lanterns, etc., have been manufactured in large quantities for temples and their approaches. Portrait-statues, like the monuments erected in foreign countries to honor the memory of celebrated men, have never been made in Japan As articles for household uses, we may mention fire-pots, water-pots, flower-vases, and basins in which miniature gardens are made, perfume-burners, pencil-cases, small water-pots of fanciful shapes for writing-boxes, paper-weights, and small figures representing divinities. These bronze castings are either made in the simple and severe style of the old celebrated Chinese bronzes, or else are specimens of the peculiar character of Japanese art, which chooses its subjects from natural life, either combining them with lively scenes showing a great deal of humor together with the most minute copying of nature, or else using them to produce some artistical effect, sometimes in a somewhat capricious way, quite unexpected to the beholder. Occasionally the artist takes his subjects from Chinese and Japanese mythology, and produces all sorts of legendary animals, such as the dragon, the stork, the tortoise, etc., which are largely represented on the candlesticks and other castings used in temples, or in the domestic chapels. The bronze utensils of these latter are generally composed of 5 pieces — 2 flower-vases, 2 candlesticks, and one incense-burner." [From a Japanese author.]

Bronze castings of less elaborate design are made in the usual manner, the art being well understood in Japan where it is very ancient.

The plan adopted is similar to that now used in Europe, and described on p. 2312, "*Mech. Dict.*"

The bronze is cast in clay molds formed upon models made of a mixture of wax and resin, which is melted out from the finished mold previous to pouring the metal in. The artist who makes the model generally does the casting himself, and in most cases the work-people consist only of the master's family and two or three assistants. The melting furnaces are of exceedingly small dimensions, and generally made of an iron kettle lined with clay. After casting, the pattern is carefully corrected and worked out by chiseling, but the best bronze casters prepare the model, the mold, and the alloy in such a way as to produce a casting which needs no farther correcting or finishing.

The distinction between bronze (Jap. *Karakane* = Chinese-metal) and brass (*shin-chu*) is well understood in Japan. The spelter used in the latter is imported.

The coloring of the bronze is either for the sake of variety to suit certain tastes, or to confer the appearance of age. See BRONZE COLORING; PATINA.

Differences of opinion exist as to the nationality of the great bronze statue, the "*Daibutz*" (Buddha in Nirvana), now standing at Kamakura, Japan, and shown at Fig. 5578, p. 2312, "*Mech. Dict.*" The statue is 50' high and is there stated to have been cast at Tolon Noor, in Thibet, probably as much as 600 years since. The statement has high authority, and the very name of bronze in Japanese is a word equivalent to *Chinese metal*, as above stated. It is, however, but fair to state that other authorities mention the casting of a large bronze statue of Buddha in the position of serene contemplation, by the order of the Japanese emperor Shomu (724–749, A. D.). It was erected, the account runs, at Nara, 743–752 Damaged by earthquake and fire it was recast about 1300, and yet exists at Nara. A second, of a later date, at Kiyoto, was destroyed by fire.

See also BELL; BRONZE INLAYING.

Jas'per Ware. (*Ceramics.*) A form of ware invented by Wedgwood, in 1773. This paste he used in ornamental and cameo work, reliefs, etc., and the name was adopted after a series of improvements which left it proximately perfect.

It was imitated and copied throughout Europe Flaxman made designs for it, and antique works of all suitable kinds were borrowed to form molds.

Jaw Bit. (*Railway.*) A bar extending across the jaws of a pedestal underneath the axle-box.

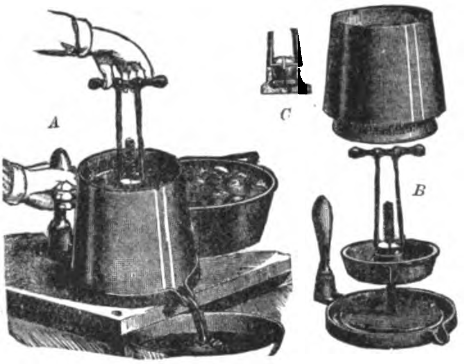
Jaw Chuck. One with movable studs on a face-plate adapted to approach and grasp the object, as in the screw and universal lathe chucks. Fig. 2833, p. 1263, "*Mech. Dict.*"

Jel'ly Pow'der. So called from its resemblance to calf's-foot jelly. It consists of 94% or 95% of nitro-glycerine and 5% or 6% collodion cotton, so mixed as to assume a gelatinous form. It is tough, but can be easily cut with knives or shears, and applied to cartridges and balls. It is water-proof, acts in the same way as dynamite, but is at least 50% stronger, and does not possess the great defect of the latter in parting with its nitro-glycerine when damp. — *Nobel.*

Jel'ly Press. A domestic hand-press for expressing juice from fruit, etc.

It consists of a guttered base upon which is an inner perforated cylinder into which the pulp is to be introduced, and an outer plain cylinder which serves to prevent any waste of the liquid pressed out. The plunger, which is shown at *B*, slides over the screw. The lower end of the screw handle, as will be seen at *C*, is split so that the han-

Fig. 1482.



Jelly Press.

dle can be pressed downward over the screw very rapidly, until the conical cap of the plunger bears so strongly upon the lower ends that they firmly clasp the screw. The greater part of the compression is thus quickly done. A few turns of the handle after it has been pressed down as far as possible, will complete the work. See also Fig. 872, p. 274, *supra*.

Jerk Net. (*Fishing.*) A folding net closed by a jerk upon a line.

Jerk Snare. A species of snare which is sprung by a line held by a party in ambush.

Jet. A solid black, glossy lignite, found principally near Whitby, in England. Also found in Spain. It is sawn, carved, bored, etc., and polished on wheels. Some cannel coal nearly approaches it. A dull kind is called *dazed jet*, as it will bear no polish.

"*Scientific American*" . . . . xlii. 23.
*"*Scientific American Supplement* . . . . 1571.

Jet Pho-tom'e-ter. An instrument for measuring the light of a burning gas-jet.

There are two modes of working:—

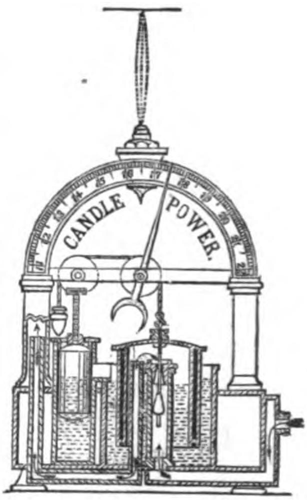
In one, the jet is regulated so as to reach a certain height, and the candle-power is shown by an index hand upon a graduated arc.

In another, it reads by an inverse method: the pressure being set at a regulated point, the height of the jet is measured as a determination of the candle-power.

The idea of ascertaining the candle-power of coal-gas by the height of the flame, while burning through a circular orifice under varying pressure originated with Mr. Lowe of London. The apparatus shown in Fig. 1488 is the American Meter Co.'s improved Lowe apparatus.

Gas is brought into and consumed from a small holder made so as to commence to rise from the water at .41 of an inch pressure, and cease at .71. The gas acting directly under the top of holder, which is of large area, causes it to rise through a space of nearly two inches by the increase of pressure from .41 to .71 of an inch, or in reality a rise of about .6 for every .1 pressure.

Fig. 1488.



Jet Photometer.

The holder, in rising, carries the pointer over the range of scale from 22 to 11, and as the gas burned at jet is taken directly from under the holder it is evident that any diminution or increase of pressure will give immediate motion to the holder and pointer, showing the exact candle power of the gas under such changes of pressure.

The height of flame is adjusted by the micrometer cock to exactly 7″.

With a flame 7″ high, ordinary coal gas, burnt at .41″ pressure, is equal to 22 candles, and at .71″ pressure, equal to 11 candles.

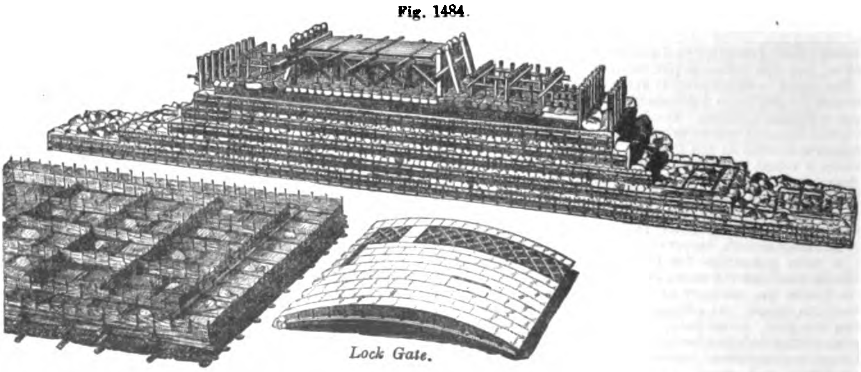
Jet'ty. Plans and sections of the jetties, rubble on mattresses, Charleston harbor improvements, are shown in the "*Report of the Chief of Engineers, U. S. Army,*" 1879, * i. 734.

Fig. 1484 shows details of the jetties of the North Sea entrance to the Rotterdam sea canal.

The principal feature is the use of the fascine mattress, common in dams and dikes on inland waters, but not before attempted in the open sea. The mattresses are made on the seashore at low water, so as to be floated off by the tide. They are made of willows and osiers, bound into fascines 10′ to 12′ long, the twigs remaining attached, making a bundle 17″ in circumference at one end and 14″ at the other. These are overlapped and tied together into long ropes called *wiepen*. To build a mattress the *wiepen* are laid parallel 3′ apart, crossed by others at the same intervals, and tied at the intersections with withes except at certain points where tarred ropes are used, to serve subsequently in binding other layers of *wiepen* to the foundation course and so on up. On this foundation bundles of twigs are laid, and then a second layer crosswise. This is followed by two layers of *wiepen* at right angles, like the former, and tied to the preceding by the tarred ropes. Stakes are driven in and baskets woven on the stakes to hold the ballast, and other stakes to form bollards for towing and mooring. The mattress is towed to the spot, anchored, and then sunk by simultaneously loading its whole surface with stone from small vessels all around it. 350 to 700 lbs. of stone to the square yard is the ballast for the mattress. Other mattresses are added until the required height is reached.

The head of the southern jetty is 82.5′ wide and 3.3′ height

Fig. 1484.



Jetty at North Sea Entrance Rotterdam Sea Canal, Netherlands.

above mean low water mark. 10′ above that level is a timber platform supported on piles. The platform is 25′ wide, and carries a railway track. The sides of the jetty are stone-faced.

See Boulogne	* "*Scientific American Sup.*," 2396.
	"*Scientific American*," xxxix. 153.
Charleston Harbor . .	"*Scientific American*," xxxix. 298.
Galveston Harbor . .	* "*Scientific American Sup.*," 245.
Malta	* "*Engineering*," xxv. 576.
Mississippi, maps & profiles	* "*Scientific Amer. Sup.*," 328, 435.
	"*Scientific American*," xxxiv. 80.
	"*Scientific American*," xxxv. 273.
Levees, Miss.	"*Scientific American*," xxxiv. 160.

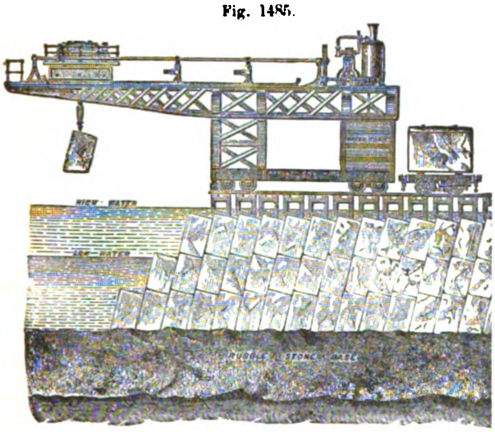
See also **Apron**, Fig. 103, p 44, *supra*.

Jet′ty Crane. A form of crane for building jetties of blocks.

That shown in Fig. 1485 is thus described by the engineers: —

"The object of the crane, appropriately called a *Titan*, is to lift blocks of from 20 to 30 tons' weight from the trucks

Fig. 1485.



The "Titan," Jetty Crane.

and place them in position *in advance* of the finished work, and thus to dispense entirely with the use of staging: it was first used for this purpose in the Manora Breakwater. The Titan, illustrated in Fig. 1485, fulfills all the conditions indicated when tenders were invited for the work.

"These conditions were, that the blocks, each weighing 27 tons, should be lifted, traversed out, and placed in position 25 feet in advance of the point of support afforded by the finished work. The main framing is made throughout of wrought iron, and travels on a pair of rails, 22′ gage, which were carried on blocking pieces up to the front face of the work, as shown in the engraving; the height from rail level to the upper side of the projecting girders is 20′. The lower members are of box-girder section, and are fitted on each side with two pairs of wheels placed close together, fore and aft, traveling on the rails above named, and the front group can be relieved of the strain due to the weight of the block, by powerful short-stroke hydraulic jacks placed under the front end of each girder.

The engines are two 7″ cylinders with link-reversing motion; the boiler is of the vertical type, and the several motions for lifting and traversing the load, and for moving the Titan, are transmitted by suitable shafts and gear with the necessary clutches and levers. The engine and boiler are mounted on a platform laid on the transverse girders, tying the two frames together; a pair of wrought-iron tanks, capable of holding 30 to 40 tons of water ballast are fixed over the trailing wheels, and form part of the framing. The cost of the *Titan* is £2,500, the weight 85 tons, and the duty, 6 blocks laid per day, allowing for the time required for the divers to place the blocks under water.

"The cost of the 10 trucks, which were required for bringing the blocks from the drying ground, was £180 each, and the weight 7 tons each.

"A convenient form of *Goliath* for lifting the blocks, after they are dried and are required for use, is one with a direct-acting hydraulic cylinder and ram of the stroke required to lift the block on the trucks, the ram and cylinder being mounted on a traveling jenny with an engine and boiler of sufficient power to give the traveling motions and to work the hydraulic pumps. The cost of this for 50′ span is £1,150, and the weight 30 tons.

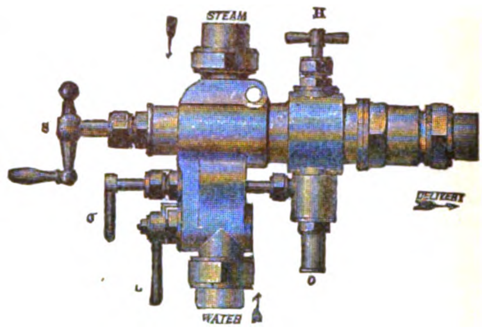
"Since the work above referred to was designed, it has been found necessary to use blocks weighing 40 tons, and the *Titan* for laying them has a swinging jib of about 50′ radius, carried on a frame somewhat similar to that already described; the jib is provided with swinging gear, and describes an arc of about 190°, and will lay stones across a face nearly 100′ wide." — *Appleby*.

Jet Valve. A valve in the lifting injector which is used in starting the injector.

In Fig. 1486, *J* is the jet valve; *S*, steam-valve; *L*, lazy cock; *H*, heater cock. To start, open jet *J*: when water appears at overflow *O*, open valve *S* and close *J*. To stop: close valve *S*.

To heat water in tender: close *S* and open *H*.

Fig. 1486.



"*Monitor*" *Lifting Injector.*

Jew′el-er′s Ce-ment′.

Turkish: Dissolve five or six bits of gum-mastic, each the size of a large pea, in as much spirits of wine as will suffice to render it liquid. In another vessel dissolve in brandy as much isinglass, previously softened in water, as will make a two-ounce vial of strong glue, adding two small bits of gum ammoniac, which must be rubbed until dissolved. Then mix the whole with heat. Keep in a vial closely stopped. When it is to be used, set the vial in boiling water. Known to the trade as *diamond* cement.

Jewelry, electric, French . . .	* "*Sc. Amer.*," xli. 263.
Furnace (East Indies)	"*Sc. Amer.*," xxxvi. 169.
Manufacture	"*Sc. Amer.*," xxxvii. 306.
Setting, platinum, *Ripley & Co.*	* "*Sc. Amer.*," xxxviii. 217.
Jade	"*Sc. Amer.*," xxxiv. 49.
Jet mining	"*Sc. Amer. Sup.*," 653.

Jew′el-er′s Forge. A small forge with pedal blast and circular table; with charcoal grate or gas pot, according to circumstances. See references under Forge, p. 354, *supra*.

Jew′el-ing Rest. (*Watchmaking.*) A tool for setting jewels in plates or settings. It calipers each jewel separately, and turns a recess to fit.

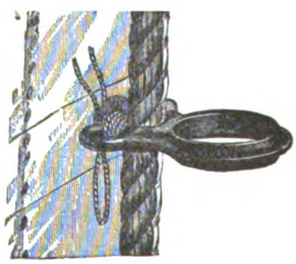
See Watchmaker's Lathe, where it is shown in connection with a universal head. See Jewel-setter, "*Mech. Dict.*"

Jib Crane. A crane with a projecting arm; as in Fig. 1408, p. 478, *supra*. See also Figs. 1504–1507, pp. 642, 643, "*Mech. Dict.*," and Fig. 1489, next page.

A convenient form for foundry use, has a mast of cast-iron and a jib of wrought plate iron in two pieces. A device retracts the jib when required, as when columns, belts, or other obstacles are in the way.

Pratt & Whitney.
* "*Iron Age*," xxiv., Sept. 11, p. 1.

Fig. 1487.

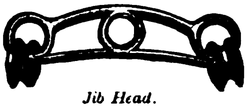


Jib Hank.

Jib Hank. (*Nautical.*) A ring on the leech of a jib and which slips on the stay.

Jib Head. An iron used at the head of a jib when the latter has been stretched too much. The jib is shortened at the head and the jib head attached to the sail; clew thimbles are at the ends.

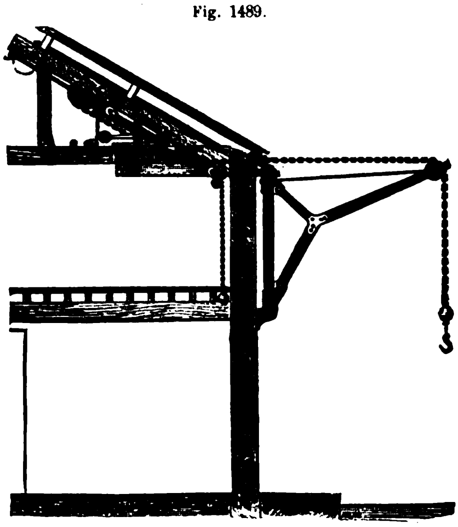
Fig. 1488.



Jib Head.

Jig'ger. (*Add.*) 7. A simple form of warehouse crane. The power is a hydraulic ram fixed

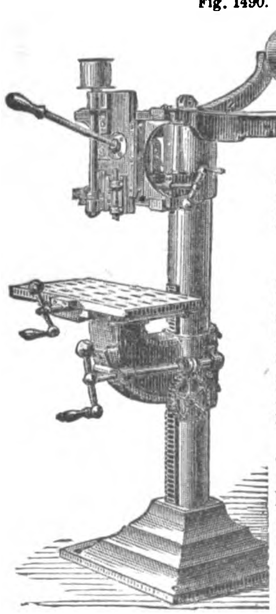
Fig. 1489.



Jigger.

to the timbers of the roof. A supplementary power is used to turn the jib when the load has been lifted the required height.

Fig. 1490.



Jigging Machine.

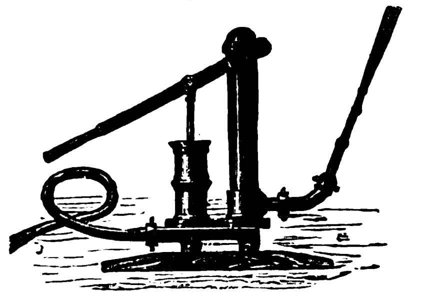
Hancock's copper-ore jigger, Moonta mines, S. Australia. * "*Scientific American Supplement*," 269.

Jig'ger Pump. A hand-pump on a portable stand. That shown in Fig. 1491 has a copper air-vessel, working lever, suction pipe, and delivery nozzle, all on iron base.

Jig'ging Machine'. A tool convertible into a drilling or profiling machine. It is especially adapted for first cutting or making duplicate dies, for light drilling and for single spindle profiling.

Jig Saw. A tool, the precursor of the band-saw. It is a fine reciprocating saw, cutting on the

Fig 1491.



Jigger Pump.

down-stroke, elevated by a spring, and kept taut between the latter and the pitman or crank-pin whence it derives its motion. See also SCROLL SAW.

Figs. 4768–4770, p. 2077, "*Mech. Dict.*"

Richards, Br.	* "*Engineering*," xxii. 238.
Jig-saw spring	* "*Man. & Builder*," xi. 196.

John'ite. An explosive: —

Nitrate of potassium	75
Sulphur	10
Lignite	10
Picrate of sodium	3
Chlorate of potassium	2
	100

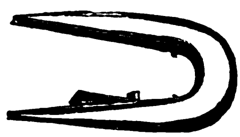
Join'er. A wood-working machine capable of a variety of work. See Fig. 2726 and description, p. 1217, "*Mech. Dict.*"

General, *Reynolds*, Br. . .	* "*Engineer*," xlv. 417.
Universal, *Rasse*	* "*Iron Age*," xx., Dec. 27, p. 1.

Join'er's Bench Stop. An abutment on the bench against which the work rests in planing. See BENCH STOP, Fig. 294, p. 96, *supra*.

Join'er's Clamp. A device for holding a piece while being worked; or holding parts together after being glued.

Fig. 1492.



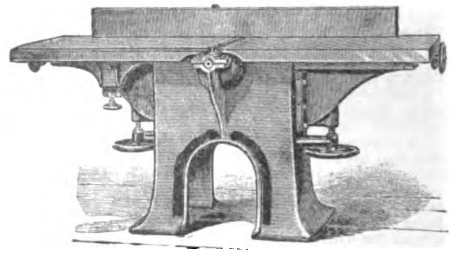
Clamp.

See BENCH CRAMP, Fig. 286, p. 95; CLAMP, p. 560, "*Mech. Dict.*"; CRAMP, p. 641; CARPENTER'S CLAMP; DOOR CLAMP, etc., *Ibid.*

The little clamp, Fig. 1492, is a two-fingered instrument adjusted in an instant, and fastened by a tap of the hand.

Joint Bolt. A bolt used for fastening two timbers, one end-wise to the other. A nut is inserted in one, and the hole bored through both. Used commonly as a fastening for a bed-rail to the bed-post. See JOINT-HOLDER BOLT.

Fig. 1493.



Smith's Stave Jointer.

Joint End. (*Vehicles.*) An iron piece with hole for a bolt; being united to the wooden portion, it forms the end of a carriage bow; or to a rod, forms the end of a stop-prop.

Joint'er. A machine for edging staves and headings.

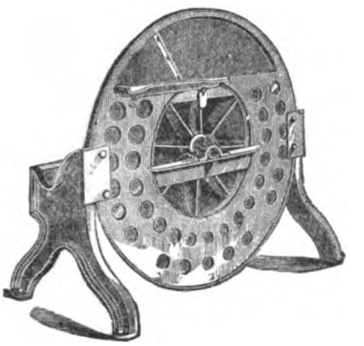
The old-fashioned jointer was a long plane, set obliquely with one end on the ground.

In the modern jointer the tool revolves and the stave is on a rest.

In Smith's jointer, Fig. 1493, the stave is run along the straight bed, against the fence, and the revolving tool planes the edge. The tool is a true planer, and has many shop uses besides jointing. By change of cutter the machine may mold, rabbet, chamfer, etc.

Fig. 1494 is Trevor's jointer. The plane bits are set ob-

Fig. 1494.



Stave Jointer.

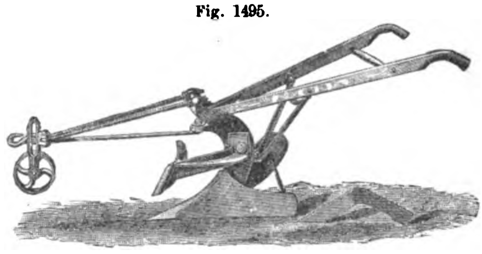
liquely in the face of the wheel, and the stave lies upon the horizontal rest.

See also Fig. 218, p. 78, *supra*.

Stave jointer, *Holmes* . . . . * "*Engineer*," xli. 431.

(*Add.*) 4. (*Plow.*) A small share in advance of the main plow body; designed to overturn weeds

Fig. 1495.

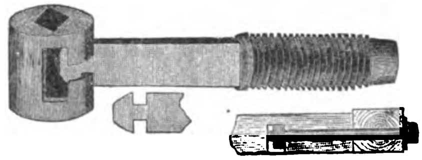


Gale's Jointer Plow.

and double them up so as to be more completely covered in the furrow.

Joint-hold'er Bolt. A furniture joint. Used in bedsteads, especially in fastening the rails to the posts.

Fig. 1496.

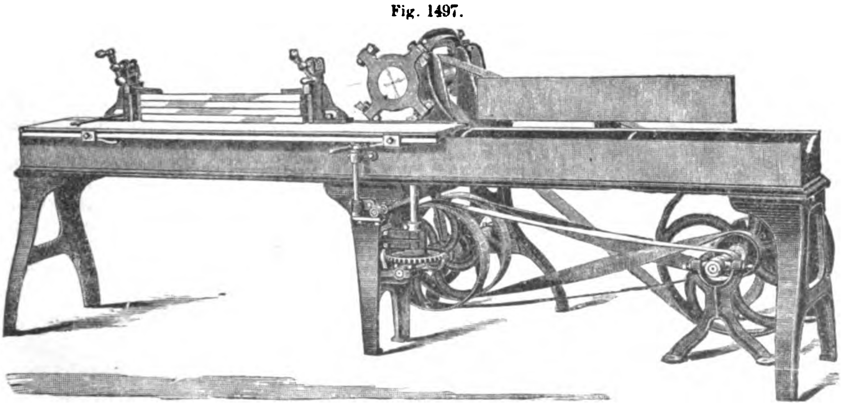


Joint Holder Bolt.

Two forms are shown: in the upper one, the socket is mortised into the side of one member of the frame and the bolt screwed into the end of the other. The notch-headed bolt being inserted into the channel of the socket and the latter rotated, the parts are indissoluble by direct draft.

The other bolt passes through both members and into a nut introduced at a side mortise.

Fig. 1497.



Cabinet Jointing Machine.

Joint'ing Ma-chine'. A planing machine adapted to a special class of work, as in furniture and piano factories, for instance.

The working parts of Rogers' cabinet jointing machine are: a table 6' long, on which the work is placed against a back gage and held firmly by adjustable screw-clamps; the feed then being thrown into gear by the lever in front, the work is carried against the revolving cutter head, the table reversing its motion, and stopping on its return automatically. The work is finished perfectly square and ready for glueing if desired. This machine leaves all the corners of work perfectly square and unbroken.

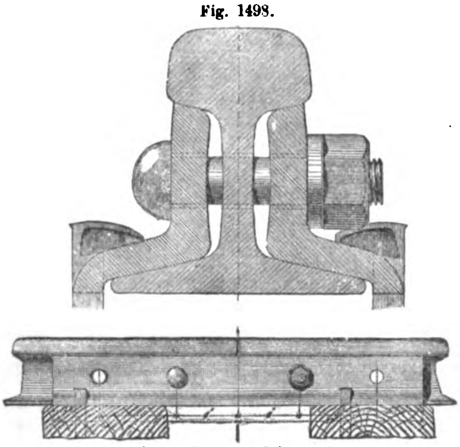
Joint Splice. A reënforce at a joint to sustain the apposed parts in true relation.

Fig. 1498 shows a standard rail section and fish plate of the Pittsburg, Cincinnati, and St. Louis Railway. The upper view is a vertical section, and the lower an elevation on a much reduced scale.

Jon'val Tur'bine. The turbine with *downward* discharge; in contradistinction to the Fourneyron *outward* flow, and others which are oblique, double, combined, etc. See Fig. 6784, p. 2657, "*Mech. Dict.*"

Jour'nal Bear'ing. The French *palier glissant* is shown at Fig. 3496, p. 1599, "*Mech. Dict.*" Bramah was the original inventor. See also Hydraulic Pivot; Water Bearing, "*Mech. Dict.*"

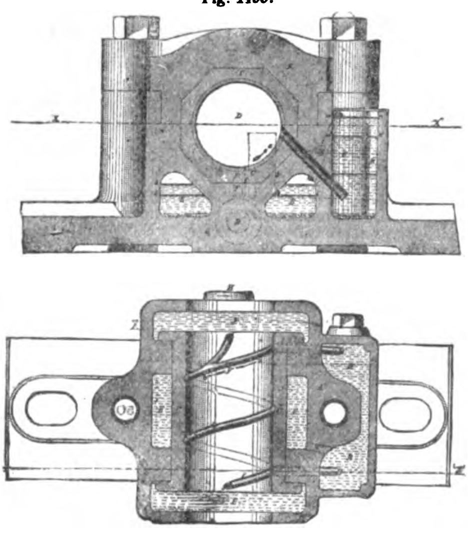
Fig. 1498.



Rail Section and Joint Splice.

The *palier graisseur sans mèche*, of Hignette, Paris, is shown in Fig. 1499.

Fig. 1499.



Journal Bearing.

A is the body of the bearing.
B, cap-piece.
C C, lining blocks.
G, helicoidal groove cut in the bearing linings.
A bifurcation assures the passage of the oil in whichever direction the shaft may run.
The reservoirs, lateral and lower, communicate by tubes with the grooves in the journal bearing.

Renewable, *Platt* . . . * "*Iron Age*," xxiv., Oct. 30, p. 11.
Marine engine . . . "*Scientific American*," xxxix. 216.
Cooler, *Dempsey* . . . * "*Scientific American*," xli. 323.

A material, a bad conductor of heat, invented by S. Coline, a French engineer, is designed for the bearing of all kinds of machines, wheels, and axles, and is stated not to require any lubrication. The following is the recipe for the composition : —

Take about 25 per cent. of asbestos, and the same of graphite, mix them very intimately and carefully ; add sufficient liquid silicate of soda or potash to reduce the whole to a half dry paste, which must then be submitted to the action of a hydraulic or other press, till it is converted into a solid mass, which is afterwards dried either in a furnace or by exposure to the air, until all moisture has disappeared. The bearings may either be turned out of the block or molded from the composition while in the moist state. When the bearing is finished it is steeped in hot melted paraffine, mineral wax, or in a solution of paraffine, benzole, or other mineral oil, until all the pores in the composition are filled.

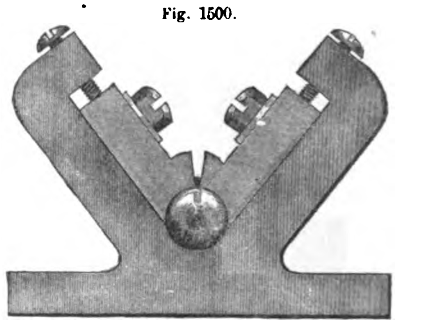
Jour'nal Bear'ing Key. (*Railway.*) A plate on top of axle box to hold the latter in plate. See 8, Axle Box.

Called also *wedge, liner, slide, saddle, keeper*, etc. — *Forney.*

Jour'nal Box. (*Railway.*) A metallic box which incloses the journal of a car-axle, the brasses and the key. See Axle Box.

Ellis's journal box is shown in Fig. 1500, and is made in three parts, the upper two of which are separately adjustable toward the journal, permitting the latter to be kept central and tight.

Fig. 1500.



Adjustable Journal Box.

Jour'nal Brass. The bearing or box of a journal or axle.

Jour'nal Pack'ing. (*Railway.*) Waste cotton or wool saturated with oil or grease and filled into an axle-box to lubricate the axle.

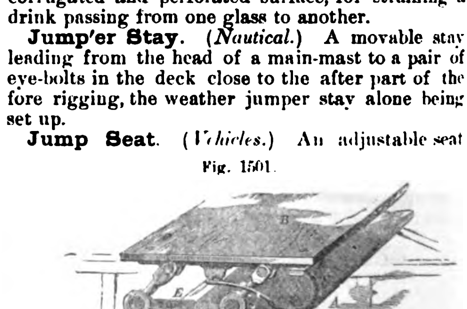
Jour'nal Spring. (*Railway.*) A spring which supports part of the weight of a car and is placed directly over the journal, and which usually rests on the journal box under the truck-frame. Such springs are sometimes placed above the truck-frame and supported by straps, and the weight of the car is transmitted to the journal box by a vertical pin or stirrup. — *Forney.*

Ju'lep Strain'er. A round or oval ladle with corrugated and perforated surface, for straining a drink passing from one glass to another.

Jump'er Stay. (*Nautical.*) A movable stay leading from the head of a main-mast to a pair of eye-bolts in the deck close to the after part of the fore rigging, the weather jumper stay alone being set up.

Jump Seat. (*Vehicles.*) An adjustable seat

Fig. 1501.



Jump Seat.

which may be brought into position for use when it is desired to convert a single-seated vehicle into a double-seated one.

In Fig. 1501 the seat *A* is shown out of use, in position below the seat *B*. When two seats are required, the seat *A* is thrown forward on its pivoted supports *C* and the seat *B* thrown backward on its pivoted supports which are braced together by the bar *E*. The supports of the front seat *A* are secured by a latch to the plate *D*, and the seat may be removed entirely if desired.

Junk Hook. (*Fishing.*) Used in hauling heavy pieces of blubber on deck.

Junk Vat. (*Leather.*) A large vat into which is pumped the tan liquor or ooze which has been deprived of a great part of its strength in the layers. The liquor is run into the stringers where a weak ooze is required.

Ju'nod's Arm. (*Surgical.*) A dry cupping apparatus. See CUPPING; ARM.

Ju'pon. (*Fabric.*) A French dress goods made on a taffeta loom. It has a simple cotton warp and carded wool weft.

Ju'ry Mast. (*Surgical.*) *Sayre's* apparatus for supporting the head by means of head and chin straps, and a spinal bar which rests below upon bands encircling the body. Fig. 194, Part IV., *Tiemann's "Armamentarium Chirurgicum."*

Jute. Fiber of the *Cochorus capsularis* and *C. olitorius;* an East India plant. Useful for many purposes in India. See p. 1221, "*Mech. Dict.*"

Jute, on, *Lockert* . . .	"*Technologiste*," xli. 171.
Ramie machine, *Favier*	"*Technologiste*," xli. 26.
Ramie, *Léger*	"*Technologiste*," xxxix. 117.
Jute carding engine . .	* "*Scientific American Sup.*," 1681.
Jute machinery, *Mc-Kean & McGrath*, Br.	* "*Engineer*," xliii. 196. *Laboulaye's* "*Dictionnaire*," ii., ed. 1877, *Cap.* "*Jute.*"
Jute manuf., *Fleming* .	"*Sc. Am. Sup.*," 738, 2180, 3928.

The product of the jute fiber by the Sachs process is known as *Kalameit*, which see. See also AGAVE; ISTLE; RAMIE; TAMPICO, etc., "*Mech Dict.*," and herein.

K.

Kal'a-meit. The name adopted for the fiber of jute as prepared by the Sachs process, for textile manufactures made by the Barrow Flax and Jute Co. (Br.), and shown in the shape of curtains, table-cloths, and dress goods at the Paris Exposition, 1878. See JUTE, *supra.*

Ka-lei'do-scope. An improved form has been made by M. Thomas, of Paris.

The two mirrors are, as usual, put in a tube; but the objects employed to produce the images are inclosed in a transparent case, which is separate from the tube. This case, almost flat and with its two faces formed of watch-glasses, is supported by a rod, which is fixed to the tube by a hinge. It can also receive a movement of rotation round its axis of suspension. In this way it can be inclined in any direction to the axis of the tube. A button, manipulated with the hand, enables one to turn it about its center, so as to change the positions of the objects within. A pasteboard disk, white on one side, black on the other, is placed behind the case. Transparent or opaque objects may thus receive light on one or the other side of the case and be displayed on the white or black background of the disk, according as it may be desired to observe them by transmission or reflection. — "*Société d'Encouragement*," *Paris.*

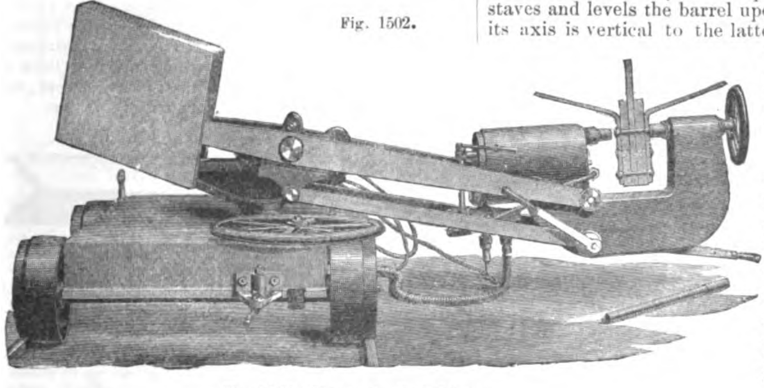
Kedge. (*Nautical.*) A small anchor used in warping; to keep a ship steady and clear of her bower when riding, etc.

Kedg'ing. (*Nautical.*) Tide-working in a narrow channel or river by kedge-hauling.

Keel Riv'et-er. A machine for riveting the keels of iron vessels upon the stocks.

Fig. 1502 shows Tweddell's hydraulic keel-riveter, as made by Fielding & Platt of Gloucester (Br.), and used at the Barrow Shipbuilding Co.'s works.

Fig. 1502.



Tweddell's Hydraulic Keel Riveter.

A short length of tramway is laid under the vessel and alongside the keel, and upon this travels a bogie or carriage carrying the riveter. This riveter is attached to one end of a pair of levers, and is balanced by a counterweight on the other end. Thus balanced, the riveter is easily moved up and down as required to meet not only the varying heights of the keel from the ground level, but also the different positions of the rivets themselves. The arrangement of levers is attached to a small carriage which is free to travel inward and outward along a pathway on a species of turntable, and this turntable is supported on a large pin which is free to revolve on a socket on the traveling bogie or carriage. By this means the riveter can be readily moved to or from the keel bar, which is sometimes necessary owing to the rails not being laid exactly parallel to the keel, and to other causes, while the whole apparatus can be turned round on its carriage.

A hand-wheel behind the cupping die on the *hob* of the riveter turns a screw, which takes the thrust of the die upon closing a rivet. By this means, when the hot rivet is put in, the screw being turned inward a slight pressure is brought to bear on the rivet head, and the machine is thus steadied in position. Keel rivets having very shallow heads, the rivets also being countersunk, some such contrivance as this is necessary to insure fair work. The riveting die is close to the top of the cylinder; this gives room when the garboard strakes come nearly at right angles to the keel.

The keels of the large steamships "City of Rome" and "Servia" were riveted by these machines.

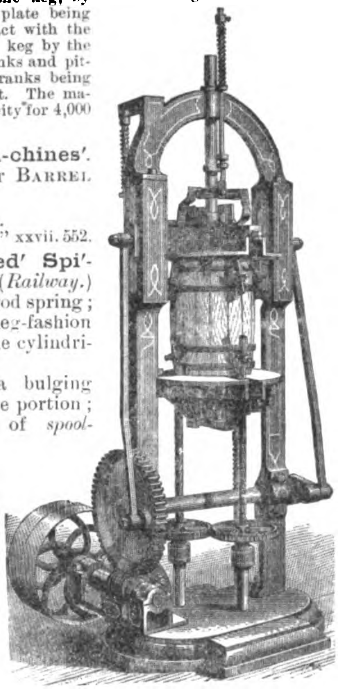
"*Engineering*" . . . . * xxx. 535.

Keep'er. (*Electricity.*) *Keepers*, also known as *shoes* (*Ganot*), are lateral projections from the polar extremities of a magnet to bring them in closest possible proximity to the revolving armature short of actual contact.

Keg Lev'el-ing and Trus'sing Ma-chine'. A machine which presses upon the ends of the staves and levels the barrel upon the table so that its axis is vertical to the latter; the staves being practically of a length, it also forces them endways, so that they are in range at the chine.

Holmes's machine is shown in Fig. 1503. The truss hoops are put on the keg in setting up, and the keg placed in the machine. The truss-hoop drivers are attached to two plates, one of which forms a stationary table and is adjustable for various sizes of kegs; and the other is moved to and from it perpendicularly. The drivers move automatically in and out, to allow the reception and discharge of the keg into and from the machine. The plates level and the drivers drive the truss-hoops at one and the same operation upon the keg, by the movable plate being brought in contact with the upper end of the keg by the action of the cranks and pitmans, the two cranks being on the same shaft. The machine has a capacity for 4,000 kegs per day.

Fig. 1503.



Keg Leveler and Trusser.

Keg Ma-chines′. See list under BARREL MACHINERY.

British, *Ransome*.
* "*Engineering*," xxvii. 552.

Keg-shaped′ Spi′-ral Spring. (*Railway.*) A coiled steel-rod spring; bulging — keg-fashion — from the true cylindrical form.

One with a bulging waist or middle portion; the opposite of *spool-shaped*.

Ker′a-tome Scis′sors. (*Surgical.*) Another name for *iridectomy scissors*. *d*, Fig. 4672, p. 2054, "*Mech. Dict.*"

See KERATOME, p. 1223, IRIDECTOME, p. 1195, "*Mech. Dict.*"

Ker′o-sene. (*War-light.*) From κηρός, wax, and a customary termination, as in camphene, paraffine, gelatine, etc.

The trade-mark name of the hydro-carbon oil, made for lighting purposes by the "Downer Kerosene Oil Company."

The distillation of petroleum gives a large number of products, which are known in a practical way by their gravity and flashing points.

	Gravity — *Beaumé.*
Gasoline	90° — 80°
Benzine	74° — 68°
Naphtha	65° — 62°
Kerosene	59° — 38°

Between the ranges 59°-38° the oil, when purified by chemical treatment, is sufficiently mobile and colorless to be suitable for burning in ordinary flat-wick lamps. The fire-test of the 59° B. is 90° Fah., and that of the 38° B. = 200° Fah.: between the stated limits are numerous grades capable of segregation, but for practical purposes they are combined, with a result of a fire test quality for the whole of 150° Fah.

The lighter grades of petroleum, having the gravity 90°-80° B., are used in the apparatus for carbureting air and gas. The grade known as *benzine*, 74°-80° B., is a substitute for turpentine in paint, and is largely used in scouring and cleaning. *Naphtha*, 65°-62° B., is used in paints and varnishes, and also as a solvent for caoutchouc.

The kerosene oil known as *Mineral Sperm* (Downer Kerosene Oil Co.) has a specific gravity of 36° B., and a fire test of 300° Fah. It is as safe as fatty oils, and is burned in lamps of special construction.

The still heavier products, 32° to 22° B., making in the mixture 24°-26° B., are lubricating oils, and yield from 20 to 25% of paraffine wax, which has to be removed in order that the oil may remain fluid.

Ker′o-sene Stove. See PETROLEUM STOVE, Figs. 3664, 3665, p. 1676, "*Mech. Dict.*"

Ker′o-sene Test′er. See PETROLEUM TESTER, Fig. 3666, p. 1676, "*Mech. Dict.*"

Ket′tle. A boiler. That shown in Fig. 1504 is a compact form of double-bottomed boiler, the space being heated by steam introduced through the trunnion on which the kettle may be tipped to discharge its contents. Used as an agricultural or laundry boiler.

Kier, boiling and bleaching. Br. . "*Sc. Amer. Sup.*," 1684.

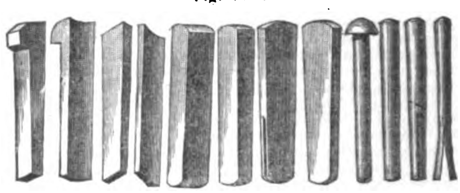
Fig. 1504.

Double-bottomed Bascule Kettle.

Key. A fastening piece to secure parts; a gib or spline, a forelock, a pin, a cotter, as the case may be. See the above definitions in "*Mech. Dict.*," and Fig. 2742, p. 1225, *Ibid.*

Fig. 1505 shows a number of forms: headed, plain, taper, stud, bracket, split, etc.

Fig. 1505.



Keys.

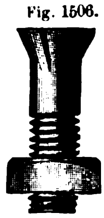
See also: —

Ancient, Munich . .	* "*Scientific American*," xli. 25.
Fastener, *Johnson* . .	* "*Scientific American*," xliii. 54.
Screw-headed, *Oliver* .	* "*Scientific American*," xxxix. 121.
Keyways, cutting, *Rose*	* "*Scientific American Sup.*," 1256.
Drilling, *Sharp, Stewart & Co.*, Br.	* "*Engineer*," xli 187.
Fitting, *Rose*	"*Scientific American Sup.*," 888.

Key Grind′ing. An application of the emery wheel to the dressing of keys, cotters, splines, gibs, etc. See reference to many machines of the class, p. 312, *supra*; and Fig. 6083, p. 2458, "*Mech. Dict.*"

Key′-head Bolt. One with a protuberance on the chamfer of its head, to prevent its rotation when the nut is revolved.

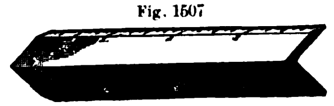
Fig. 1506.



Key-head Bolt.

Key′-seat Rule. An instrument by the aid of which parallel lines on shafts for key-seats, mortises, etc., can be readily and accurately drawn.

Fig. 1507



Key-seat Rule.

Key′-way Cutter. A species of planing machine for cutting seats in the center holes of wheels and pulleys. See Fig. 2748, p. 1227, "*Mech. Dict.*"

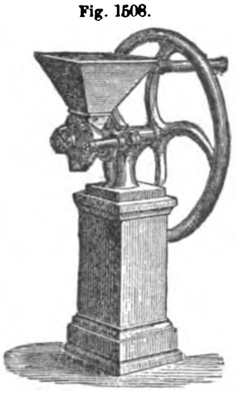
See also French . . .	* "*Engineering*," xxi. 88.
On cutting and fitting .	* "*Sc. American Sup.*," 888, 1255.
Drilling, *Sharp, Stewart & Co.*, Br.	* "*Engineer*," xli. 187.

Kib'bling Mill. A hand grinding-machine for mashing grain for stock. By it oats, etc., are flattened and broken, so as to insure more perfect digestion.

Kiln. A furnace for baking. fritting, calcining, firing, etc. See —

Brick.	Malt.
Faïence.	Pipe.
Porcelain.	Pottery, etc.

Fig. 1508.



Kibbling Mill.

King'-bolt Plate. 1. (*Railway.*) A plate on the floor of a car concealing the head of the king-bolt, which may be withdrawn when the cover is removed.

2. (*Carriages.*) A plate on the fore axle of a vehicle bushing the hole through which the king-bolt passes.

King'-bolt Tie. (*Vehicles.*) A saddle piece on a king-bolt, having opening at the ends for clip bolts.

Kite. A form of kite for lifting a person from the ground in order to reconnoiter an enemy's position, has been tried at Chatham, Br. The invention of Mr. J. Simmonds. A series of kites of relatively increasing size are flown, one attached to the other in series, the first assisting in flying the second, and so on. "*Iron*," viii. 300.

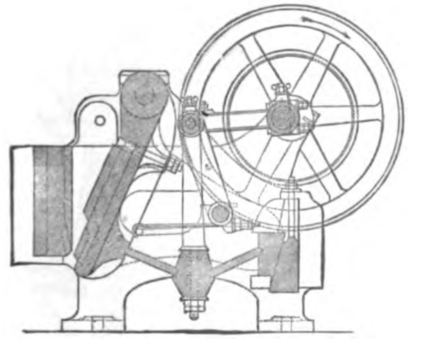
Knap'ping Ham'mer. A soft steel hammer, disk shaped or sharp edged, for breaking flint flakes into lengths for gun flints.

See *Evans' "Ancient Stone Implements of Great Britain*," p. 17, *et seq.* See GUN-FLINT.

Knap'ping Ma-chine'. A form of stone-breaking machine in which the stone is broken by a sudden blow, rather than by a sustained pressure, which is said to have the effect of more evenly cubing it, and producing less chips and dust.

The motion in the Baxter (Br.) machine, Fig. 1509, is obtained by a crank radius-link and lever. The blow is given by a quarter revolution of the fly-wheel shaft, the jaw remains stationary half a revolution, and retires during the remaining quarter.

Fig. 1509.



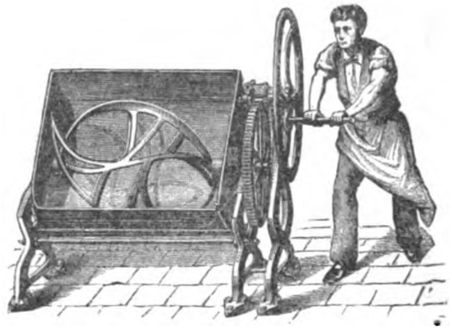
Knapping Machine.

Knead'ing Ma-chine'. A machine for incorporating the ingredients of dough.

See DOUGH BRAKE, Fig. 858, and DOUGH MIXER, Fig. 859, p. 270, *supra*.

Boland's kneading machine, shown in Fig. 1510, is an endeavor to approximate in machinery the action of human arms. The hand process has a dividing and rolling action; the hands in contact, and the arms bowed, a sweeping motion is made obliquely down through the mass of dough, which is divided, turned over, and thrown on top of the remainder. Until the mass attains a certain amount of solidity the action is principally as described, and may be compared to the beating of eggs with a spoon in a bowl, the mass being divided, and one portion flirted on top of the remainder. The action of the machine is a very close imitation of the human arm method.

Fig. 1510.



French Kneading Machine.

The subsequent pommeling of the tough dough can be dispensed with in great measure, as the capability of the machine for cutting and mixing the dough and slapping the masses together is much greater than that possible with large quantities by the human arms.

Knee Ap'pa-ra'tus. (*Surgical.*) Apparatus for fracture, luxation, weakness or deformity of the knee.

See ANCHYLOSIS APPARATUS, Fig. 202, p. 99, "*Mech. Dict.*"; PATELLA APPARATUS, Fig. 3567, p. 1636, *Ibid.*

Also, KNOCK-KNEE BRACE, BOW-LEG BRACE, etc., referred to under CURVATURE APPARATUS, *supra*.

See, also, GENU-VALGUM BRACE, p. 397, *supra*.

See, also, Patella Apparatus. Figs. 119-121, Part IV., *Tiemann's "Armamentarium Chirurgicum."*

Anchylosis Apparatus, *Ibid.*	Figs. 90-92.
Sayre's knee-joint apparatus, *Ibid.* . .	Figs. 93-97.
Sayre's knee compressor, *Ibid.* . . .	Fig. 195.
Andrews' splint, *Ibid.*	Fig. 188.
Andrews' straightening apparatus, *Ibid.*	Fig. 190.
Holthouse's extender, *Ibid.*	Fig. 145.
Hooper's extender, *Ibid.*	Fig. 80 *b*.
Hutchinson's apparatus, *Ibid.*	Figs. 94, etc., Sup.
Stillman's splint, *Ibid.*	Figs. 95, etc. Sup.

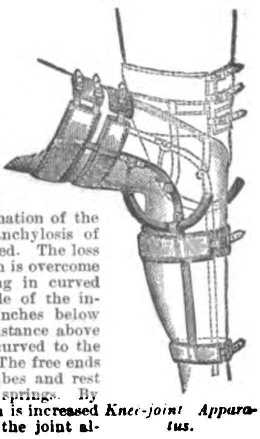
Knee Cap. (*Surgical.*) A water or ice-bag for topical applications to the knee.

Knee'-i-ron. An angle-iron at the junction of timbers in a frame.

Knee'-joint Ap'pa-ra'tus. (*Surgical.*) See KNEE APPARATUS, where a diversity of devices are referred to; including those for curvature, deformity, reduction, straightening, etc.

Dr. Hooper's knee-joint apparatus, shown in Fig. 1511, is an extension device to prevent the articulating surfaces from coming in contact, pending the suppression of inflammation of the parts. To prevent false anchylosis of the joint flexion is permitted. The loss of extension during flexion is overcome by placing a helix spring in curved tubes fastened on each side of the instrument shown, three inches below the joint. At the same distance above the joint are fixed rods, curved to the same arc as the tubes. The free ends of the rods fit into the tubes and rest upon the upper end of the springs. By this arrangement extension is increased by flexion. The play of the joint al-

Fig. 1511.



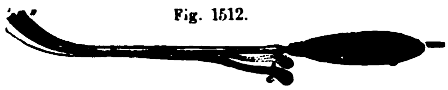
Knee-joint Apparatus.

lows the limb to be flexed at right angles. The action of the spring ceases when the limb is extended to its utmost, thereby preventing any undue pressure upon the joint in a direction contrary to the one in which it should be applied.

Knick'er-boc'ker. (*Fabric.*) A French all-wool goods, with irregular spots of different colors and materials.

Knife. A cutting implement wielded by the hand, and known by name indicative of material, shape, purpose, or mode of using.

Fig. 1512.



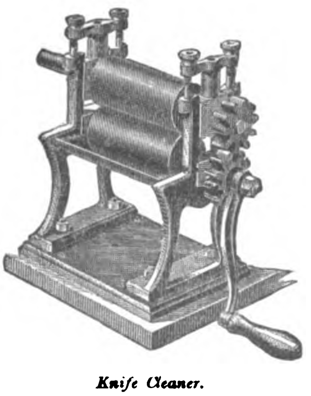
Knife and Tenaculum.

The following list includes many which are defined or illustrated under their alphabetical heads. See, also, list of 144 knives on p. 1233, "*Mech. Dict.*"

Bait knife.
Bait-mill knife.
Blubber knife.
Boarding knife.
Boat knife.
Border knife.
Bread knife.
Bush hook.
Butter knife.
Cane knife.
Carver.
Cheek knife.
Cheese knife.
Chopping knife.
Cigar knife.
Clam knife.
Corn hook.
Corn knife.
Currier's knife.
Drawing knife.
Fatting knife.
Filling knife.
Finning knife.
Fish knife.
Fistula knife.
Flaying knife.
Flesher.
Fleshing knife.
Flitching knife.
Fruit knife.
Gilder's knife.
Hacking knife.
Hay knife.
Heading knife.
Head knife.
Hemp knife.
Herniatome.
Honey knife.
Hunter's knife.
Kitchen knife.
Lacing cutter.
Lancet.
Lemon knife.
Machete.
Mackerel knife.
Mackerel plow.
Microtome.
Mincing knife.
Moon knife.
Net-maker's knife.
Oyster knife.
Pallet knife.
Peat knife.
Pocket knife.
Pruning knife.
Putty knife.
Razor.
Ripping knife.
Round moon knife
Scaling knife.
Scalpel.
Scraper.
Section knife.
Sheath knife.
Shoe knife.
Short-hair knife.
Skinning knife.
Slicer.
Slivering knife.
Spatula.
Splitting knife.
Sticking knife.
Straw knife.
Tanner's knife.
Throating knife.
Tracheatome.
Urethratome.
Uvulatome.
Valentine knife.
Whaleman's knife

(*Surgical.*) The cutting implement has many uses and specific names in surgery. They will be found under specific heads herein and in the "*Mech. Dict.*" See list of knives, p. 1233, *Ibid.*

Fig. 1513.



Knife Cleaner.

The *dissecting* knife is made of various shapes for the more ready separation of the parts of animal and vegetable tissues.

The *section* knife is either a flat knife for slicing thin sections of various soft tissues, for microscopic purposes, or *Valentine's* knife, which has two parallel blades for cutting out a thin section at a single stroke.

Fig. 1512 is Dr. Skene's knife and tenaculum for uterine operations.

Knife Clean'er. An implement for removing stains from and polishing table-knives.

Two forms are shown in Figs. 1513, 1514. In the former the knife-blade is passed between two elastic rollers which

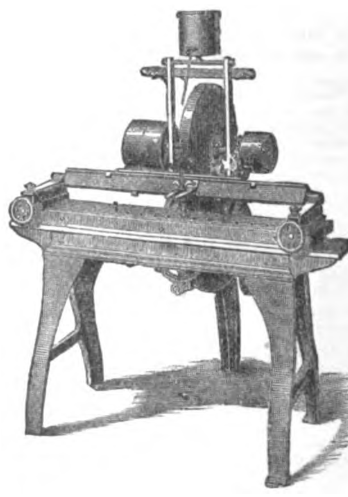
Fig. 1514.

Knife Cleaner.

have the abradant upon them. In the latter, the knife-blades are thrust into holes in the periphery of a round box, and are rubbed between the faces of two adjacent disks revolving in opposite directions, the distance between them being regulatable.

Knife-grind'ing Ma-chine'. An emery wheel mounted on a bench with a way upon which the

Fig. 1515.



Automatic Knife-sharpening Machine.

knife carriage is automatically traversed in front of the grinding wheel. Water is supplied from a trickling cup above.

See grinder, automatic .	* "*Scientific Amer.*," xxxviii. 371.
Grinding machine . .	* "*Scientific American*," xxxv. 367.
Manufacture	* "*Scientific American*," xxxvii. 88.
Polishing mach., *Chase*	* "*Scientific American*," xliii. 403.
Knife and tape line.	
Hastings	* "*Scientific American*," xxxv. 194.

Knife Guard. (*Cutlery.*) A pivoted piece on the back of a carving fork, to protect the hand should the knife slip in carving.

The guard is combined with a rest in the carver of the *Meriden Cutlery Co.*

Knife Head. That piece in the cutting apparatus of a harvester, to which the knife is fastened, and to which the pitman-head is connected. In the Harrison knife-head, rubber buffers are placed on each side of the pitman wrist, to take up the jar and keep the eye from being battered.

Knife Rest. A bench for holding a knife while being ground or filed. Such are used in connection with grindstones and emery wheels. See under the various heads and references *passim*. Also list under GRINDING.

The rest for harvester-knives, shown in Fig. 1516, is fold-

Fig. 1516.

Harvester Knife Rest.

ing, portable, and has a box for files. It has thumb-screws for holding the knife steady.

Knit'ting Ma-chine'. Considered at length, * pp. 1234–1238, "*Mech. Dict.*"

G. W. Gregory's Report on Knitting Machines, "*Centennial Exhibition Reports*," vol. vii., Group XX., p. 53 *et seq.*, describes the following: —

Lamb	p. 53.
Campbell & Clute	p. 55.
Dana & Bickford	p. 56.
Franz & Pope	p. 56.
Hawley & Bronson	p. 56.
Tuttle	p. 57.
Gunison & Coltman	p. 58.

See also machine for jackets. * "*Engineer*," xli. 391.
Gunison & Coltman . . . * "*Scientific Amer. Sup.*," 431.
Tuttle . . . . . . * "*Sc. American*," xxxvii. 388.
See also, DARNING MACHINE, *supra*.

Knock'ing. (*Add.*) 2. A jar produced by "lost motion" in the connecting parts of machinery in motion, particularly in connecting-rod bearings or brasses, in the shaft bearing or boxes, etc.

See article with diagram, "*Scientific American Supplement*," pp. 1, 17.

Knock'-knee Brace. (*Surgical.*) A supporter, to correct inward curvature of the knees. A GENU VALGUM BRACE.

Knot.

See Artificer's knot.
Bend.
Boat knot.
Bowline knot.
Bowline on a bight.
Builder's knot.
Capstan knot.
Carrick bend.
Clove hitch.
Diamond knot.
Dog shank.
Double knot.
English knot.
Figure-of-8 knot.
Flemish knot.
Galley knot.
Half hitch.
Harness hitch.
Hawser bend.
Hitch.
Lark's head.
Lashing knot.
Loop knot.
Marlinspike hitch.
Matthew Walker knot.
Midshipman's hitch.
Overhand knot.
Prolonge knot.
Reef knot.
Rosette.
Sheepshanks.
Shortening knot.
Shroud knot.
Sixfold knot.
Spritsail sheet knot.
Tack knot.
Twist knot.
Wall and crown.
Wall knot.
Weaver's knot.

Knot Ty'er. (*Surgical.*) An instrument for tying a ligature in a deep-seated situation.

See LIGATURE INSTRUMENTS, Fig. 2944, p. 1308, "*Mech. Dict.*"

Knurl'ing Tool. A tool to produce knurl work; such as that on the edge of a thumb-screw.

* "*Scientific American*," xl. 223, Fig. 2; Figs. 16–21, p. 223.

Kuft Work. (*Fine Art Metal-work.*) The name for the damasceening of Hyderabad: gold or silver wire let into undercut graved lines on a steel, iron, or bronze object, and incorporated by hammering.

A cheap *Kuft* work — a sham in fact — has gold leaf laid on a surface roughened by etching, while the gold wipes off the smoother surface.

Ky'ak. The Eskimo canoe, used in hunting and fishing.

Kys'to-tome. (*Surgical.*) See CYSTOTOME, "*Mech. Dict.*"

L.

L. A rectangularly bent pipe connection. An *ell*. See BEND, *c. d*, Fig. 295, p. 97, *supra*.

La'bel-ing Ma-chine'. A machine for attaching labels to cans, bottles, boxes, packages, etc. See Fig. 2781, p. 1242, "*Mech. Dict.*"

Bigelow's machine is adapted to labeling round cans and is adjustable to those of any circumference and length. The labels are applied either with marginal paste, or paste all over their backs. It is operated by two persons, one to lay the can on at one end and the other to take it off at the other end; the weight and velocity of the can passing down the inclined chute doing the work. Capacity, 40 per minute.

In *Russell's* machine the paste is applied all over the back of the label, the process is automatic, the cans being simply put in and taken out; the motion is by hand crank.

La'bel Ma-chine'. A machine for preparing and printing labels.

In *Hutchinson's* label machine, Fig. 1517, the ribbon of paper is wound upon reel *B*, from which it is drawn by a regular motion of the feed-rollers *J*. The guides *C C* steady it, in its onward course, in a direct line. The rollers *D* flange it and crease it. The guide d^1 turns the flange d^2 up at right angles. The reel e^1 has on it the tape e^4. In using the tape, carry one end down under guide e^6, through the mucilage e, up through scraper e^5, down again under roller *G*, then under guide g^1, where it is pressed down to the paper; and, as it passes forward, the flanged edge is folded down over it by the folder *H* and is pressed firmly down by spring presser-bar *h*. It then passes between feed-rollers *J*, and on between the plate *V* and stop s^1, and the hole is punched. At the proper interval of time, the inking-roller *N* passes under the type m^1, and recedes again. The type descends with the knife and prints the tag, and the knife *L* cuts off the tag complete. A piece of strong paper strips may be used instead of the tape, or the flanged edge may be gummed, without any tape being used; or a ribbon of paper and cloth, combined in one article, may be used instead of the paper ribbon.

Lab'o-ra-to-ry Forge. A compact form of forge for the work room.

That shown in Fig. 1518 is a French form, and has bellows, hearth, vise, and drilling arrangement.

See also CHEMIST'S FORGE, Fig. 610, p. 193, *supra*, etc.

Laboratory equipment, *Schacht* * "*Sc. Amer. Sup.*," 1578.
Laboratory furnace . . . * "*Sc. American Sup.*," 319.

Lab'o-ra-to-ry Fur'nace. A compact form of furnace for the work-shop.

For instances, see BLAST GAS FURNACE, Figs. 321–323, p. 105; BUNSEN BURNER FURNACE, Figs. 473–475, pp. 146, 147; CRUCIBLE FURNACE, Fig. 738, p. 283, *supra*, also p. 1242, "*Mech. Dict.*"

Lab'o-ra-to-ry Lathe. A form of lathe for dentists, jewelers, etc. Adapted for drilling and polishing.

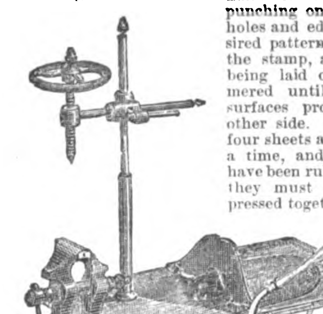
It is foot-power, stands on a tripod, and the head is thrown forward 5" from the perpendicular to allow a person to sit while using it. The height of the head is adjustable.

Lab'y-rinth. (*Metallurgy.*) An apparatus in which the slimes or finely stamped metallic matters and gangue are placed in an extended trough exposed to a current of water. The bottom of the trough has little trenches formed by slats, and the matters deposit according to relative fineness and levity, the lighter at the greater distance from the point of ingress.

Lace Paper. Paper surface-stamped and perforated to resemble lace.

The difficulty in manufacturing these papers is to produce a surface which will exhibit, as in real lace, the fine gradations of lines. Small leaden hammers are used for punching on stamps. The holes and edges of the desired pattern are raised on the stamp, and the paper being laid on it is hammered until the hollow surfaces project on the other side. From two to four sheets are stamped at a time, and unless they have been rubbed with talc they must be closely pressed together.

Fig. 1518.



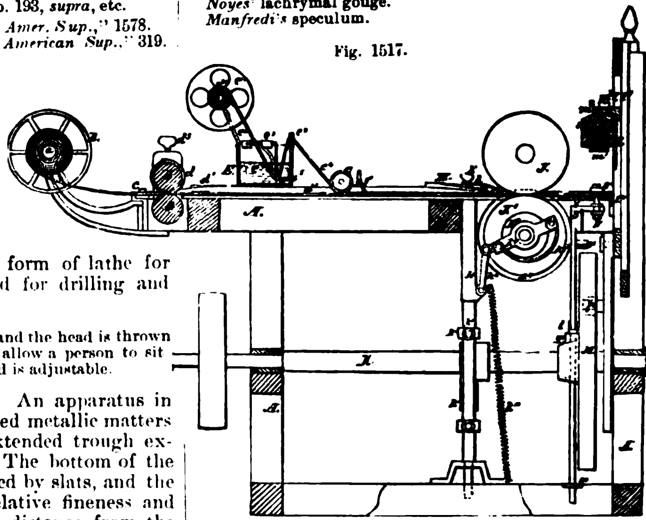
Laboratory Forge.

Lach'ry-mal Duct In'stru-ments. (*Surgical.*) These include syringes, dilators, probes, forceps, gouges, catheters, specula, knives.

See CANALICULA, also LACHRYMAL DUCT DILATOR, p. 1244, "*Mech. Dict.*"

See also pp. 6, 7, Part II., *Tiemann's* "*Armamentarium Chirurgicum*," for —
Anel's, *McFarland's*, *Liebold's*, *Agnew's* eye syringes.
Galezowsky's, *Weber's* canalicula dilators.
Anel's, *Bowman's*, *Williams's*, *Liebreich's*, *Levi's*, probes.
Liebreich's fistula knife.
Noyes' lachrymal gouge.
Manfredi's speculum.

Fig. 1517.



Label Machine.

Noyes' conjunctiva forceps.
Speirs' lachrymal catheter.

La'cing. (*Nautical.*) A cord to lace a sail to a gaff, or a bonnet to a sail.

La'cing Cut'ter. (*Leather.*) A knife with a gage, to preserve the width of the strip.

Lacing cutter, *Elliott* . * "*Scientific American*," xliii. 178.

La'cing Hook. (*Boot.*) Hooks on the margins of the upper, over which a lace is caught side by side alternately to close the opening in the shoe.

Fig. 1519.

Laboratory Lathe.

Lac'quer. From *lac* (*Hindu*), "the hundred thousand," alluding to the smallness of the insect, *Coccus lacca*, which produces the resinous exudation on certain Indian trees.

The Japanese lacquer, *urushi*, is from the sap of the *rhus vernicifera*, which is obtained by a process of tapping, similar to that employed in obtaining turpentine. The process is described and illustrated in the author's article on the subject in the "*Atlantic Monthly*," * vol. xl., p. 559, *et seq.* See also digest from report of Japanese Commissioners at Centennial Exhibition, 1876, in "*Scientific American*," xxxv. 89; and "*Scientific American Supplement*," 676.

The lacquer work of Japan is admittedly superior to that of China, which is attributed to the advantage possessed by the former in having a moister climate, and to the comparative absence of dust in the atmosphere. The Japanese lacquer itself is, however, more limpid than that of China, the latter having a yellow tinge.

The perfection of the Japanese and Chinese lacquer work does not altogether depend upon the excellence of the varnish or the preparation of the colors. The most elaborate pains are previously taken with the surface of the material to be embellished. The surface of the wood is carefully smoothed; joints, if any exist, are filled with fine tow, and covered with thin strips of silk or paper; the surface is then anointed with a vegetable oil, found in the mountains; when dry, the varnish is applied. On this surface the gold or silver ornamentation or relief work is applied, and the whole covered with another coat of varnish.

Recipes: —

For Brass Castings:	Seed lac	6 oz.
	Amber of copal	2 oz.
	Dragon's blood	40 grains,
	Extract red sandal wood	30 grains.
	Oriental saffron	36 grains.
	Pounded glass	4 oz.
	Alcohol	44 oz.

Expose articles to a gentle heat and dip in the lacquer, several times if necessary. Has a good color, is durable, may be cleaned with water and dry rag.

Gold Color Lacquer:	Copal	2
	Shellac	1
Melt and add:	boiled oil	2
	Mix gradually in oil turpentine	10

Color with gum guttæ in turpentine for yellow; dragon's blood for red.

For Brass or Bronze:	Shellac	16
	Dragon's blood	4
	Turmeric root	1
	Alcohol	332

Warm the article before applying.

Black Lacquer:	Shellac	9
	Methylic alcohol	50
Digest, and then apply asphaltum		10
	Dissolve in benzine	50
	Lamp-black, *ad lib.*	

Dilute with alcohol and benzine.

See also Brass Lacquering, p. 130, *supra*.

Lacquer, Japanese . . "*Sc. Amer. Sup.*," 1831, 2756.
Painting, Japanese . . * "*Iron Age*," xvii., Feb. 3, p. 7; April 6, p. 1.
Ware, Japanese . . . "*Van Nostrand's Mag.*," xiv. 364.

Lac'to-den-sim'e-ter. A specific gravity instrument by Quevenne.

It is of the hydrometer form, and has one spindle with two scales, — one to show the density of pure milk, another for skimmed milk; both scales expressing the specific gravity of the milk.

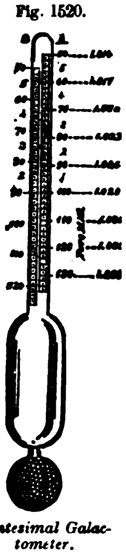
The greatest density of cow's milk is 1.035, produced under favorable circumstances. The usual density of pure good milk is 1.030, water being 1.000. A scale of 35° shows, therefore, the full range between water and the best milk, and serves to register all the information which a trial of the density can elicit.

See Lactometer.

Lac-tom'e-ter. An instrument for testing milk.

It is usually on the principle of the hydrometer, and determines the specific gravity.

Fig. 1520.



Centesimal Galactometer.

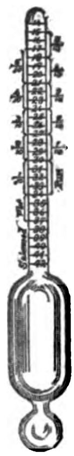
The centesimal galactometer is the invention of *Dinocourt*. It has two scales: one for pure milk, and colored yellow on the staff of the instrument; the other for skimmed milk, colored blue on the instrument.

"The first degree on the top of the scale is marked 50, which corresponds to the sp. gr. 1.014. The marks following extend from 50 to 100 (sp. gr. 1.029), and over. Each degree starting from 100, in mounting up to 50, represents a hundredth of pure milk; the degrees formed by a *line* are equal, as 50, 52, 54, etc.; the degrees formed by a dot are unequal, as 81, 83, 85, etc. To illustrate by an example: If the galactometer is sunk to the 85th degree, that will indicate 85 hundredths of pure milk, and consequently that 15 hundredths of water has been added to this milk; if sunk to 60°, that will indicate 40 hundredths of water, or four-tenths of water added.

"The skim-milk scale is, like the first, divided into hundredths (100°), of which the first 50 have been cut off as useless, as in the case of the other scale, each degree commencing from 100 to 50, and mounting upwards represents a hundredth of pure skimmed milk, consequently the manner of estimating the quantity of water added to skim milk is absolutely the same as for pure milk with cream." — "*Mott.*"

The instrument of *Bouchardat & Quevenne* is shown in Fig. 1521. It differs from that of *Dinocourt* in the division of its scale. The shaft bears three graduations.

Fig. 1521.



Lacto-densimeter.

Fig. 1522.

Board of Health (N. Y.) Lactometer.

The middle one comprises the figures between 14 and 42, answering to 1.014 and 1.042 specific gravity. For instance, if the instrument be sunk in a liquid up to the figure 29, this signifies that a liter of this milk weighs 1.029 grams, and that its density is consequently 1.029. The instrument has been graduated for the temperature of + 15° C. The scale on the right is employed when it is certain that the milk acted on is not skimmed. This scale shows what are the variations of the density of milk in proportion as water is added, and the figures .1, .2, etc., indicate that the liquid operated upon has been mixed with this proportion of water. The scale on the left contains the same indications relative to skimmed milk. Milk is marked pure on this instrument, between the specific gravities 1.030 and 1.034; skimmed milk is marked pure between the gravities 1.034 and 1.037.

In graduating the Board of Health lactometer, shown in Fig. 1522, the 100° is placed at the standard 1.029, and 0 at 1.000, the gravity of water, the intermediate spaces being divided into 100 equal divisions. The point to which the lactometer sinks in the milk under examination indicates the percentage of milk in 100 parts. Thus, if the lactometer sinks to 80, the milk must consist of, at least, 20 per cent. of water and 80 of milk. This assumes the original milk to have had a specific gravity of 1.029; but if the milk had originally a gravity of 1.034, it would require 16.67 per cent. of water to bring it down to 1.029, and 20 per cent more water to lower it to 80° on the lactometer. The temperature at which examinations are made with the lactometer should be 60 F.

The following is the rapid method of chemical analysis of milk, devised by Prof. Lehmann, of Munich.

A weighed quantity, say 9 or 10 grams of milk, is diluted with an equal weight of water, and poured out in a thin layer upon a porous plate of burnt clay, very dense and fine-grained. The water of the milk, as well as the milk sugar, albumen, and a portion of the salts dissolved in it, are absorbed by the clay plate, while the total amount of fats and caseine in the milk remain on the plate in the form of a thin skin or film. This film is easily removed with a horn spatula, and then dried and weighed. If it is desired to determine the fats alone, this film may be extracted with ether, and thus the two most important constituents of milk very quickly determined. In many cases it is sufficient to know the total weight of the principal solid constituents of the milk, hence also the amount of water, for which scarcely two hours are required. This method also possesses the advantage that a great number of samples can be tested at once without much trouble. It also does away with the use of numerous costly platinum dishes and troublesome water baths, which are always getting dry if not carefully watched. The operation is so simple that it can be used by any person who possesses an accurate balance and set of weights.

Comparing the milk of the cow, mare, and sow by composition, the latter is found very much the richest, as the following analyses show: —

	Cow.	Mare.	Sow.
Water	87.00	90.310	81.760
Fats	4.00	1.055	5.830
Albuminoids	4.10	1.953	6.180
Sugar	4.28	6.285	5.335
Mineral matter	0.62	0.397	0.895
	100.00	100.000	100.000

Rich as sow's milk is, it is remarkable that the lactometer shows no cream. Drying on the water-bath, it exhales the odor of roast pork, and on putrefying, that of putrid bacon.

See *Horsley*.	"*Technologiste*," xxxviii. 172.
	* "*Scientific American*," xxxiv. 208.
Banks-Schubler . . .	*Laboulaye's* "*Dictionnaire, etc.*," ii., *cap.*, "*Lait.*"
Lactoscope, *Huesner*	"*Scientific American*," xxxvi. 21; xxxvii. 244.
Paper by *Dr. Mott* . .	* "*Sc. Am. Sup.*," 1050, 1131.
And analysis	"*Scientific American*," xxxiv. 8.

Refer to "*Jour. Phar. et Chem.*," 3d series, 1844, t. v. p. 187; "*Jour. Chem. Medic.*," 4th series, 1856, t. 11, p. 342–401.

See "*Dic. Ency. Sci. Med.*," p. 144 — Lait.
"*Répertoire de Pharmacie*," Juillet, 1856.
Tilloch's "*Philosophical Magazine*," Nos. 57, 58, p. 241.
See also PIOSCOPE.

Lac'to-scope. The lactoscope of Dr. Heusner of Barman is based on the opacity of pure milk.

It consists of two round plates of glass about the size of a watch crystal, placed parallel and held about ⅛″ apart by a metal strip, which passes between them, dividing the space between them into two sections. In the lower section is placed and secured some pure milk, or, better, some permanent white fluid of precisely the same opacity as pure milk. On one of the glass plates are some fine black lines. The upper section is filled with the milk to be tested, and secured by an elastic band. On holding the apparatus between the eye and the light, the black lines being on the side opposite the eye, the black lines will be seen more distinctly through the less opaque medium. If the milk to be tested is less opaque than the normal liquid, as shown by the lines being more distinctly visible through it, the milk has probably been watered or skimmed.

Compare DIAPHONOMETER, p. 255, *supra*.

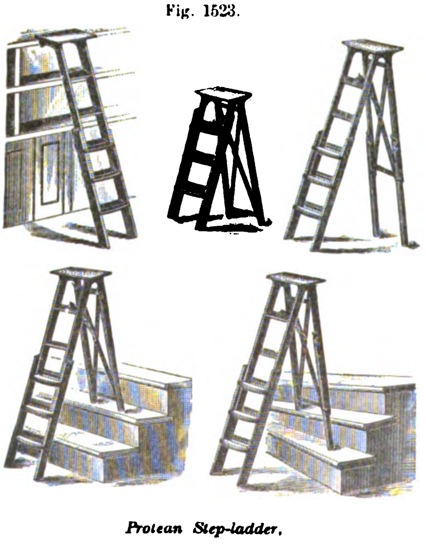
Lac Work. A very extensive industry in India. There are many styles: —

The surface of furniture, boxes, or trinquetry are covered with the lac, and this is laid on in colors, and the designs cut through to expose lower colors.

The surface thus prepared is etched or painted.

A drab ground, ornamented with geometrical flower forms, in colors.

Fig. 1523.



Protean Step-ladder.

These are but a few. The subject may be pursued in *Dr. George C. M. Birdwood's* "*Handbook to the British Indian Section.*" Paris, 1878; pp. 73, 74, 1st ed.

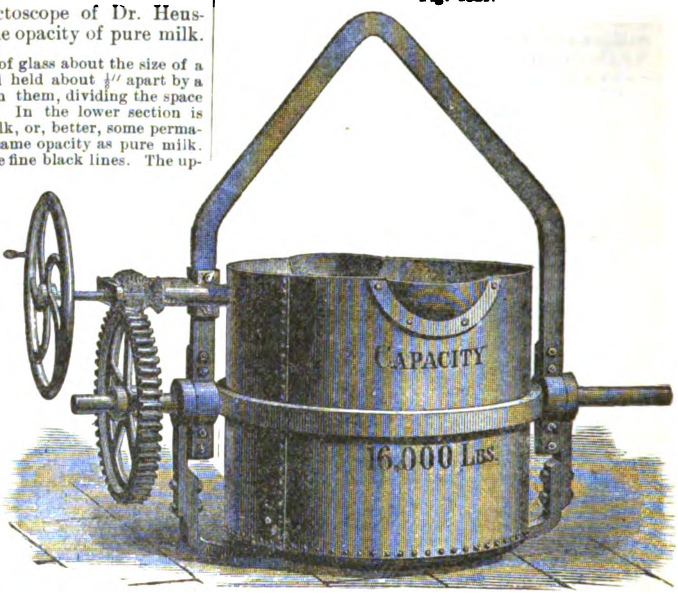
Lad'der. A portable frame with steps. A list is given on p. 1244, "*Mech. Dict.*"

A protean step-ladder is shown in Fig. 1523. It is shown closed, extended, on stairs, on winding stairs, etc — *Covert*.

Lad'der Truck. A vehicle for carrying fire-ladders and hooks. A hook-and-ladder truck. Furnished with (say) 5 ladders, 6 hand-hooks, 2 axes, 2 picks, 4 lanterns, rope-reel, drag-rope, and side-ropes, etc.

La'dle. (*Founding.*) A pan or kettle with a handle, to hold molten metal for pouring.

Fig. 1524.



Balanced Foundry Ladle.

The smaller are known as bullet or plumber's ladles, etc.; the larger, as *shanks*. The glass ladle is a *cuvette*.

Fig. 1524 shows a balanced foundry label of large size, with a capacity up to 8 tons. It pours from either side, and is tipped by gearing from the hand-wheel. It is slung by the bail above from the chain of the crane, and turns on pivots.

A nickel-plated concave disk may be attached to the handle of a foundry ladle to protect the workman from heat and reflect light upon the mouth of the flask.

La'dle Fur'nace. A gas furnace in which the metal to be melted is contained in a ladle over the Bunsen jet. Its capacity is (say) ladles of 6″ diameter, to melt 6 or 8 pounds of zinc, tin, lead, etc. See Fig. 1525.

Lag'ging. (*Mining.*) The timber over and upon the sides of a drift.

Lag Screw. An iron screw, driven by a wrench, but screwing into wood; securing the lagging around a cylinder or other object. See Fig. 1526.

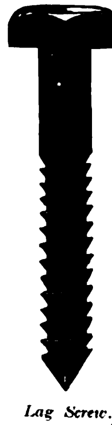
It has a square or hexagonal head, a wood screw-thread cut on it, and is round under the head.

Lake. A precipitate of hydrate of alumina, formed in a solution containing an organic coloring matter: as *madder* lake; *cochineal* lake, etc.

Fig. 1525.

Ladle Furnace.

Fig. 1526.



Lag Screw.

Yellow lakes for dyes are produced from quercitron bark, yellow berries, yellow wood and annatto.

Blue lakes are furnished by litmus derived from lichens found in Southern Europe, Africa, South America, and the East Indies, and indigo.

Red and violet lakes are obtained from cochineal, madder, Brazil wood, lac dye, and safflower.

Lam'i-na-ted Beam. One of the methods of forming a curved beam. They are as follows: —

The *Scarfed*,	*Flitched*,
Bent,	*Laminated*.

The latter is made of thin planks or boards, bent to shape, laid together and secured to form an integral beam, as in Figs. 312–316, pp. 138–139, "*Mech. Dict.*"

Lamp. A device in which a liquid oil or grease is burned in a wick.

Kendall's hydrostatic safety lamp is shown in Fig. 1527. The water is shown by horizontal shading, the oil by oblique. The water forms a seal for the oil, and forces the latter up the wick tube.

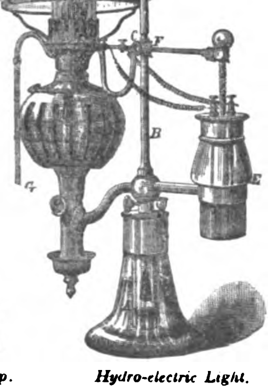
Lavendar's steam lamp (Br.) for collieries consists of a glass lantern 18″ square, with a funnel 24″ high. Into this is introduced a jet of steam, about 1-16″ in diameter, the object of which is to create a partial vacuum in the lantern. The consequence is, that the surrounding air is forced through the burner of the lamp, causing almost complete combustion of the oil. A very brilliant light is thus produced, the increase in brilliancy being partly owing to the products of combustion being continuously removed and a volume of fresh air introduced. The results obtained from a 4″ wick have been calculated as equal to a light of upward of 600 sperm candles.

See *Jobard*, Fr., * *Laboulaye's* "*Dictionnaire*," etc., iv., cap. "*Éclairage*," Fig. 3518.

Fig. 1527.

Hydrostatic Safety Lamp.

Fig. 1528.



Hydro-electric Light.

Zimmerman's hydro-electric self-lighting light is shown in Fig. 1528. The lamp has a Dobereiner apparatus and galvanic battery combined with any form of burner or kind of illuminating liquid.

The *Dobereiner* lamp *A* serves as the pedestal, and contains the acid, water, and zinc. The gas ascends the vertical tube *B*, passes through the valve at *C*, and escapes at an orifice just below the burner. *E* is a galvanic battery, which is normally out of action, but set in activity by pressing a knob, and has wire connecting with the hydrogen outlet near the burner, heating an electrode red-hot at the same moment that hydrogen is allowed to escape. The hydrogen is inflamed and the wick lighted by the single pressure on the knob.

Blast lamp, Br. . . .	* "*Engineer*," xlii. 309.
Cleaner	"*Scientific American Sup.*," 778.
Electric, *Rapieff* . . .	* "*Teleg. Journal*," vi. 333, * 363, * 430.
Extinguisher, *Hale* . .	* "*Scientific Amer.*," xxxix. 358.
Mining, *Boesch* . . .	* "*Mining & Sc. Press*," xxxv. 41.
Safety-valve, *Lewars* .	"*Iron Age*," xx., Aug. 9, p. 11.
Self-lighting time lamp.	
Covert	* "*Scientific American*," xl. 182.
Steam lamp for collieries.	
Lavendar, Br. . . .	"*Scientific American Sup*," 764.
Wick trimmer, *Bannihr*,	* "*Scientific American*," xxxv. 181.

Dissertation on lamps. Report of Azel Ames, Jr., "*Centennial Reports*," v., Group. XIV., pp. 23–31.

Lamp'black Ap'pa-ra'tus. A black pigment obtained from the smoke of burning resin, fat, or gas. See p. 1247, "*Mech. Dict.*"

See *Mallet's* report, "*Centennial Exhibition Reports*," vol. iv., Group III.

Lamp-black apparatus, * p. 110; *Neff's*, * p. 111.

Lamp'black. United States patents on Lamp-black apparatus: —

	Number.
Chater, N.	1,358
Mini, J. G.	3,824
Clark, E.	6,001
Mortimer, C.	7,266
Griswold, G. W.	11,326
Jaeger, W. G. W.	11,331
Roth, J. A.	17,519
Child, R. S.	32,753
Lundgren, J. E.	42,257
Weisman, J.	43,444
Prenatt, A.	50,493
Millochan, A.	72,068
Perlee, R. N.	72,078
Matlack, M.	75,943
Millochan, A.	84,131
Vander Weyde, P. H.	87,382
O'Reilly, P.	91,038
Brenton, J.	95,977
Farrar, A.	96,409
Howarth, J.	131,446
Wilson, G. F.	90,327
Rogers, J.	146,951
Tait, A. H.	148,778
Bottenberg, J. H.	153,234
Farrar, A.	154,467
Neff, P., & L. S. Fales	159,440
Neff, P.	160,785-160,789
Neff, P.	162,492
Neff, P.	162,679
Neff, P.	163,027
Neff, P.	166,936

Lamp Ce-ment'. For attaching the brass collar to the glass socket on the reservoir of a petroleum lamp: —

Boil 3 parts resin with 1 part caustic soda and 5 parts water. Mix with half the weight of gypsum. It sets in 45 minutes. Zinc white, white lead, or precipitated chalk may be substituted for the gypsum, but harden more slowly.

Lamp Fur'nace. One in which a lamp — in contradistinction to a gas jet, Bunsen burner, or charcoal — is used as a means of heating.

Used in laboratories: *Griffin's* for instance; see "*Chemical Handicraft*," * p. 123.

Lamp Jack. (*Railway.*) A hood over a lamp chimney on the roof of a car.

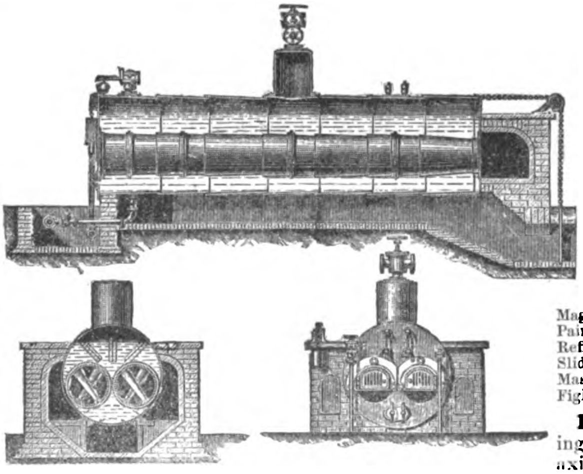
Lamp Stove. See PETROLEUM STOVE, Figs. 3364, 3365, p. 1676, "*Mech. Dict.*"

Lan'ca-shire Boil'er. The long horizontal two-flue boiler is an improvement upon the invention of the illustrious Smeaton, the originator of the flue traversing the boiler. Smeaton's boiler had a single flue; the common boiler used on our western rivers has two; but in neither case is the furnace or course of draft the same as in the Lancashire boiler, as it is called in England.

The front of each flue in the latter boiler, shown in Fig. 1529, constitutes the furnace, and the volatile products of combustion pass backward through the flues into a back chamber, revert along each side, dive under the front, and then pass underneath the length of the boiler and escape by a sub-flue to the stack.

The Cornish boiler has but a single flue and is sometimes mounted with side reverting flues; it usually carries a lower pressure than the Lancashire boiler and is of larger diameter. The Lancashire has some advantages, especially where great power is required. In large boilers, the two flue tubes form good stays for the flat ends; the fire grates can be made of the proportions which give the greatest economy. If the

Fig. 1529.



Appleby Bros. Lancashire Boiler. (*English.*)

flues are stoked alternately a more even temperature is maintained; the heat in one furnace is always at its highest when the other is at its lowest, and the two flues meeting in one combustion chamber, it follows that the gases from the hottest furnace ignite and consume the thick smoke from the other which is being stoked, so that no unconsumed products need escape from the chimney.

A range of large boilers is often fitted with lifting bridges, a flue connecting the two furnaces in the front, and, after a furnace has been newly fired, the bridge is lifted by a lever in front of the boiler, and the whole of the smoke is made to pass over the fire of the other furnace. In all large works there is at least one boiler more than is required for daily use, so that any of the boilers may be laid off for periodical examination and repair when it is required.

Lance. (*Fishing.*) A fishing spear used in killing captured whales, sword-fish, porpoises, etc. For list see HARPOON.

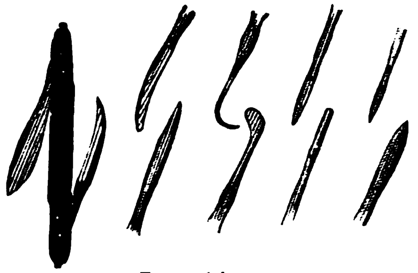
Lance Hook. (*Fishing.*) These are fastened on the boat's side to hang the lances upon.

Lan'cet. (*Surgical.*) A delicate cutting instrument which often bears a special name derived from its form or the place of its application.

Fig. 1530 shows several forms: —

Those on the left, in a handle, are a scalpel and spear bistoury.

Fig. 1530.



Forms of Lancets.

The next two are straight spear and curved probe bistouries.
The next two are a tenaculum and a gum lancet.
The next are sharp and blunt point tenotomes.
Next, tenotome and scalpel.

Land'ing Gaff. (*Fishing.*) A barbed spear for landing fish.

Land'ing Net. (*Fishing.*) A bag-net with hoop mouth for landing a hooked fish.

Land Line. (*Fishing.*) Line passing from the end of the seine to the shore.

Land Rol'ler. An implement for leveling land and breaking clods. See ROLLER. See also CLOD CRUSHER, Fig. 638, p. 201, *supra*.

Land'scape Mir'ror. A mirror which condenses or diminishes the view into a perspective effect. A *Claude Lorraine*.

Lan'tern. (*Founding.*) A perforated *core-barrel*, generally short, and of large diameter.

A portable case for protecting a light.

Miller's, *Coogan*	*	"*Amer. Miller*," vii. 167.
White . . .	*	"*Iron Age*," xix., Jan. 11, 5.
Slides		"*Sc. Am. Sup.*," 1650, 2757.
Vertical . . .	*	"*Sc. Am. Sup.*," 704, Fig. 3.
Magic lantern . .	*	"*Man. & Builder*," ix. 46.
Painting	*	"*Sc. Amer.*," xxxvii. 355.
Reflecting, *Knight* .	*	"*Sc. Amer. Sup.*," 1389.
Slides		"*Sc. Amer.*," xxxvi. 229.
Mast-head, *Stone*, Br.		See *infra*.
Fighting, Br. . . .		Fig. 1025, p. 333, *supra*.

Lap. 1. A wheel or disk used in grinding or polishing. Usually on a vertical axis. See p. 1252, "*Mech. Dict.*"

(*Watchmaking.*) Grinding and polishing laps are made of emery, copper, tin, boxwood, ivory, and Arkansas oil stone, of various dimensions.

The various kinds of wheels, and the abradants for grinding and polishing, are mentioned on p. 1253, "*Mech. Dict.*" Their relative hardness is given in a table, p. 1617, *Ibid.*

Japanese lapidary . . "*Scientific American*," xli. 298.

2. A fleece of wool or cotton. See LAPPING MACHINE.

Lap-doub'ling Ma-chine'. A machine which winds two fleeces of cotton upon the roller by means of two sets of rack gear and a top plain roller, which rests on two fluted calender rollers, and is lifted as the lap is formed. *Platt Bros.* (Br.)

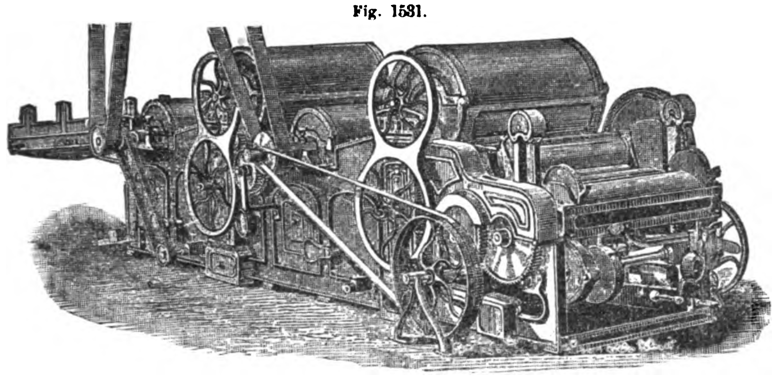
Lap Scale. A scale with a pan in which a given quantity of wool or cotton is weighed to be spread upon a given length of the traveling feeding apron of the lapper or carding machine, as the case may be.

Lap'per. Primarily, a machine for taking cotton from the opener and making it into a lap.

Fig. 1531 is a machine receiving bale cotton, to open, clean, and make it into a lap.

The machine, as shown in the figure, has in fact two open-

Fig. 1531.



Kitson Cotton Opener and Lapper.

ers, each separate and complete in itself, both delivering the cotton on to one pair of screens, when the two quantities unite and pass through the rest of the machine to form the lap. The aprons run slowly, and a draft of 12 to 1 is obtained.

A second operation may take place upon a *finisher lapper*. Clarke and Pelham's three-roll sectional evener is used on the Kitson finisher lapper to vary the speed according to the varying thickness of the cotton passing into the machine. This evener has two fluted bed-rolls above which are eight sectional rolls which are saddled in pairs. Each pair of saddles has a single saddle, and above there is one which thus bears upon the whole system beneath. In the center of the main saddle is a rack operating a pinion attached to a quadrant which communicates by a chain with the belt shipper on the concave and convex cone pulleys, so as to affect the rate of feed.

Lap Ta'ble. A sewing or cutting-out table, supported in or over the lap; a lap-board.

Lard Press. A domestic press for squeezing lard from cracklings.

A *screw-down* press is shown at Fig. 2811, p. 1256, "*Mech. Dict.*"

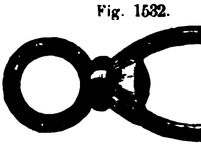
A *draw-up* press at Fig. 872, p. 274, *supra.*

Toggle motion, *Boomer & Boschert*, * "*Sc. Am.*," xlii. 242.

Lark's Head. (*Nautical.*) A form of bend; see 24, 25, Fig. 2777, p. 1240, "*Mech. Dict.*"

Lar'i-at Swiv'el. A coupling link for a lariat and picket pin, preventing the twisting of the rope as the animal wanders around the picket pin.

Fig. 1532.

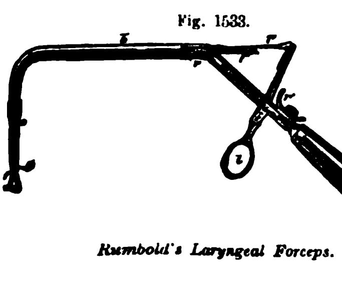


Lariat Swivel.

Lar-yn'ge-al For'ceps. An instrument for the extraction of laryngeal tumors.

The method of using the instrument is as follows: After the vertical portion *c*, being temporarily made as short as possible, has been introduced into the larynx, it is lengthened by the lever *l* pushing both rods *t'* and *f'* into the tubular portion *b c*, which causes both the smaller tube *t* and the forceps *f* to descend. As soon as the length desired is attained, the serrated rod *f'* is arrested by pressure made on the hook-shaped projection *r'* with the thumb, causing the claws to grasp and retain it. The forceps are closed by continuance of the pressure on the lever *l*, causing the rod *t'* to push the smaller tube *t* over the base of the forceps and close them upon the tumor.

Fig. 1533.



Rumbold's Laryngeal Forceps.

Lar-yn'ge-al In'stru-ments. (*Surgical.*) This includes a number of instruments, notably: —

Caustic carrier.
Powder blower.
Scoop.
Écraseur.
Electrode.
Forceps.
Inhaler.
Syringe.
Laryngoscope.
Mirror.
Lancet.
Scissors.
Tonsillotome.
Lantern.
etc.

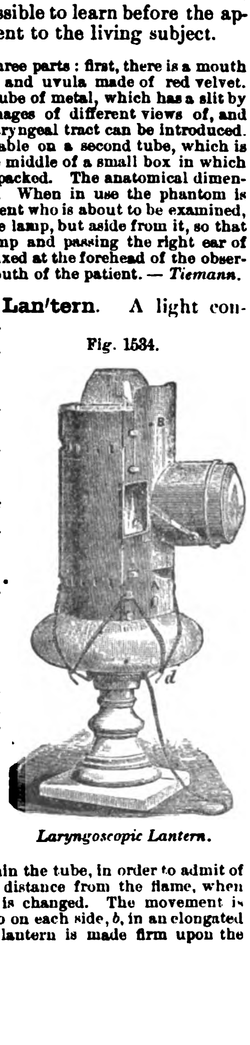
Lar-yn'go Phan'tom. An apparatus devised by Dr. Isenschmid, of Munich, and intended to familiarize medical students and practitioners with as many of the details connected with the use of the laryngoscope as it is possible to learn before the application of the instrument to the living subject.

The phantom consists of three parts: first, there is a mouth of thin metal, with tongue and uvula made of red velvet. This is fixed on a laryngeal tube of metal, which has a slit by which the thirty painted images of different views of, and different conditions of the laryngeal tract can be introduced. The laryngeal tube is movable on a second tube, which is tightly fixed on a peg in the middle of a small box in which the whole apparatus can be packed. The anatomical dimensions are taken from nature. When in use the phantom is placed like the head of a patient who is about to be examined, one or two feet in front of the lamp, but aside from it, so that the rays coming from the lamp and passing the right ear of the patient on to the mirror fixed at the forehead of the observer, are reflected into the mouth of the patient. — *Tiemann.*

Lar'yn-go-scop'ic Lan'tern. A light concentrated for use in laryngoscopic examination and operation.

Fig. 1534 shows Dr. Oliver's, which is designed for direct light, though the frontal deflector — shown in Fig. 2815, p. 1257, "*Mech. Dict.*," may be used if desired. It is an attachment to an ordinary lamp.

Fig. 1534.



Laryngoscopic Lantern.

The lantern is made up of three main portions — the front piece *A*, and two wings which hinge upon the front piece, and by which the diameter of the lantern may be increased to suit the diameter of the glass chimney. The wings are locked together at the desired point, as at *a a*. As the lens must be on a level with the flame, the tube containing it is attached to a slide *B*, which, moving in grooves in the front main piece, may be raised or lowered, as found necessary. The lens is also movable within the tube, in order to admit of its being retained at its focal distance from the flame, when the diameter of the lantern is changed. The movement is made by the sliding of a knob on each side, *b*, in an elongated opening in the tube. The lantern is made firm upon the lamp by a cord. At *c* is seen the little mirror for use in auto-laryngoscopy.

La-ryn'go-stro-bo-scop'ic Ap'pa-ra'tus. A method by Dr. Oertel, of Munich, of observing the vibrations of the vocal cords during the production of sounds.

The apparatus consists of a laryngoscope mirror, a strong light, and an arrangement by which the light shall be rapidly interrupted. The effect of the interruption of the light is to prevent the impressions made by the vibrations upon the retina from being modified before they can be perceived. The interruption may be conveniently produced by means of a perforated diaphragm revolving rapidly, and at a rate proportioned to the rapidity of the vibrations of the sounding cord; or it may be by a tuning-fork of the proper note. The interrupting apparatus must be placed between the light and the mirror, or behind the mirror, between it and the observer. By this means it is possible not merely to observe accurately the vibrations of one of the vocal cords, but also to compare the vibrations of one with those of another.

Lar'ynx, Ar'ti-fi'cial. A metallic instrument provided with vibratory reeds and attached to the upper surface of the tracheotomy tube. The removal of the natural larynx by dissection from the surrounding parts, and the invention and placing of the substitute were by Prof. Billroth, of Vienna.

Lash'ing. (*Nautical.*) For list of *whipping, seizing, lashing*, etc., see SEIZING.

Lash'ing Eye. (*Nautical.*) A spliced loop in the end of a rope by which it may be lashed fast to an object. Lower stays, block straps, etc., are thus fitted.

Lash'ing Knot. (*Nautical.*) A form of bend; see 31, Fig. 2777, p. 1240, "*Mech. Dict.*"

Latch. (*Fishing.*) A clamp for the inboard end of a fishing line.

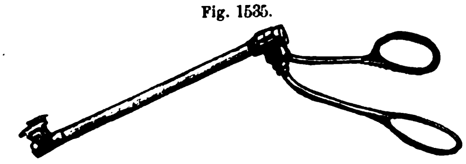
Stacey, June 2, 1868 . . . . . Patent, No. 78,546.
See also MACKEREL LATCH.

Lat'er-al Branch. A pipe with side connections. See several forms in Fig. 420, p. 129, *supra.*

Lat'er-al Cur'va-ture In'stru-ments. (*Surgical.*) A name applied to knock-knee and bow-leg braces, to some species of talipes instruments, wry neck, etc. See enumeration under CURVATURE APPARATUS, p. 236, *supra.*

Lat'e-ral Scis'sors. (*Surgical.*) A scissors

Fig. 1535.



Dr. Turnipseed's Lateral Scissors.

the blades of which approach like those of cutting pliers. Used in vesico-vaginal fistula, etc.

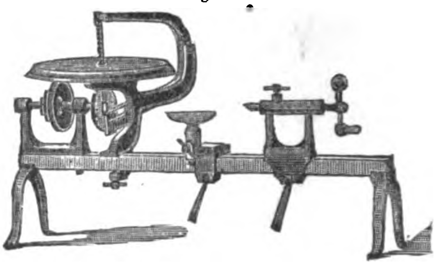
Lathe. See account and enumeration of 136 varieties, pp. 1261, 1263, "*Mech. Dict.*"

See also: amateur's . .	* "*Scientific American*," xxxix. 370.
Chuck, *Cushman* . . .	* "*Am. Man.*," Jan. 16, 1880, p. 12.
	* "*Scientific Amer.*," xxxviii 226.
Horton	* *Thurston's* "*Vienna Rept.*," iii. 337.
Pratt & Whitney . .	* "*Iron Age*," xxi., June 13, p. 1.
Cornell Univ. foot . .	"*Scientific American*," xxxv. 148.
Dog, *Clements*, Br. .	* "*Railroad Gazette*," viii. 53.
Driver, *Harris*	* "*Min. & Sc. Press*," xxxiv. 361.
Driver, *Timmins*, Br. .	* "*Engineer*," xlvii. 258.
100-ton guns.	
St. Chamond . . .	"*Scientific American*," xliii. 225.
Overhead motion, *Greenwood & Battey*, Br. .	* "*Engineering*," xxvi. 16.
Scroll saw, etc., *Stevens*	* "*Scientific Amer.*," xxxvii. 374.
Sellers	* *Thurston's* "*Vienna Rept.*," ii. 209.
To test a, *Rose* . . .	"*Scientific American*," xxxix. 213.
Universal, *Koch & Miller*	* "*Scientific American Sup.*," 157.
	* "*Scientific American*," xxxvi. 118.

See *Campin's* "*The Practice of Hand Turning in Wood, Ivory, Shell, etc.*"
"*The Turner's Companion.*"
Watson's "*Manual of the Hand Lathe.*"

Lathe and Saw. A combination for light

Fig. 1536.



Lathe and Saw.

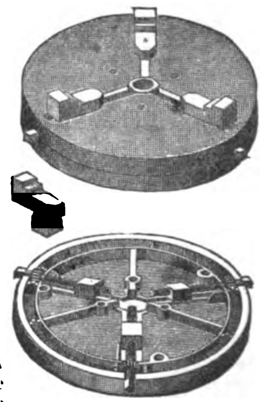
work, for amateurs and juveniles. The mandrel has a face plate with a wrist to which the lower end of the saw is attached; the upper end is connected with a spring arm.

Lathe Car'rier. A piece secured to the object in the lathe, and having a projection which collides with a stud on the face plate to cause the object to rotate in concert with the mandrel and face plate.

Fig. 1537.

Lathe Carrier.

Fig. 1538.

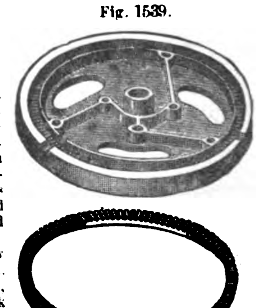


Inside Jaw Chuck.

Lathe Chuck. A device screwed to the mandrel of a lathe and grasping the object to be turned, bored, ground, polished, or what not.

Figs. 1538, 1539, show *Horton's* lathe chuck. The jaws are moved by geared screws and circular rack.

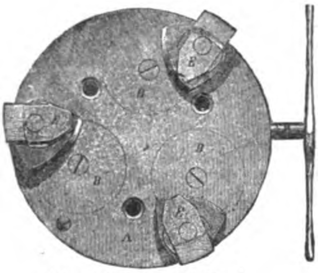
Fig. 1539.



The circular wrought iron rack is inclosed in the deep groove or recess in the back plate, the center faces of back and front plates are then turned true, which, when bolted together, makes a tight casing for the gearing, excluding dirt, chips, etc. When the rack is taken out, it makes an independent jaw chuck. The jaws are made solid, and forged of one piece of metal, and case-hardened.

Figs. 1540, 1541, show *Johnson's* universal chuck. Fig. 1540 is a face view, and represents the chuck ready for use. Fig. 1541 has a section through the edge of the body parallel with its face, the back part being removed to show the internal arrangement. Figs. 3, 4, 5, are details of construction; the jaw *E* revolves upon a steel pin in the arm of wheel *B*, to which it is also tongued and grooved, but

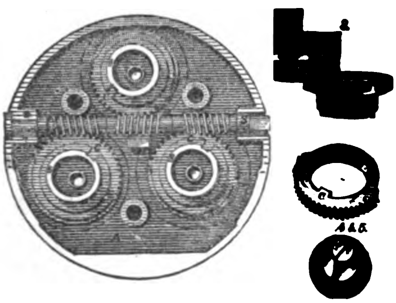
Fig. 1540.



Johnson's Universal Chuck.

which when turned to a certain position can be removed therefrom at will. The toothed ring *C* has a solid feather, and is accurately fitted and forced to its seat upon *B*. The

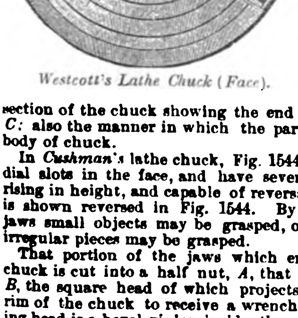
Fig. 1541.



Universal Chuck. (Section and Details.)

screw and plate *D* secure *B* in place. The worm shaft *S* is of cast steel. The toothed rings *C C C*, and jaws *E E E*, are of hammered iron, and case-hardened.

Fig. 1542.



Westcott's Lathe Chuck (Face).

Westcott's combination lathe chuck is shown in Figs. 1542, 1543.

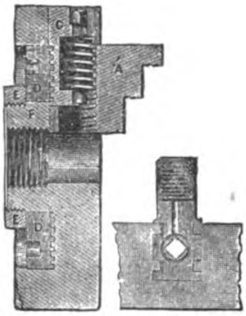
The jaws are reversible, can be made to act independently, or concentrically and simultaneously. May hold round, oval, or irregular shapes. Fig. 1542 is a face view of the chuck with one jaw reversed.

Fig. 1543 is a vertical section, showing the manner in which the ring *D* engages in box *C*; also showing the position of the screw *B*. The figure also gives a section of the chuck showing the end of the screw and box *C*: also the manner in which the parts are secured to the body of chuck.

In *Cushman's* lathe chuck, Fig. 1544, the jaws slide in radial slots in the face, and have several shoulders or steps, rising in height, and capable of reversal. One of the jaws is shown reversed in Fig. 1544. By a reversal of all the jaws small objects may be grasped, or by partial reversion irregular pieces may be grasped.

That portion of the jaws which enters the body of the chuck is cut into a half nut, *A*, that engages with a screw *B*, the square head of which projects through the face or rim of the chuck to receive a wrench. Below this projecting head is a bevel pinion inside the rim that engages with circular rack or toothed ring *C C*. Turning any one of these screws will actuate the rack and every other screw, and so far it is simply a concentric-jawed chuck. But the chuck is capable of transformation into one of eccentrically-placed jaws. The toothed ring rests upon a plain ring, *D*, *D*, the periphery of which is a screw-thread that engages with a similar thread on the inside of the shell, so that by turning the ring in one direction it is moved forward toward the face of the chuck, and by turning it the other way it is carried towards the back of the chuck. By this means the circular rack may be meshed in gear with the pinions in the screws, or disengaged from them. Should it be required to move one or more of the jaws farther from the center than the others, the spring catch is released by thumb-pressure, the supporting ring is turned out by a knob at the back of the chuck, and the circular rack unmeshed. In this condition it has the characteristics of an independent jaw-chuck. Then the jaws, one or more, may be moved singly into the position required, when the circular rack and the screw pinions may be again meshed, forming a chuck with eccentrically-placed but simultaneously moving jaws.

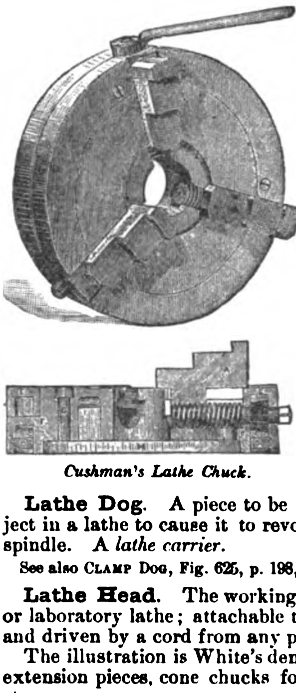
Fig. 1543.



Westcott's Lathe Chuck (Section).

See also DRILL CHUCK, pp. 275, 276, *supra*: and Fig. 2838, p. 1263; Figs. 1287, 1288, pp. 548, 549, "*Mech. Dict.*"

Fig. 1544.



Cushman's Lathe Chuck.

Fig. 1545.

Lathe Dog.

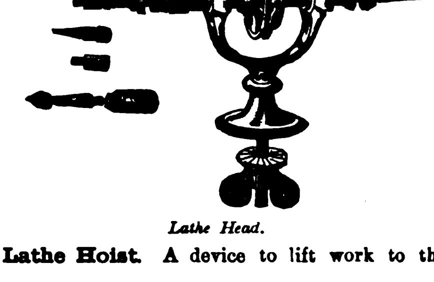
Lathe Dog. A piece to be attached to an object in a lathe to cause it to revolve with the lathe spindle. A *lathe carrier*.

See also CLAMP DOG, Fig. 625, p. 198, *supra*.

Lathe Head. The working part of a jeweler's or laboratory lathe; attachable to a lathe or stand, and driven by a cord from any pedal motor.

The illustration is White's dental lathe with burs, extension pieces, cone chucks for polishing cones, etc.

Fig. 1546.



Lathe Head.

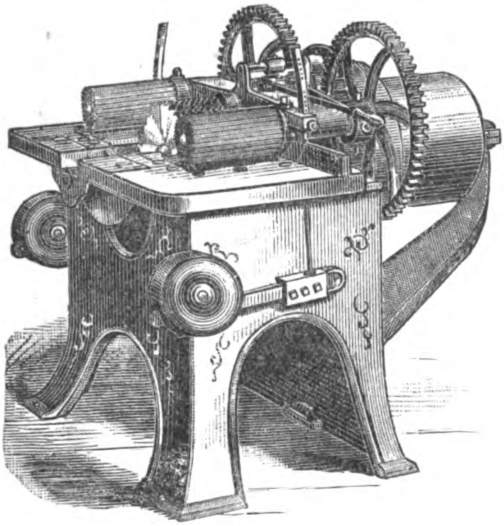
Lathe Hoist. A device to lift work to the height of the lathe centers in order to be placed in the lathe.

See Axle-lathe Hoist, *Thomas*, * "*Railroad Gazette*," viii., p. 289.

Lath Mill. A gang-saw, for sawing lath from the bolt.

The gang of saws in *Smith's* lath mill occupies a space 10″ in width, so that in cutting ⅛″ lath 16 saws may be employed. Plank of any width may be passed. The feed

Fig. 1547.



Smith's Lath Mill.

works consist of four rollers which may be started or stopped at will; the two upper rollers are weighted and driven by power. The rates of feed are 35′ to 45′ per minute. To prevent the lumber from springing and binding the saws a steel comb is attached to the bed, with teeth projecting upward, directly in the rear of the saws.

In the *Leonard & Silliman* machine the annular saws are separated by rings on a cylinder keyed on to the main shaft. The interior of the cylinder has spiral wings, which make a draft, and draw away the dust.

Lathing machine, *Trimble* * "*Scientific Amer.*," xxxiv. 131.

Lat'i-mer-Clark Bat'te-ry. (*Electricity.*) A battery designed as a standard, having a perfectly constant electro-motive force.

It consists of a combination of zinc in sulphate of zinc, and mercury in sulphate of mercury.

This battery has an electro-motive force of 1.4578 volts in absolute measurement.

"*Phil. Trans. Royal Society*," June 19, 1875.

Niaudet, Am. transl., 148.

Lat'rine. A water-closet for public use; the hoppers are flushed periodically.

Jennings . . . . * "*Manufacturer & Builder*," viii. 154

Lat'tice. A form of screen made of intersecting overlaid slats.

A form of girder having series of flat bars laid crosswise and riveted at the intersections, or at the junction with the upper and lower members, or both. See Iron Bridge, p. 120, "*Mech. Dict.*"

Launch. Formerly: the largest of the suit of boats attached to a man-of-war.

Now: a large boat with steam power.

The Thorneycroft (Br.) launches have acquired most distinction.

One of these attained at Cherbourg a speed of 19 knots per hour; and 18 knots for two consecutive hours, developing 220 horse-power. The dimensions were —

Length, 63.04′.
Beam, 8.53′.
Draft, 2′ (average).
Displacement, 15 tons.
Weight of hull, 9,900 pounds.
Weight of engine boilers and water, 16,060 pounds.
Power at speed of 18¾ knots, 220 horse.
Weight of machinery, 72.6 pounds per horse power.

The engines are condensing, two cylinder, on the compound system. The boilers are of the locomotive type, with the difference that the tubular surface is reduced about one half. This is the only sacrifice which has been made for the economic production of power; and it was necessary in order to reduce the weight of the apparatus. The safety valves are loaded to 132 lbs. The engine makes 430 revolutions per minute, which requires great mechanical excellence of the mechanism, and especially of the air-pump. The consumption of coal per horse power per hour is 3.52 lbs. The grate surface is 11.19 square feet. An artificial blast is conducted directly to the fire chamber instead of to the ash-pit.

The screw shaft is placed on a level with the keel, instead of being at a point half way between the keel and the waterline, as is usually the case. The screw then projects below the keel for nearly half its diameter, and consequently it acts upon a section of vein greater in area than the greatest section of the vessel. This arrangement doubtless contributes materially to the speed; while a sharp bend of the keel protects the propeller from damage.

Launch, steam . . .	* "*Scientific American Sup.*," 2715.
For Africa, Br. . . .	* "*Engineering*," xxix. 475.
Sectional for Africa . .	* "*Scientific American Sup.*," 3802.
"Barrancas,"	* "*Scientific Amer.*," xxxviii. 371.
"Cinderella,"	* "*Scientific American Sup.*," 1423.
Herreshoff	"*Scientific American Sup.*," 4121.
Lewin	* "*Scientific American Sup.*," 1567.
Maxim	* "*Sc. Amer. Sup.*," 1279, * 2516.
Passenger, Neva . . .	* "*Engineer*," xlii. 272.
N. Y. Safety Steam Power Co.	* "*Manufact. & Builder*," viii. 152.
Russian, *Crichton* . .	* "*Scientific American Sup.*," 1186.

2. A slip. See Marine Slip, "*Mech. Dict.*"

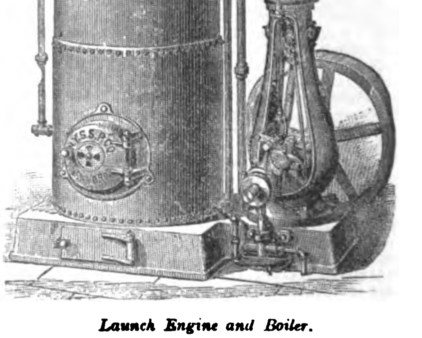
Launching slip, iron-clad Kaiser, Br. . .	* "*Engineer*," xliv. 170.
Launching iron-clads .	* "*Scientific American Sup.*," 1539.

Launch En'gine. A relatively small engine, for use in launches, large boats acting as tenders, police boats in harbors, etc. A small class of surveying and pleasure steamers are also called launches.

The engine and boiler of the *New York Safety Steam Power Co.* are shown in Fig. 1548, and a section of the boiler in Fig. 1549.

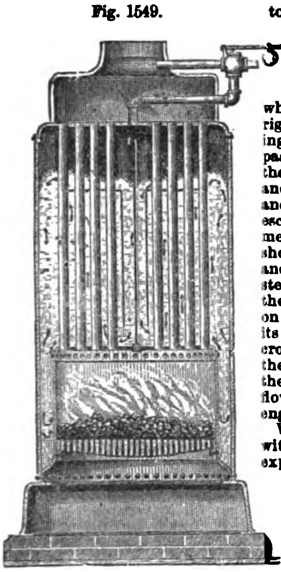
The engine is upright, having the cylinder mounted on

Fig. 1548.



Launch Engine and Boiler.

Fig. 1549.



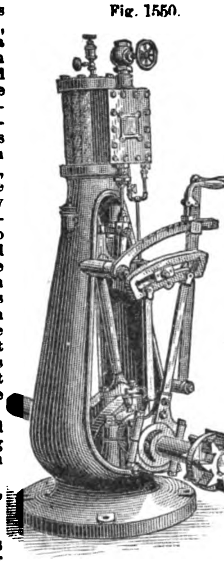
Launch Engine Boiler.

top of the bottle-shaped frame, which has two large openings at each side for access to the working parts. The fly-wheel, being at the base, secures steadiness. The engine has a plain slide-valve, and the slides are concave and cast with the frame. In Fig. 1548 the engine is shown combined with the boiler, both being placed on a cast-iron base which forms the ash-pit, and also contains the heater. An upright tubular boiler, Fig. 1549, is used, and, to prevent priming, a baffle-plate is introduced, through which all the tubes pass at or about the water-level. A large tube hangs from the center of this plate nearly to the crown of the furnace, and an annular space is left around the outside of the baffle and between it and the outer shell, sufficient for the easy escape of the steam and water. The effect of this arrangement is to stop the current of steam and water tending to shoot up between the tubes, and compel it to flow outward and escape between the baffle and shell, at which point the steam and water separate, most of the water flowing down the side of the shell, while the remainder of the water falls on the top of the baffle-plate and flows through the tube in its center, thus keeping up a current over the center of the crown sheet and among the tubes. It will be observed that the steam is taken off from the center of the boiler; and as the steam is delivered at the outer edge of the baffle it must flow inward between and around the tubes on its way to the engine and become dried and slightly superheated.

When designed for a steam launch the engine is provided with a link-motion for reversing, and notches for working expansively. The feed-pump is driven by an eccentric on the shaft.

Fig. 1550 shows the engine as detached from the boiler, and having the provisions just cited.

Fig. 1550.

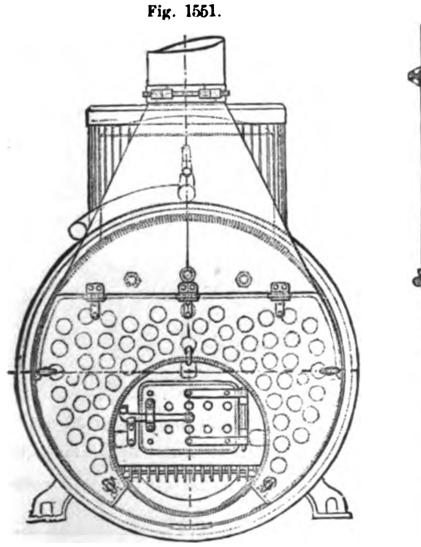


Launch Engine.

Figs. 1551 to 1555 show the launch engines of a United States cutter, having a length of 33′; beam, 8′ 7″; and depth, 3′ 9½″.

The boiler is of the ordinary multi-tubular type, and consists of a shell 3′ 4½″ in diameter outside, with a furnace 20½″ in external diameter, all the plates of the shell and furnace (including the tube-plates) being ¼″ thick. The boiler is provided with 60 return tubes 3′ 1½″ long over tube-plates, 58 of these tubes being 2″ in diameter outside and

Fig. 1551.



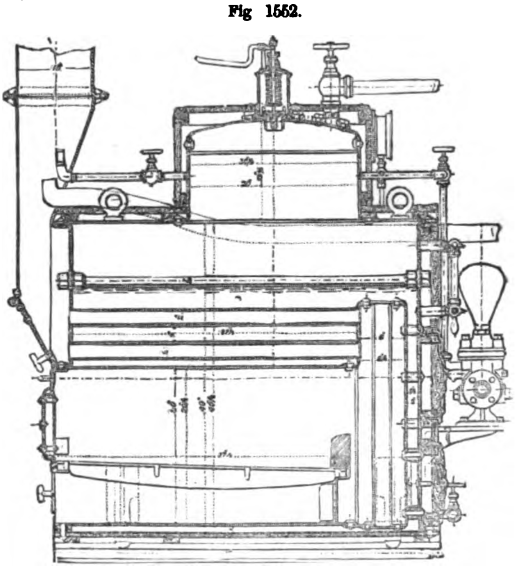
United States Launch Engine. (Cross Section of Boiler.)

the other two 1½″ in diameter. The fire-grate area is 4.5′ square, and the total heating surface 125′ square. A dome 20″ in diameter, and 13¾″ high, is fixed at the top of the boiler, and the latter is fed by a donkey pump bolted to it at the back end. The details of the boiler and its fittings will be readily understood from the figures, and the weight of the boiler complete, as shown, is 2,350 lbs. The general arrangement of the fittings is neat.

The cylinder is 8″, stroke 10″, and the engine weighs 725 lbs., the weight being rather heavy, owing to the somewhat singular arrangement adopted to obtain a long connecting-rod, and still keep the cylinder down tolerably close to the crank-shaft. The engine has a connecting-rod 26″ — or 2.6 times the stroke — in length, and its height from center of crank-shaft to top of upper cylinder cover is 38″ or 3.8 times the stroke.

As will be seen from Fig. 1555, the piston-rod, instead of being coupled direct to the connecting-rod, is screwed into a

Fig 1552.



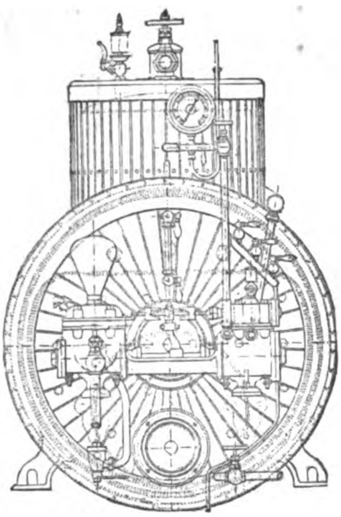
Launch Engine. (Longitudinal Section of Boiler.)

cross-head from which a pair of side rods extend upward terminating in blocks working in guides formed at the sides of the cylinder. The connecting-rod is made with a wide fork, and takes hold of pins forged in one piece with the side rods and blocks just mentioned.

The link motion is used only for reversing and not for expansive working, the link being made with a straight slot, and provision being only made for fixing the block in extreme position by the arrangement shown. The valve is driven through the intervention of a rocking shaft and levers.

Cf. . . . . * "*Scientific Amer.*," xxxviii. 371.
Hayes, Br. . . . . * "*Engineer*," xlvi. 155.

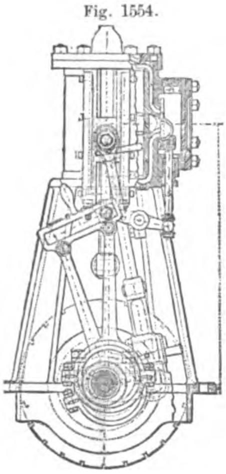
Fig. 1553.



Launch Engine. (*Elevation.*)

Herreshoff	* "*Engineering*," xxviii. 264.
Kingdon, Br.	* "*Engineering*," xxix. 495.
Lewin, Br.	* "*Engineer*," xliv. 267.
	* "*Sc. Am. Sup.*," 1567.
Messenger & Churchward	* "*Sc. Am. Sup.*," 1838.
N. Y. Safety Steam Power Co.	* "*Man. & B.*," viii. 152.
Outridge, Br.	* "*Engineer*," xlix. 439.
Steam, U. S.	* "*Engineering*," xxi. 436.
Wigzell & Halsey, Br.	* "*Engineering*," xxiii. 16.

Fig. 1554.



Launch Engine. (*Link Motion.*)

Fig. 1555.

Launch Engine. (*Section of Engine.*)

Laun'dry Ap'pa-ra'tus. Plate XXV. shows the interior of a French steam laundry with the apparatus in position and their names indicated beneath. It comprises the fittings made by Pierron & Dehaître, of Paris.

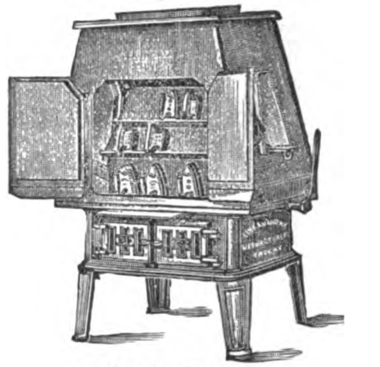
Laun'dry Boil'er. A water heater for laundry purposes. See figure in Plate XXV.; also KETTLE, *supra.*

Lav'a-to-ry. A wash-room.

Jennings . . * "*Manufacturer & Builder*," viii. 259.

Laun'dry Stove. One for heating water and smoothing irons for laundry purposes.

Fig. 1556.



Troy Laundry Stove.

The Troy laundry heater, shown in Fig. 1556, heats at one time 40 sad-irons or 80 polishing irons.

Another form has less capacity for irons, but has a large belt around it in which water is heated and whence it is conducted by pipes to the tubs.

See also IRONING STOVE, Fig. 1467, p. 506, *supra.*

Lawn Hose Cart. A small vehicle for garden and yard hose.

See HOSE REEL, Fig. 2585, p. 1132, "*Mech. Dict.*"

Lawn Mow'er. A machine for cutting sward.

Hill's archimedean lawn mower is mounted on a roller, the shaft of which has a spur pinion engaging a wheel which transmits a multiplied motion to the spiral knives which cut against a straight edge, and shear off the grass in the manner of scissors. Wheels in front gage the closeness of cut.

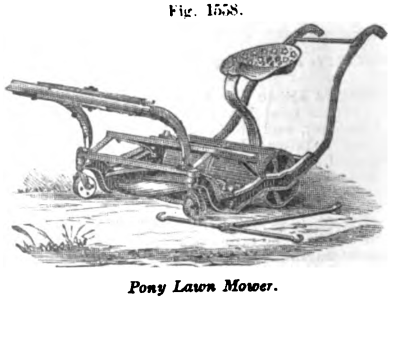
Fig. 1559 is the "Charter Oak" lawn mower, having two supporting wheels; multiplying gearing gives the rapid motion to the spiral knives. A larger size is made to run by pony. Some American and British forms have capacious boxes to catch the mown grass.

Fig. 1557.

Hill's Archimedean Mower.

Ohmer's machine has crank and reciprocating sickle.

Fig. 1558.



Pony Lawn Mower.

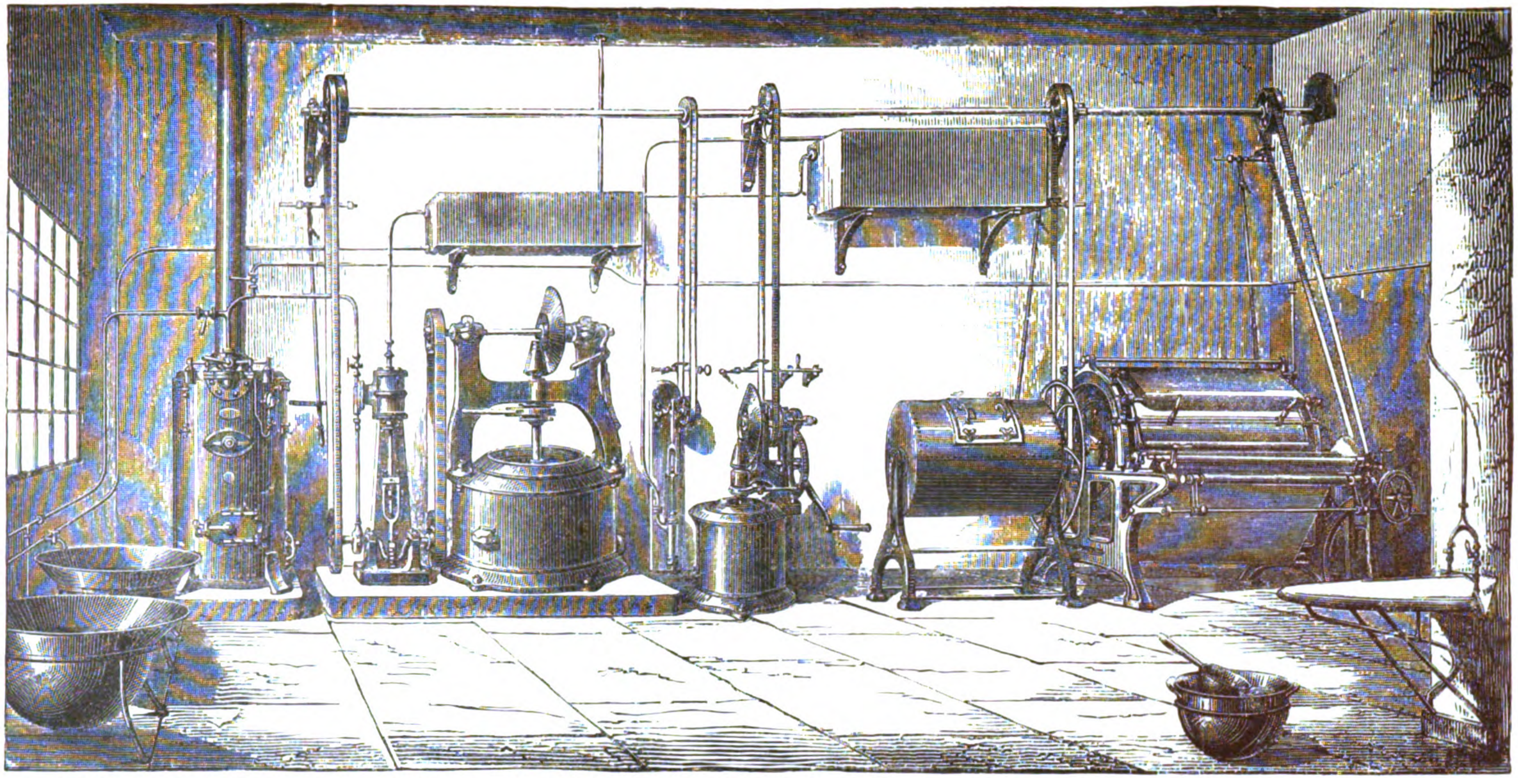


PLATE XXV.

INTERIOR OF A FRENCH LAUNDRY.
[Pierron et Dehaître, Paris.]

See page 532.

Fig. 1558 shows one of the larger sizes adapted to be drawn by a pony. It has a shaft and seat, also a pair of handles to be used when a seat is not desired. The cut is 30″.

"Ajax," . . . . . . * "*Iron Age*," xxi., May 23, p. 7.
"Buckeye," . . . . * "*Iron Age*," xxi., April 25, p. 9.
Hanley . . . . . . * "*Scientific American*," xlii. 147.
"Pennsylvania," . . * "*Iron Age*," xxi., March 28, p. 1.
* "*Scientific American*," xl. 211.
"Phila." . . . . . "*Scientific Amer.*," xxxviii. 249.

Fig. 1559.

"*Charter Oak*" *Lawn Mower.*

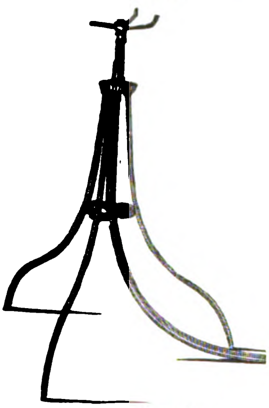
Lawn Sprinkler. A garden and lawn irrigator. Fig. 1560.

The water being projected at an angle all around the swivel collar, falls like rain, sprinkling the ground evenly from the center outward, its capacity being across a diameter of from 30′ to 45′, varying according to the head of water.

Peck * "*Iron Age*," xvii., June 8, p. 5.
Revolving * "*Min. & Sc. Pr.*," xxxvii. 153.

Lay'ers. (*Leather.*) Or *Layaways.* Vats or pits in which the sides are laid away or stratified with ground oak-bark after coming out of the *stringers*. The sides are laid flesh down, to prevent the hook scratching the grain in taking out. The *layers* contain the strongest infusion of oak-bark.

Fig. 1560.



Lawn Sprinkler.

La'zy Cock. See Jet Valve.

La'zy Paint'er (*Boat.*) A small temporary boat rope, for fine weather.

Leach'ing Vat. A tub or tank in which lixiviation of soluble substances is performed.

See Augustin leaching plant, by Vinton, in "*Eng. & Min. Jour.*," * xxv. 342.

Lead Al-loy'. This cheap and ductile metal enters into the composition of many alloys which are known by various specific names, and which themselves vary greatly in the proportions of their ingredients, and even in the number of elements thus associated. Among these alloys may be named —

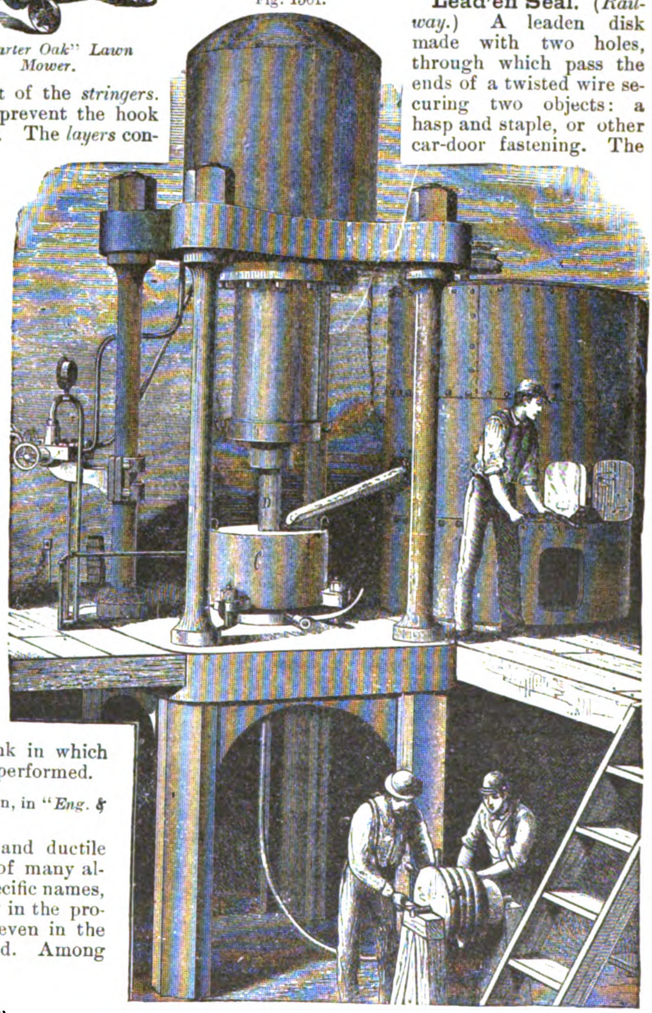
Albata	Biddery.
Fusible alloys.	German silver.
Journal-box metal.	Sheathing metal.
Organ-pipe metal.	Shot.
Pewter.	Solder.
Pot metal.	Stereotype metal.
Sabot metal.	Type metal.

TABLE OF LEAD ALLOYS.

	Lead.	Antimony.	Tin.	Arsenic.	Bismuth.
Sheathing lead	94	6	–	–	–
Journal box metal	24	4	–	–	–
Soft bearing metal	20	4	–	–	–
Organ pipe metal	5	–	5	–	–
Shot	100	–	–	2	–
Expanding alloy	18	4	–	–	1
Type metal from	6	2	–	–	–
to	14	2	–	–	–
Stereotype metal	40	8	2	–	–
Coarse solder	6	–	2	–	–
Fine solder	2	–	4	–	–
Soft solder	4	–	2	–	–
Bismuth solder	5	–	3	–	7

Lead'en Seal. (*Railway.*) A leaden disk made with two holes, through which pass the ends of a twisted wire securing two objects: a hasp and staple, or other car-door fastening. The

Fig. 1561.



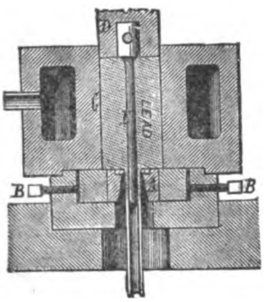
Lead Pipe Making.

lead is then pressed down by a stamp and the fastening cannot be detached without cutting the wire or defacing the seal.

Lead'er. (*Fishing.*) A net so placed as to intercept fish and lead them into a pound, weir, trapnet, etc. See POUND. It is a net fence that guides the fishes which attempt to get round it into the heart. It is usually made in pieces 10 rods in length. See HEART SEINE, *supra*.

Lead Pipe. The lead pipe press is shown in perspective in Fig. 1561, on page 533. Lead pipe is made by forcing the congealed lead through a die, in the axis of which is a mandrel, as shown in Fig. 1562. The hydraulic press is used.

Fig. 1562.



Lead Pipe Die.

The die *A* is a metallic disk which fixes the outside diameter of the pipe, and is adjustable by set screws *B B* to bring it in line. The lead receptacle *C* is heated by steam. *D* is the press plunger and from it depends the core or mandrel *E*, which occupies an exactly axial position in the die and determines the bore of the pipe. The plunger being raised, a charge of metal is run into the chamber; the plunger is then depressed and forces the metal out in the annular space between the core and the die. The pipe is reeled up as made.

Tin-lined pipe is made by a modified process. Before the lead is run into the chamber, a mandrel is inserted, which closes the die aperture and extends up through the receptacle. This mandrel consists of a central stem, around which are grouped dovetailed sections, so that when the central portion is removed the sections are easily taken out, leaving a hollow space in the lead, which is run in while the mandrel is in place. The sides of the mandrel are tapered, or rather crenelated, there being three or four shoulders and a different taper from each. The object of this is that after the mandrel is removed, the tin which is poured into its place may have several purchases against the lead which surrounds it. Before the tin is let in the core is inserted. Afterwards the pressure is applied in the usual manner, the result being that the pipe emerges with a thin lining of tin.

Protecting from corrosion by water: —

Treat for 15 minutes with a 2 to 5 per cent. solution of sulphuret of potassium or sodium at 212° Fah. *Dr. Schwartz*, Breslau, No. 1,519, British Patent Reports, 1863.

A boiling solution of sulphur in caustic answers the same purpose.

Or, "by causing a warm concentrated solution of sulphide of potassium to flow through the pipe for 20 minutes." "*Revue Industrielle.*"

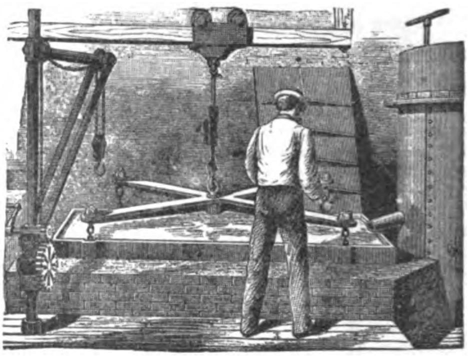
Lead Pro'cess. See the following: —

Altenace	Painter's "*Rept. Vienna Exp.*," iv. 106.
Blast-furnace, *Clerc*	* "*Eng. & Min. Jour.*," xxii. 248.
Bleyberg	*Painter's* "*Rept. Vienna Exp.*," iv. 1.
Bohemian	*Painter's* "*Rept. Vienna Exp.*," iv. 159.
Carinthian . . .	*Painter's* "*Rept. Vienna Exp.*," iv. 169.
Clausthal	*Painter's* "*Rept. Vienna Exp.*," iv. 101.
Clausthal	* "*Engineering*," xxv. 19, 57.
Clausthal furnace .	* "*Engineering*," xxiv., 259, 319, 383, 428.
Crosby, lead bath .	Fig. 2855, p. 1270, "*Mech. Dict.*"
Desilverizing process.	
Rozan, Fr. . . .	*Blake's* "*Rept. Vienna Exp.*," iv. 10.
Desilvering . . .	p. 689, "*Mech. Dict.*"
Fuller, lead bath .	Fig. 2853, p. 1269, "*Mech. Dict.*"
Hasenclaver-Helbig	* "*Report Vienna Exp.*," iv. 147.
Harz, smelting pro.	*Painter's* "*Rept. Vienna Exp.*," iv. 99.
Holloway, ore proc.	"*Iron Age*," xxiv., July 31, p. 15.
Holzappel	*Painter's* "*Rept. Vienna Exp.*," iv. 151.
Lautenthal . . .	*Painter's* "*Rept. Vienna Exp.*," iv. 118.
Lead Bath	* p. 1269, "*Mech. Dict.*"
Nassau	*Painter's* "*Rept. Vienna Exp.*," iv. 154.
Pattinson's pots .	Fig. 3574, p. 1639, "*Mech. Dict.*"
Pibram	*Painter's* "*Rept. Vienna Exp.*," iv. 163.
Pipes, action of water	"*Scientific American*," xxxv. 179.
Pipe press	* "*Manuf. and Builder*," ix. 173.
Rhenish	*Painter's* "*Rept. Vienna Exp.*," iv. 143.
Rose, lead bath . .	Fig. 2854, p. 1269, "*Mech. Dict.*"
Schemnitz . . .	*Painter's* "*Rept. Vienna Exp.*," iv. 179.
Silver-lead furnace	Fig. 5094, p. 2183, "*Mech. Dict.*"
Stolberg, furnace .	*Painter's* "*Rept. Vienna Exp.*," iv. 59, 149.
Styrian	*Painter's* "*Rept. Vienna Exp.*," iv. 172.
Tyrolese	*Painter's* "*Rept. Vienna Exp.*," iv. 165.

Lead Sheet. Sheet lead is made by running a flat ingot of lead repeatedly through a rolling mill until the required thickness of the sheet is reached.

The lead is run into a flat cake weighing about 4 tons, and having a size 7′ 10″ × 5′. After cooling in the mold, which takes some days, it is lifted out by the crane and carried by the overhead tackle to the mill, where, after the edges have been adzed true, it is passed and repassed between the rolls some 150 times, till it becomes 30′ × 7′ 10″, the original longer dimension being maintained, while the narrower dimension of 5′ has become 30′, more or less, according to the original thickness and the degree of tenuity or thinness of the rolled sheet, say a weight of 30 pounds to the square foot. The sheet is then cut up by vertical knives actuated by a screw, in a frame which is adjusted so as to cut across

Fig. 1563.

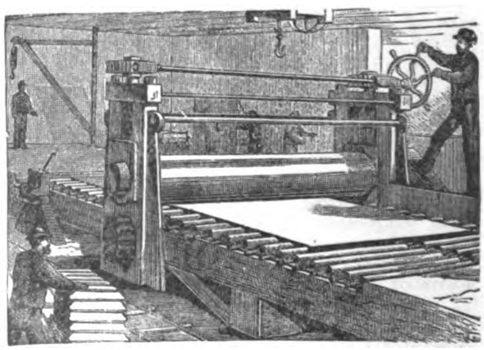


Melting the Lead.

the bed of the mill, and between two of the supporting rollers shown in Fig. 1564. The sections of lead are again rolled into 18′ lengths, varying in weight from 2½ to 10 pounds per square foot, according to the purpose for which they are required.

The mill has a cylinder 30″ diameter and 9′ long, and the bed is a double series of parallel rollers upon which the lead traverses. The vertical adjustment of the ends of the roll are performed simultaneously by hand-wheel at one end, com-

Fig. 1564.



Sheet-lead Mill.

mencing by gearing with the boxing of the roller at the respective ends of the latter.

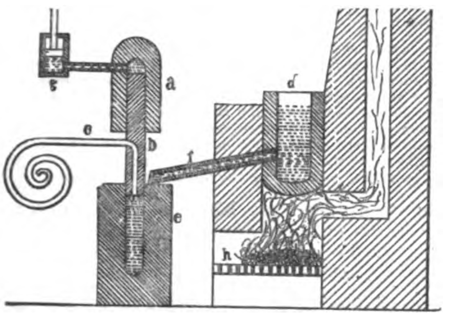
Chinese sheet-lead for lining tea-chests is made by pressing between tiles faced with several thicknesses of unsized paper. These plies act as a non-conductor.

Lead foil with tin surfaces is made by rolling an ingot of lead with layers of tin run upon each side, so as to sandwich the lead between the two. The compound ingot is rolled and re-rolled until the required thinness is attained.

Lead Soap. An insoluble oleate of oxide of lead; spread on cloth to form *diachylon* plaster.

Lead Wire. The apparatus for making lead wire is a copy in miniature of the lead-pipe apparatus.

Fig 1565.



Lead Wire Apparatus.

a. Hydraulic press.
b. Piston perforated with a hole for emission of the lead wire *c*.
f. Pipe for conducting melted lead from furnace *d* to compressor *e*.
g. Force-pump that supplies water to the hydraulic press.
h. Grate bars.

The lead is heated in a pan, conducted to the cylinder of the hydraulic press, forced thence in a wire having the size of the aperture through the plunger, and coiled on a shaft.

Leaf Sight. A form of sight having a hinged plate, known as a *leaf*, and erected for use, but lying flatly on the barrel for safety at other times.

The leaf is graduated for distance, say for from 100 to 1000 yards, and the slider with the sight notch is raised so that the upper surface coincides with the required graduation. See also HAUSSE, Figs. 1329-1331, p. 447, *supra*.

Fig. 1566.

Sporting Leaf Sight.

Leak'age Valve. A small valve used between the triple valve and the brake-cylinder in the Westinghouse car-brake arrangement, to prevent the leakage from the pipes from operating the triple-valve, and thus applying the brakes. See TRIPLE VALVE.

Leak Stop'per. An apparatus for the forcible application of a tampon against the side of a leaky shaft.

See * "*Engineer*," xlv. 373. A segment is forced against the breach by means of a hydraulic jack, then keyed up and wedged.

Leath'er. Tanned or tawed skin.

The principle of tanning: "Take the skin of an animal, remove from it the hair, fat, loose flesh, and other impurities, and immerse it in a dilute solution of tannic acid; the cellular and elastic tissues will gradually combine with that substance, as it penetrates toward the interior, and will form a compound perfectly insoluble, and which will completely resist putrefaction; this compound is leather." — *Lieut. Lyle*.

The treatment of hides and skins to make the various kinds of leather, including the work of the tan-yard and currying shop, is succinctly told in *Lieut. Lyle's* appendix K to "*Ordnance Report*," 1878, pp. 61-89, under the following heads: —

Sole leather.	Grain leather.
Harness leather.	Wax leather.
Bridle leather.	Polish leather.
Collar leather.	Oil-pebble leather.
Buff leather.	Trunk leather.
Splits.	Lace leather.
Mixed leather.	Bellows leather.
Skirting leather.	Belting.
Latigo.	Calfskins.

Leath'er, Tan'ning, etc. See under the following heads: —

Abating.	Leather whitening machine.
Alligator leather.	Liming.
Astringents.	Mill.
Beam.	Pebbling.
Blacking.	Pebbling machine.
Bloom.	Polar oil.
Bruising.	Polishing jack.
Boarding.	Rolling mill.
Buffing.	Rosin oil.
Chamoied.	Rub stone.
Chrome leather.	Scouring.
Clamp.	Scouring table.
Clearing stone.	Screw soling machine.
Closing machine.	Screw press.
Dampening.	Screw wiring machine.
Daubing.	Set.
Dubbing.	Shaving.
Enameled leather.	Shoe embossing machine.
Flattening.	Shoe sewing machine.
Flaying knife.	Sizing.
Flesh side.	Skin-beating machine.
Fly.	Skiver.
Glassing.	Skiving.
Glassing jack.	Skiving machine.
Glove cutter.	Slicker.
Glove sewing machine.	Slicking.
Graining.	Soft boarding.
Graining board.	Sole.
Grain side.	Sole molding machine.
Handlers.	Sole riveting machine.
Handling.	Sole rolling machine.
Impression-stitch machine.	Sole screwing machine.
Jack.	Splitting.
Junk vat.	Staining.
Layers.	Stock stone.
Leather.	Stoning.
Leather dressing.	Stoning jack.
Leather finishing machine.	Stringers.
Leather furniture.	Stripper.
Leather glazing machine.	Stuffing.
Leather grease.	Tanner's knife.
Leather punch.	Tanning.
Leather raising and creasing machine.	Tawed-leather dresser.
Leather rolling machine.	Unhairing machine.
Leather scourer.	Vat.
Leather splitting machine.	Wax-thread sewing machine.
Leather stretching machine.	Welt machine.
Leather waterproofing.	Whip making.
	Whitening.

Elaborate tests of leather by *Theron Skeel*, pp. 13-34, Report on Leather, Group XII., in vol. v., "*Centennial Reports*."

Cf. Artificial leather		"*Scientific American Sup.*," 849.
Birch-oil for Rus. leath.		"*Scientific American Sup.*," 845.
Dressing machine.		
Rosensteel	*	"*Scientific American*," xxxiv. 134.
Enameling machine	*	"*Scientific American*," xxxiv. 259.
Human skin leather		"*Scientific American*," xxxvi. 7.
Manufactory.	*	"*Scientific American*," xli. 407.
Morocco		"*Scientific American*," xl. 386
Preparing kid skins		"*Man. & Builder*," viii. 191
Scourer, *Lockwood*	*	"*Scientific American*," xxv 210
Stamping mach., *Urner*.	*	"*Scientific American*," xxxvi 355.

See LEATHER, IMITATION, and lists, pp. 1275-1276, "*Mech. Dict.*"

Leath'er, Ar'ti-fi'cial. A material made to resemble leather; it sometimes consists of leather waste and scraps agglutinated; or of paper or cloth treated with paints, resins, etc.

See LEATHER, IMITATION, and references *passim*.

Leath'er Board. Leather scraps and manilla of old rope, ground into a pulp, made up in the manner in straw board, and calendered. An article in very great use, not alone in the soles of cheap shoes, but for making drums, chair-seats, toys, etc.

Leath'er Ce-ment'.

Molesworth.	Gutta percha	16
	India-rubber	4
	Pitch	2
	Shellac	1
	Linseed oil	2

melted and mixed.

Water-proof Cement: Chase.

Ale	1 pint.
Russia isinglass	2 ozs.

Dissolve, and add common glue, 4 ozs.; then add slowly, linseed oil, 1¼ ozs., stirring well. Dilute in ale, put on hot with a brush, and weight the objects united.

To fasten Leather to Iron: Steep the leather in infusion of gall-nuts. Spread hot glue on the metal. Apply leather under forcible pressure, and allow it to dry without relieving pressure.

For joining pieces of leather: —

Bisulphide of carbon	10
Turpentine	1

Add gutta percha to thicken the composition. Free the leather from grease, and press the joint till the cement is dry.

Water-proof Cement. Moore: Gutta percha dissolved in bisulphide of carbon. Warm the parts, and maintain the pressure till dry.

Leath'er Cloth. An imitation leather. See Leather, Imitation.

Leath'er Dress'ing.

Castor oil.

An adhesive: printer's ink.

For belts:	Beef kidney tallow	1
	Castor oil	2

An adhesive, powdered chalk.

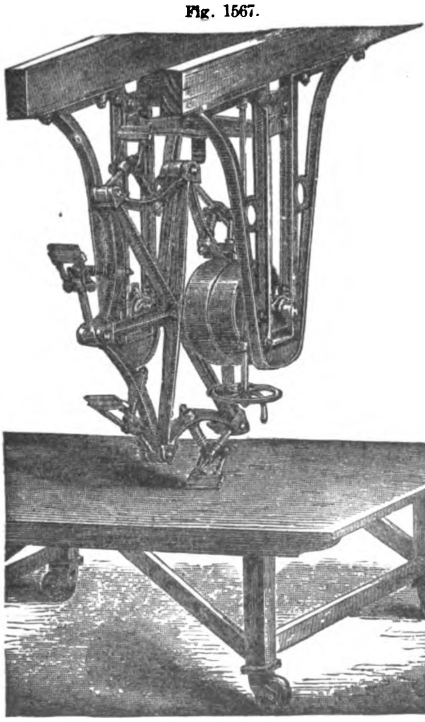
For belts:	Fish oil	4
	Lard or tallow	1
	Colophonium	1
	Wood tar	1
Or:	Tallow	2
	Bayberry tallow	1
	Beeswax	1

Heated to boiling, and laid on with a brush, and the beeswax driven into the belt by holding a hot iron plate against it.

See also Harness Grease, p. 439, *supra*.

Leath'er-ette'. An imitation of leather. A compound of fiber and some agglutinating materials, finished by passing between leather-covered rollers to give the surface imitation. See Leather, Imitation.

Fig. 1567.



French Leather Finishing Machine

Leath'er Fin'ish-ing Ma-chine'. A machine for giving the texture and surface finish to leather by means of a vibrating slicker or roller, according to the requirement.

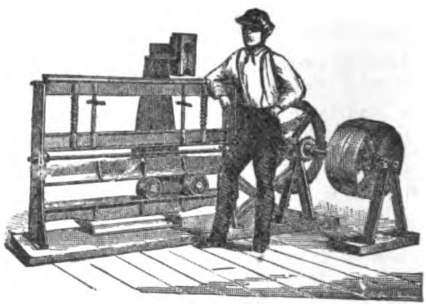
Graining, glossing, glassing, slicking, polishing, pebbling, dicing, are all terms within the definition of *finishing*.

The machine shown in Fig. 1567 has tools revolved by machinery, the pressure being due to a spring at the back of each tool-stock. The leather is upon a table on casters, so that a fresh surface of leather can be brought within the range of the tool by moving the table. The tool-head is a hexagonal frame, like a six-spoked wheel, and as it revolves each of the six slickers (for instance) in turn presses upon the surface of the leather. A hand-wheel adjusts the pressure by raising or lowering the boxing of the wheel.

Leath'er Gla'zing Ma-chine'. One for giving a surface gloss to leather. The glassing tool is reciprocated over the skin, compacting the surface, giving it a polish, and raising the grain.

The reciprocating tool, in imitation of the hand, is shown in Leather Finishing Machine, "*Mech. Dict.*," *et supra*. The *Baker* machine, shown at Fig. 1568, is a more compact form,

Fig. 1568.



Leather Glazing Machine.

and has all the strain within itself. It is shown without the table on each side on which the skin lies. The machine occupies a narrow space between two tables, and the skin passing across the interval rests on a bed, and its upper surface is subjected to the pressure of the *glass* which reciprocates above it, being effective on one stroke, and the pressure relieved on the return.

Leath'er Grease. See Leather Dressing; Harness Grease.

Leath'er, Im'i-ta'tion. See the following recipes: —

Paper treated with dilute sulphuric acid, so as to become toughened. Parchment paper.

Leather parings and caoutchouc worked by a machine into a homogeneous fibrous mass, gelatinized with ammonia water, and rolled into sheets, or pressed in molds. — *Sören Sörenson*, "*Deutsche Industrie Zeitung.*"

Leather fibers from leather offal, treated like paper stock; made into a pulp, mixed with flax fiber, and then treated as in paper manufacture. — *Rice, Kendall & Co.*

Sheets of carded wadding placed on polished heated metallic plates, and then saturated with a decoction of pearl-moss, fucus, or laminaria, and dried. The metal gives a polished surface to the material, which is then rolled between heated rollers, to give it compactness and the required thinness. It is then coated with boiled linseed oil and dried by artificial heat. When dry, coat with vegetable wax, and soften by passing between fluted rollers. It is then surfaced by rollers, which give it the appearance of morocco, pig-skin, or what not; or is varnished, bronzed, enameled.

Thicken decoction of fucus with cotton waste, and treat as paper pulp, or papier-maché.

Cocoa-nut fiber or waste of rope, hemp, or flax, treated with fucus, or any mucilage, and rolled into floor cloth.

Cork powder and caoutchouc. See Camptulicon, p. 435, "*Mech. Dict.*"

Cork powder incorporated with paper pulp. See Cork Board, p. 220, *supra*.

Caoutchouc or its analogue compounded with camphor and sulphur, and vulcanized. — *Gerner*. See Hevrenoid, p. 457, *supra*.

Heavy cotton cloth treated with dilute sulphuric acid, and then saturated with resinous compounds or paint.

Asbestos treated with gums, pigments, etc.

Leather ground into fiber, mixed with vegetable fiber, saturated with gummy solutions and paint. See BOULINIKON, p. 124, *supra*.

A number of compositions are given under LEATHER, ARTIFICIAL, pp. 1276, 1277, and LEATHER PAPER, p. 1278, "*Mech. Dict.*"; they consist of various materials compounded or associated: fiber, gums, resins, oils, gelatine, leather scraps, clay, gypsum, oxides, pigments.

Some compositions resemble leather in its more solid aspects as molded, but have not the pliability which is an ordinary characteristic of leather.

Such are *Bois-durci*, p. 320, "*Mech. Dict.*"
Bonesilate, p. 130, *supra*.

See also other titles under COMPOSITIONS, p. 212, *supra*.

"*Manuf. & Builder*," iv. 143; vi. 78, 192, 339; vii. 275.

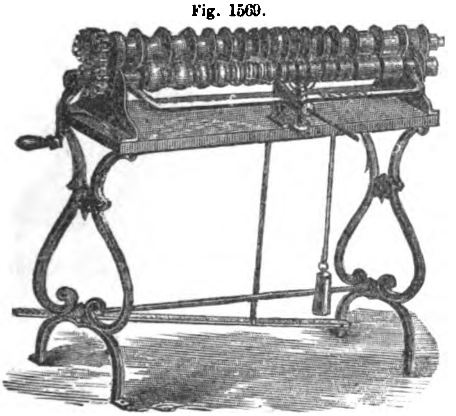
Millwood, "*Technologiste*," xli. 243.

"*Scientific American Supplement*," 185, 227, 692.

See also LEATHER BOARD; LEATHERETTE; LEATHER CLOTH; LEATHEROID; LEATHER WASTE.

Leath'er-oid. An artificial substance resembling leather in appearance, and serving as a substitute for it for some purposes. It is made in two varieties: one soft and flexible, the other like vulcanized rubber, and susceptible of a polish. See LEATHER, IMITATION.

Fig. 1569.



Raising and Creasing Machine.

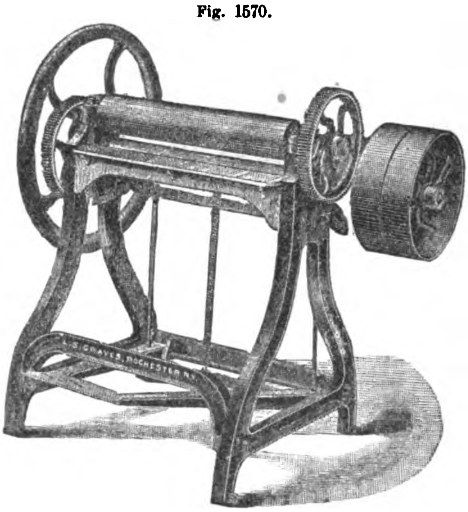
Leath'er Rais'ing and Creas'ing Ma-chine'. A machine for ornamenting straps, leather reins, saddle skirts, etc., by raising a ridge, giving a molded or wavy edge, or what not, according to the pattern of the rollers, between which the dampened leather is passed.

Fig. 1569 shows a machine with a numerous assortment of passes of varying widths and patterns, adapted to raising, creasing, stretching, polishing, and waving.

Leath'er Rol'ling Ma-chine'. A machine to compress and harden leather, as a substitute for the hammer and lap-stone.

The one shown in Fig. 1570 is a small-sized machine,

Fig. 1570.



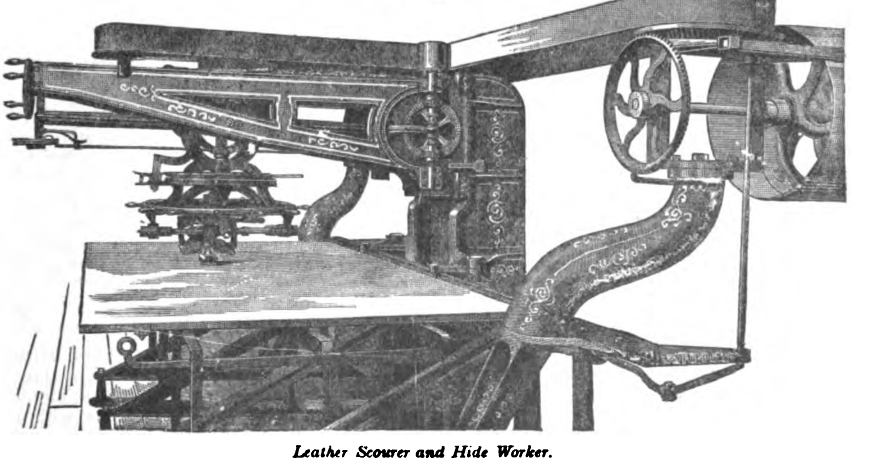
Leather Rolling Machine.

adapted to be run by hand or by power. The pressure, is given by the weight of the operator on the treadle, transferred by levers to the upper roll.

Leath'er Scour'ing Ma-chine'. A machine for working tanned and curried skins, bringing the pressure of a reciprocating tool upon the hide in successive strips as the skin is moved beneath it from time to time in a direction transverse to the motion of the tool.

The texture and elasticity, as well as the surface appearance of the leather depend upon this intermittent pressure, which glazes the surface and raises the grain, while also affecting the body of the leather. The machine simulates the

Fig. 1571.



Leather Scourer and Hide Worker.

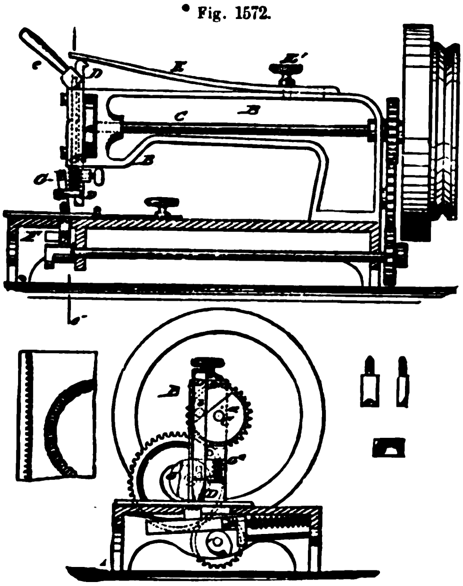
hand processes in reciprocating a comparatively narrow tool in direct lines over the surface, a strip at a time. Under LEATHER FINISHING, and LEATHER GLAZING, machines similarly actuated are shown. See also LEATHER MACHINERY, pp. 1277–1282, "*Mech. Dict.*"

Lockwood's machine, Fig. 1571, is capable of any required pressure, is universal in its movements, and so far automatic that the strength of the finger will guide its movements. It will scour, set out, or gloss; will take a slow or quick, a long or short stroke.

Leath'er Stamp'ing Ma-chine'. A machine for producing ornamental designs on leather for saddle flaps, carriage aprons, chair and sofa seats and backs, books, portfolios, etc.

Urner's machine is shown in Fig. 1572. The upper revolving shaft, *C*, works the stamp rod *D*, which moves in a guide in the arm *B*, and is acted upon by a band spring, *E*.

* Fig. 1572.



Leather Stamping Machine.

The spring may be adjusted by the clamp screw *E'*. The shaft *C* raises the stamp rod by means of a cam, *a*, which engages with a friction roller, *b*, on the rod; on being released from the cam, the rod is brought down forcibly by the spring. Either of the variously-shaped stamping bits may be clamped into the lower portion of the stamp rod *D*. The leather is fed by a vibrating feed mechanism, *F*, and retained by a presser wheel, *G*, which is attached to an arm on a presser rod, G^2, which is pushed down by a coiled spring, and raised or lowered by the lever *e*. A piece of leather, as marked by the machine, is shown at the side. The mechanism is operated by the belt wheel and gearing on the right.

Leath'er Waste. Utilized in the making of imitation leather by various processes. That of Sörenson, of Copenhagen, is as follows:—

The leather waste is first washed, after which it is reduced, by tearing, stamping, cutting, rasping, or rubbing, to a uniform and fibrous condition. When reduced to this finely divided condition, the leather is treated with ammonia water, by which it is converted into a gelatinized mass, which, when pressed into molds, or rolled out between rollers, and dried, makes a very hard and stiff product, having considerable cohesiveness, but without elasticity and soluble in water.

To make an elastic and water-proof fabric, the material is treated with caoutchouc dissolved in benzine, the mass kneaded, and then rolled or pressed into shape.

"*Bay. Industrie u. Gewerbe Blatt*" . . . viii. 140.

Leath'er Wa'ter-proof'ing.

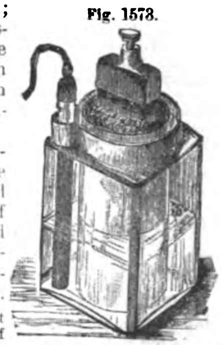
MacKenzie. Mixture of drying oil and oxides of lead, copper, or iron; or gummy resins in place of oxides.

Or: Caoutchouc shredded into and dissolved in warm copal varnish.

Or: Glue, 12 ozs., dissolved in water. Add Rosin, 8 ozs. Melt, and add Turpentine or benzine, 4 ozs.

Leath'er Whi'ten-ing Ma-chine'. (*Leather.*) A machine for doing the work otherwise performed by the knife at the beam; cleaning the hide by passing the knife with a fine edge lightly over the flesh side to bring it to a clean and fit condition for waxing.

Fig. 1573.



Leclanché Battery. (Porous Cup.)

Le'clanché Bat'te-ry. (*Electricity.*) One having its amalgamated zinc in a dilute solution of chloride of ammonium, and the carbon plate in a mixture of peroxide of manganese and coke. Fig. 1573.

In the Leclanché improvement the positive pole is composed of a plate of carbon inserted between, and in connection with two compressed prisms of peroxide of manganese and carbon (with a small cylinder of bisulphate of sodium in the center of the electrode), the three being held firmly together by rubber bands. The object of the acid salt is to prevent the formation of the oxychlorate of zinc.

Fig. 1574.

Leclanché Battery. (Prism.)

The negative pole is composed of a pencil of amalgamated zinc.

The two poles are set in a solution of sal-ammoniac and water contained in a glass jar, with a cover through which the carbon head and the zinc project.

As the zinc is indefinitely preserved without alteration in the sal ammoniac, and as the peroxide of manganese is insoluble in this liquid, no internal chemical action takes place when not in use.

Niaudet, American trans., N. Y., 1880	* 180, 181.
Prescott's "*Electricity*"	* 75.
Ganot	* 691.
"*English Mechanic*"	* xxiii. 157.
* "*Scientific American*,"	* xxxv. 115 : xxxix. 195.
"*Scientific American*"	* xlii. 198.
"*Scientific American Supplement*"	* 2728.
"*Technologiste*"	xxxvii. 140.
Improved, "*Telegraphic Journal*" .	* vi. 228.
"*Telegraphic Journal*"	iv. 218.
"*Scientific American Supplement*"	3033, 3238.
"*Iron Age*"	xviii., Sept. 21, p. 19.
Electro bronzing, "*Teleg. Jour.*" .	vii. 234.
Gaiffe's impt., "*Sc. Amer. Sup.*" .	* 129 ; 3187.
"*Telegraphic Journal*"	vi. 185.

In *Clark & Muirhead's* improvement the carbon electrode as well as the carbon fragments are platinized to reduce polarization.—*Niaudet*, American translation, 193.

"*English Mechanic*"	* xxiii. 191.
Howell's modification, "*Sc. American Sup.*" . .	3791.

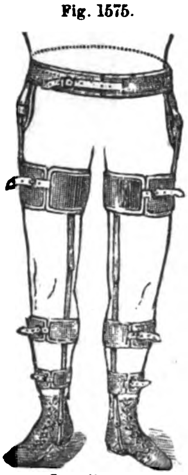
Leech, Ar'ti-fi'cial. A form of uterine leech and aspirator by Dr. Reese, for depleting the engorged neck of the uterus, is a graduated glass cylinder 7½" long and ½" diameter, with a piston, through which is conducted a metallic rod with a spear point. The point is retracted by a spring after puncturing, and the blood aspirated by withdrawing the piston. — *Tiemann.*

Leg, Ar′ti-fi′cial. See Figs. 2894–2898, pp. 1284, 1285, "*Mech. Dict.*"

Dr. J. H. Thompson's report on Group XXIV., "*Centennial Exhibition Reports*," vol. vii., gives account of the following: —

Verduin (Paris, 1696) . . * p. 31.
Martin, French . . . * p. 33.
Charrière, French . . . * p. 33.
Béchard, French . . . * p. 33.
Mathieu, French . . . * p. 33.
Palmer, U. S. . . . . * p. 37.
Palmer, U. S. (1873) . . * p. 41.
And mention of numerous others exhibited.

Fig. 1575.



Leg Support.

Leg Boot. (*Manége.*) A horse-boot which extends from the hoof to the knee: it is made of soft leather, closely fitted to the leg; its principal use is to protect the horse's leg from injury by ice or mud.

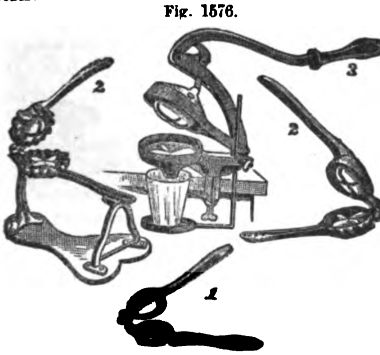
Leg Sup-port′. An apparatus to modify the effects of, or cure bow-legs, knock-knees, weak ankles, shortened limbs, and other deformities and deficiencies.

Fig. 1575 shows right and left apparatus for several parts.
See Fig. 6084, p. 2459, "*Mech. Dict.*"
See also references under Curvature Apparatus, p. 236, *supra*.

Lem′on Squeez′er. One for pressing the juice from lemons.

Fig. 1576 shows several forms of the *Sammis* lemon squeezer.

Fig. 1576.



Lemon Squeezers.

1. For half lemons.
2. For cutting and squeezing whole or half lemons.
3. Large size, lever power for hotels and bars.

Length. (*Mining.*) A certain portion of the vein when taken on a horizontal line.

Lens For′ceps. (*Surgical.*) An instrument for withdrawing an opaque lens in the operation for cataract.

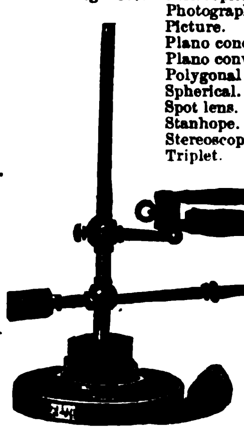
Critchet's and *Graefe's* lens scoops and spoons and others of silver, hard rubber, and shell, as well as lens forceps, are shown on pp. 30, 31, Part II., *Tiemann's* "*Armamentarium Chirurgicum.*"

Lens Hold′er. A support for a lens or combination of lenses, while an object is adjusted to the focus on an adjustable sliding forceps or a stage beneath. Fig. 1577.

For history, forms, and manufacture of lenses, see p. 1286, *et seq.*, "*Mech. Dict.*"

Achromatic.
Aplanatic.
Bull's eye.
Coddington.
Concavo-convex.
Condensing lens.
Convex.
Convexo-concave.
Crossed.
Cosmorama lens.
Cylindrical.
Demonstration lens.
Diacaustic.
Diamond.
Double-concave.
Double-convex.
Doublet.
Eye glass.
Field lens.
Fluid lens.
Fresnel's.
Immersion objective.
Lunette.
Meniscus.
Multiplying.
Object glass.
Objective.
Orthoscopic.
Periscopic.
Photographic.
Picture.
Plano concave.
Plano convex.
Polygonal lens.
Spherical.
Spot lens.
Stanhope.
Stereoscopic.
Triplet.

Fig. 1577.



Lens Holder.

Lenses and lens-making.
Chevalier . . . . . * "*Scientific American Sup.*," 2208.
Grinder . . . . . . * "*Scientific American*," xliii. 51.
Manufacture of . . . * "*Scientific American*," xli. 159.
Photograph., *Voigtlander* * "*Scientific American Sup.*," 1849.
Variable focus, *Dr. Cusco* * "*Scientific American*," xliii. 181.

Len-tic′u-lar Knife. (*Surgical.*) A scraper used in osteotomy. A sharp-edged disk is attached to the end of a staff, in a plane at right angles to the handle.

Let′ter Bal′ance. Scales graduated for letter postage. Usually in two sizes: one varying from ¼ ounce to 8 ounces; the other from ½ ounce to 4 pounds. The latter to include printed matter.

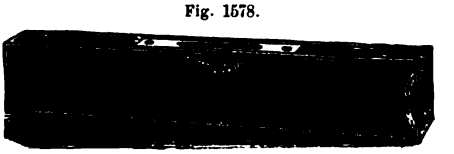
One form of letter balance has two beams, one graduated to ounces and fractions, and the other to metric weights.

Lev′ee. See Jetty.

Lev′el. 1. An instrument for determining horizontality. The subject is treated on pp. 1293 *et seq.*, "*Mech. Dict.*"

The machinist's level is shown in Fig. 1578. It has brass side-views, brass top and end plates, and corners, protected by ¼″ square rods extending the entire length of the rosewood staff.

Fig. 1578.



Machinist's Level and Plumb.

2. A level, used by Prof. Aita in the survey of Padua, for drainage and water service, was devised to overcome the difficulty of leveling in tortuous streets.

It consists of two glass tubes, doubly clamped to graduated staffs, and connected by a caoutchouc tube of any desired length. The two clamps are movable, the glass tubes being partly, and the connecting tubes wholly filled with water. The observers at the respective ends bring the clamps to the levels of the water in the respective tubes, and each enters the scale-reading in his note book. When the books are compared, the difference of readings give the difference of altitudes.

3. Attached to a gun to indicate its exact position.

Latta, Patent No. 181,580 *Haskell*, Patent No. 175,702.
Several forms . . . . * "*Scientific American Sup.*," 2110.
Aita, Italy . . . * "*Engineer*," xliv. 89.

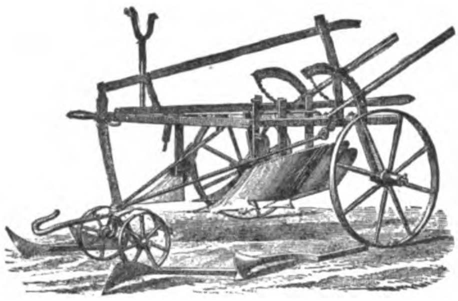
Apparatus, *Ecroyd* . . * "*Scientific American Sup.*," 1879.
Land, *Lowe* . . . . . * "*Scientific American Sup.*," 192.
Rod, *Whitehouse* . . . * "*Scientific American*," xxxv. 278.
Target, *Clesler* . . . * "*Railroad Gazette*," viii. 181.
Allen . . . . * "*Railroad Gazette*," 191.

See *Simms'* "LEVELING."

Lev'el-ing Plow. One for plowing down ridges thrown up in some forms of row culture; beets, for instance.

Fig. 1579 is a French form by *Delahaie-Tailleur & Bajac*, of Liancourt, which is adapted for a still greater breadth. The shares are thrown into or out of the soil by a single lever, and their working depth is regulated by the two rear levers,

Fig. 1579.



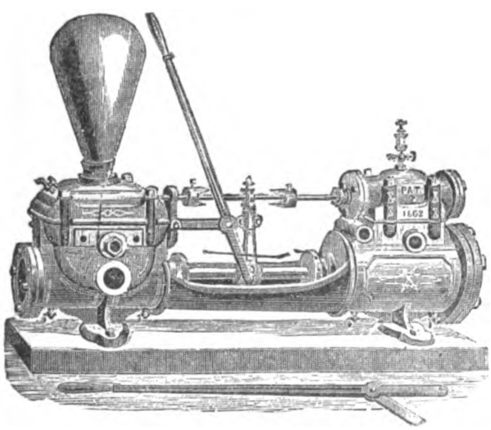
French Leveling Plow.

which actuate the bent axles of the hind wheels, so that the plows may penetrate the depth desired, or, as in the figure, be lifted clear of the soil in moving from place to place.

Lev'el-ing Screw. (*Milling.*) One in the hurst of a mill, acting against an iron plate in the back (beneath) of a bed-stone in order to adjust it vertically and bring it to an exact level. The runner is then *trammed* in accordance therewith.

Lev'er. (*Steam Engine.*) A hand-rod for moving the valves in the starting or reversing of an engine.

Fig. 1580.



Knowles' Steam Pump.

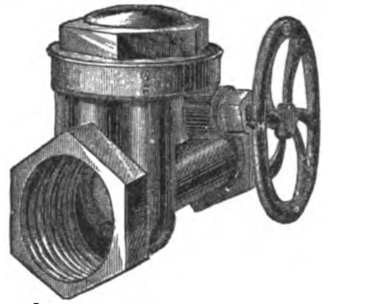
Fig. 1580 shows the hand-power lever of a steam-pump, and the lever detached.

(*Fire-arm.*) The piece by which the gun is opened or closed in some forms of breech-loaders. It may be *top, side,* or *under* lever. Examples are found in the Douglas, Henry, Maynard, and other rifles.

Lev'er and Cam Valve. A form of valve for gas or water mains.

The gate *A* moves on guides *B B*, which are arranged to

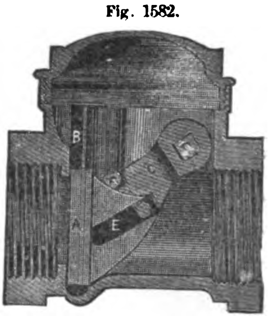
Fig. 1581.



Lever and Cam Valve. (*Perspective.*)

prevent friction by keeping the gate, when moving, from contact with the seat and wall of the valve chamber. The gate is opened and closed by means of the lever arm *C* attached to the rock shaft *D* and working in the slot *E*. When the gate is nearly down, the cam *F* forces it forward and down to its seat. One quarter turn of the wheel, which may be replaced by a straight arm or lever, opens or closes the valve.

Fig. 1582.



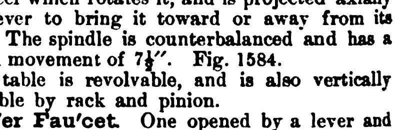
Lever and Cam Valve. (*Section.*)

Lever valve, *Young*, Br., * "*Engineer*," i. 494. * "*Sc. Am.*," xxxix. 19.

Lev'er Com-pres'sor. (*Optics.*) A means for applying pressure to an object whilst under examination with the microscope.

A screw is attached to a lever carrying a piece of glass and working on another plate in which a second glass is fixed and upon which the object is placed.

Fig. 1583.



Lever Compressor.

Lev'er Drill. A machine tool in which the tool spindle works with a spline in the socket of the wheel which rotates it, and is projected axially by a lever to bring it toward or away from its work. The spindle is counterbalanced and has a vertical movement of 7½". Fig. 1584.

The table is revolvable, and is also vertically adjustable by rack and pinion.

Lev'er Fau'cet. One opened by a lever and closed by a spring. See *a*, Fig. 232, p. 81, *supra.*

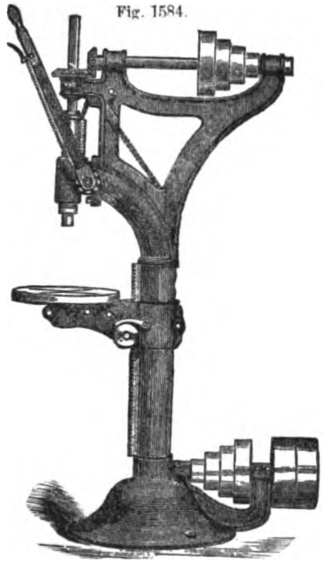
Lev'er Hand'-car. (*Railway.*) One worked by levers connected to cranks.

Lev'er Han'dle-cock. A faucet, the handle of which projects as a lever on one side only. See Fig. 234, p. 81, *supra.*

Lev'er Hook. (*Fishing.*) One so arranged that when the fish pulls at the bait, another hook strikes it and makes it fast. See list on p. 341, *supra.*

Lev'er Pla'ter. A form of calendering machine in which the force of compression is applied through the instrumentality of levers. See PLATER.

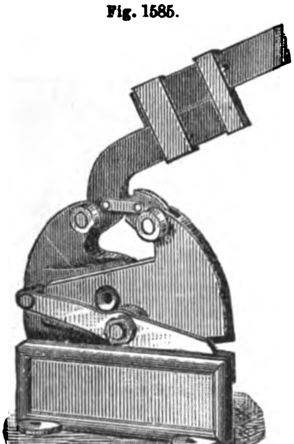
Fig. 1584.



Lever Drill.

Lev'er Press. A press for cutting or stamping tin ware, for instance, in which the punch or stamp is worked by a foot-lever; as distinct from a *pendulum*, *cam*, *screw*, or *fly press*.

Fig. 1585.



Lever Shears.

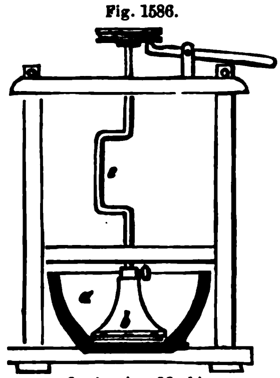
Lev'er Shears. A metal shears in which the power is applied by means of a lever; as in Fig. 1585, which is a French sheet metal shears having spur teeth on the contacting cams by which the motion of the lever is applied to the jaw.

Lev'er Valve. One moved by a lever.

See Lever; Lever and Cam Valve; Lever Cock.

Lev'i-ga-ting Ma-chine'. The porcelain levigating machine consists of a Thuringian porcelain mortar, *a*, with a flat-bottomed grooved pestle, *b*. This is attached to an iron crank, *c*, which is mounted in a strong wooden frame. There is a spout at the bottom of the mortar for running off the mixture when sufficiently ground.

Fig. 1586.



Levigating Machine.

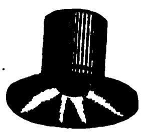
Ley'den Bat'te-ry. (*Electricity.*) A combination of Leyden jars presenting single positive and negative poles.

L. G. R. Large Grain Rifle powder.

Lid In'stru-ments. (*Surgical.*) See Eye Instruments; also Entropium forceps, Fig. 1877, p. 805, "*Mech. Dict.*"

Lieb'er-kuhn. A silvered cup, which slides or screws upon the front of the object-glass; light thrown upward by the mirror will be reflected by it down upon the object; by slightly varying the inclination of the mirror, every necessary alteration in the direction of the illumination can be obtained.

Fig. 1587.



Lieberkuhn.

Life. The endurance of a machine, or a part.

Compiled from the returns of 26 Illinois R. R. companies: —

	Years.		Years.
Locomotives . . .	$15\frac{1}{2}$	Pine ties	$4\frac{3}{4}$
Passenger cars . .	$15\frac{3}{4}$	Cedar	$5\frac{1}{2}$
Stock cars	10	Truss bridges . . .	$9\frac{1}{2}$
Freight cars . . .	$11\frac{1}{2}$	Trestle bridges . . .	8
Iron rails	7	Pile bridges	9
Steel rails	14	Joints and fastenings	7
Oak ties	7	Fencing	$8\frac{1}{2}$

"Locomotives 201, 202, 203, and 204 were placed on the Erie road in the months of June and July, 1854, and have run respectively 685,169, 532,548, 658,548, and 639,186 miles. The engines were equipped with new boilers in 1871, and are still considered good for 8 years more of good service. The locomotives are from the Rogers Works, Paterson." — *Hornellsville* (*N. Y.*) *Times*.

For endurance of car wheels, see p. 176, *supra*.

Life and Cur'rent Slide. (*Microscope.*) A slide in which are two oval cells with shallow connecting channel. By pressure on the cover the contents of a cell are caused to traverse the strait and the thin film is observed *in transitu*.

See Current Slide, Fig. 748, p. 236, *supra*.

Life Boat. Fig. 1588 represents a number of life boats in section and one in plan. They are derived from a lecture by Mr. Charles H. Beloe, read before the Liverpool Polytechnic Society.

Beginning at the left, above: —

a is the *Greathead* boat. *A A* are air-tight compartments, and *B* a water-tight deck discharging by tubes into the sea.

b is the Yarmouth sailing life boat, with air cases *A A*, and exterior cork fenders outside the gunwale. They are launched empty and the water then admitted to the well to the level of the water outside.

c, *h*, *i*, are views of the Royal National Life Boat. It is self-righting, and is the result of the experience in building the present fleet of life boats, numbering 235. It has side and end air chambers *C*, *D*, ballast *E*, relieving tubes *B* for the deck load of water.

e is *Lamb & White's* life boat. It is built of two thicknesses of plank with prepared waterproof material of an adhesive nature interposed.

f is *Woolfe's* boat.

g, *j*, are boats on the tubular principle.

k is *Hamilton & Co.'s* metallic life boat, which rids itself of deck water by discharge from the end of the boat which may be highest into a space between two bulk-heads, and then lowering it to outside level by means of a plug.

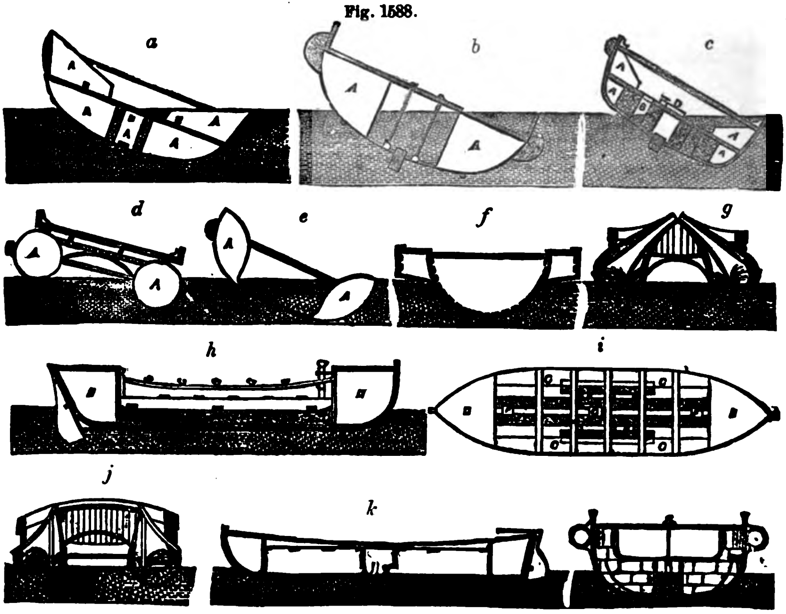
l is *Combe's* cork and cane life boat. It consists of two baskets, one placed within the other, secured to a deep wooden keel, and the intervening space filled with cork.

Fig. 1589 is the Royal Institution self-righting life boat, mounted on its carriage, and Fig. 1590 shows respectively a longitudinal section and a plan.

The boat has end and side air cases *f*, *g*, *b*. A water-tight deck with relieving tubes *a*. Spaces beneath the deck longitudinally amidships of the boat are packed with cork, forming a portion of the ballast. The extra buoyancy is obtained by the air-cases.

The self-discharge of water is provided for by the relieving tubes *B*, for, as the water-tight deck is always slightly above the level of the water outside, any sea that is shipped must flow out through these tubes, which are furnished with very simple self-acting balanced valves, that afford no obstruction to the free egress of water, but, closing by the pressure of the sea outside, effectually prevent the admission of any. The actual time occupied by one of these boats in freeing it-

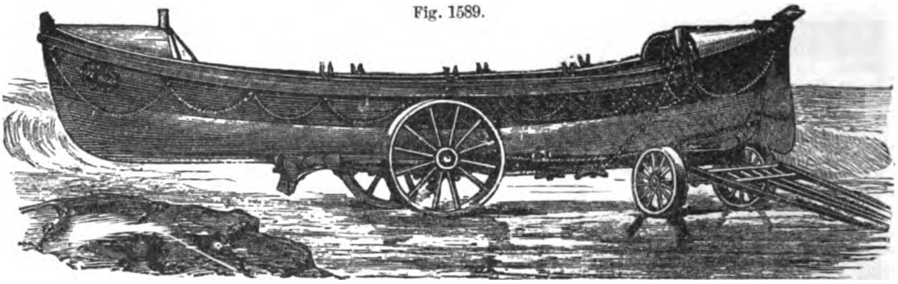
Fig. 1588.



British Life Boats.

self from water is about 80 seconds. A large portion of the ballast is composed of cork or wood. The really distinguishing feature of these boats is the property which they possess of self righting. The best proof of the safety of the boats is the fact that during the last 22 years the Institution has only lost from all causes, 29 persons from its own life boat crews, and many of these lives were lost by the men being crushed against wrecks, falling overboard, etc. The method by which this peculiar property is obtained is by attaching a heavy iron keel to the boat, and otherwise providing a sufficient weight of ballast, by giving a considerable amount of sheer, and by inclosing the bow and stern by air-tight chambers. These chambers have sufficient buoyancy to support the whole weight of the boat when upset, with the keel at a considerable height above the water; it is then floating on two points, with the ballast far above the center of buoyancy, thus forming an

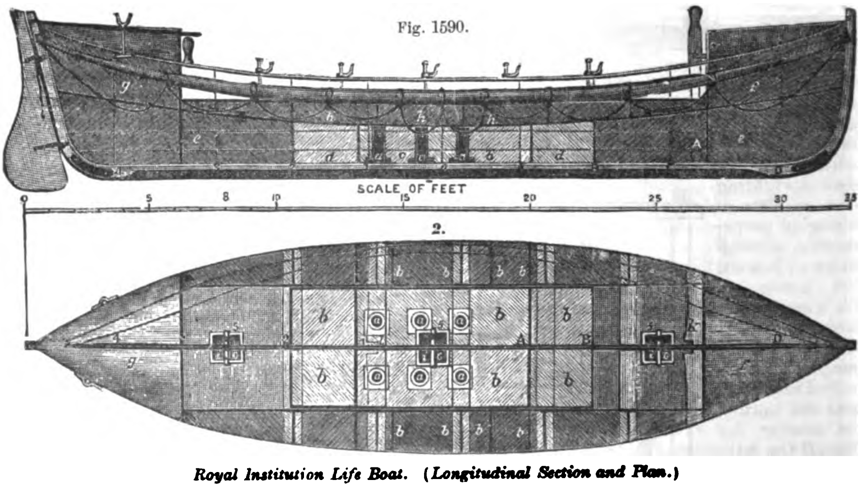
Fig. 1589.



Royal Institution Life Boat.

unstable equilibrium. In this position the boat cannot remain: and as soon as the keel falls to one side or the other of the center of gravity, the weight of ballast drags the boat round, the water escapes through the relieving tubes,

Fig. 1590.



Royal Institution Life Boat. (*Longitudinal Section and Plan.*)

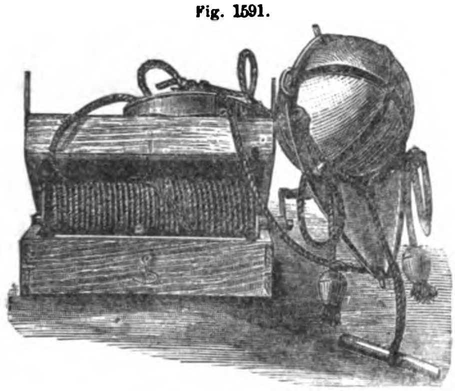
a, Delivering tubes; *b*, Air-cases; *c*, Well; *d*, Air-cases: *e*, Empty air-cases under deck; *f*, Fore air-compartment; *g*, After air-compartment; *h*, Air-cases; *k*, Mast-thwart; *s*, Scuttles for air.

and she is again ready for service. The following are the requirement requisite to insure self-righting: (1.) Ballast. (2.) Inclosed air chambers at the bow and stern, placed sufficiently above the center of gravity. (3.) Limited breadth of beam. (4.) Limited side buoyancy.

Life Buoy. One thrown to a man overboard.

The one in Fig. 1591 is Routourier's. It has two inflated canvas globes, a connecting strap, and winding-in line.

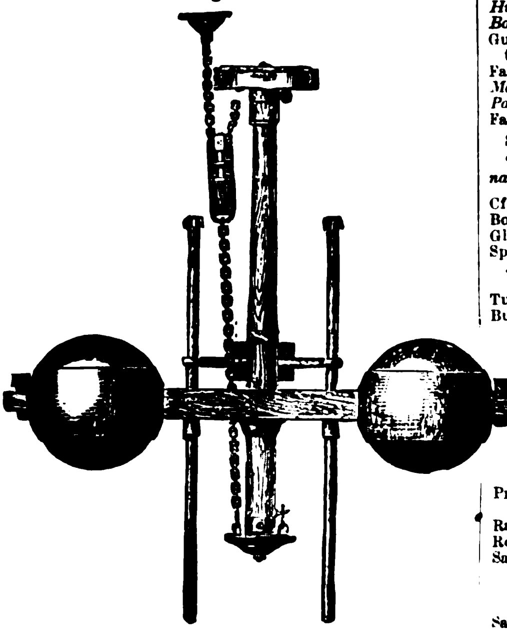
Fig. 1591.



Routourier's Life Buoy.

Fig. 1592 is Stone's improved form of Lieut. Cook's buoy (Br.). In this night life buoy, the act of throwing it overboard sets light to a port fire, which burns steadily on the surface of the water, and shows the situation of the life buoy to the party requiring its aid, as well as lighting the boat to the seaman in the water. This life buoy is in general use in the British navy.

Fig. 1592.

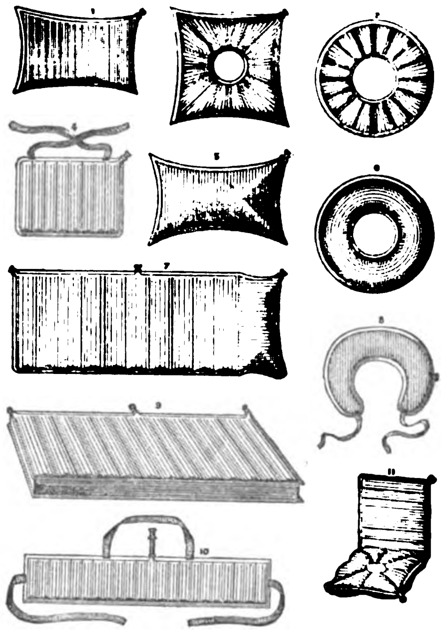


Stone's Night Life Buoy.

Life Pre-serv'er. An inflatable pillow, cushion, jacket, or what not. Fig. 1593 shows a number of forms.

Life-sav'ing Ap'pa-ra'tus. A lengthy and admirable report on life-saving apparatus, guns, projectiles, etc., by Lieut. D. A. Lyle, is to be found in "*Ordnance Report,*" 1868, Appendix P, pp. 177–334, and Plate LIV.

Fig. 1593.



Life Preservers.

History of life-saving apparatus	"*Ordnance Report,*" 1868, Appendix P., pp. 285–300.
Hunt's apparatus . . .	*Ibid.*, p. 305 and Plate LI.
Boxer's life-saving rocket	*Ibid.*, p. 314, and Plates XL., XLI.
Guns and projectiles for throwing shot-lines .	*Ibid.*, Plates I. to XXX.
Faking boxes	*Ibid.*, Plates XXXI. to XXXIV.
Manby's shot, etc. . . .	*Ibid.*, Plate XXXVIII.
Parrot's projectile . . .	*Ibid.*, Plate L.
Fakes	*Ibid.*, Plates XLVIII., XLIX.

See also Anchor Shot; Barbed Shot; Grapple Shot.

"*Report on the Manufacture of Life-saving Guns,*" "*Ordnance Report,*" 1879, * p. 270, with 7 plates.

Cf. Life Boat, *Atkin* . .	"*Scientific American Sup.,*" 192.
Boat, *Chapman* . . .	* "*Scientific American Sup.,*" 96.
Globular, *Manes* . . .	* "*Manuf. and Builder,*" ix. 185.
Spherical, *Manes* . . .	* "*Scientific American,*" xxxvii. 54.
Jackson	* "*Scientific American Sup.,*" 1568.
Stockwell	* "*Scientific American Sup.,*" 458.
Tubular, Br.	* "*Engineer,*" xliv. 404.
Buoy, Pocket	"*Scientific American,*" xxxix. 192.
Preserver, *Beck* .	* "*Scientific American,*" xxxvi. 274.
Cavalry and equestrian's inflatable saddle cloth . .	* "*Scientific American Sup.,*" 1161.
Delhommer . .	* "*Scientific American,*" xlii. 115.
Preserving cap. *McCarthy* . . .	* "*Scientific American,*" xxxv. 242.
Preserving stool. *Nash* . . .	* "*Scientific American,*" xxxiv. 291.
Preserver, *Rose* .	* "*Scientific American,*" xlii. 294.
Preservers, stuffed with deer hair	"*Manuf. and Builder,*" x. 232.
Rafts, "*Engineer*" . .	"*Van Nostrand's Mag.,*" xiv. 808.
Rocket, *Atkinson* . . .	"*Scientific American,*" xxxvi. 207
Saving apparatus. *Cummerford* . . .	* "*Scientific Amer.,*" xxxix. 182.
Bow	"*Scientific American,*" xl. 376.
Devices	"*Scientific American,*" xxxiv. 87.
Saving app. U. S. Marine	* "*Scientific American Sup.,*" 575.
	"*Scientific American Sup.,*" 2778.
Saving line shot, *Hunt* .	* "*Scientific American,*" xl. 376.
Saving mattresses . .	"*Scientific American,*" xl. 145.
Saving rocket, buoyant, Br.	* "*Engineer,*" xlix. 70.
Saving vessel, *Stockwell*	* "*Engineer,*" xl. 396.
Saving app., cannon for line shot	* "*Engineer,*" xlvii. 212.

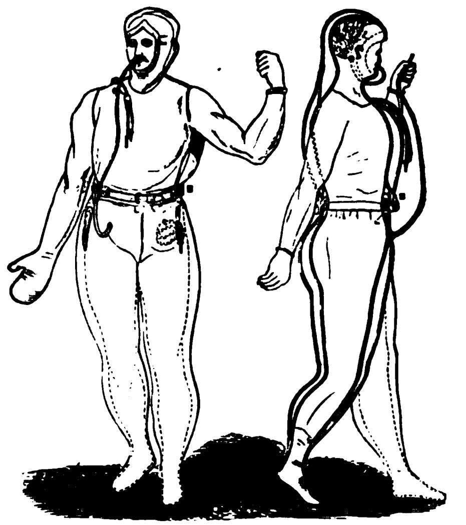
See also Line Throwing Gun, *infra*.

Article "*Porte-Amarres,*" *Laboulaye's* "*Dict. des Arts et Manufactures,*" iv., ed. 1877, has notices of *Manby, Delvigne, Tremblay.*

Life-sav'ing Suit. An inflatable dress to buoy up a swimmer or shipwrecked person.

Boynton's rubber life-saving dress is in two parts, tunic and pantaloons. The latter contains an air-chamber in each leg, which extends to the tops of the boots, while the waist is

Fig. 1594



Boynton's Life Suit.

girdled with a resisting steel band, on which is mounted a flange or ridge of heavy rubber. The jointure is made by lapping the tunic over the band, and a similar ridge drops into the groove formed. A belt thrown over the whole makes a tight joint. The tunic contains three air-chambers; one in the breast, back, and head respectively. When the latter chamber is inflated through the tube, it forms a pillow, raising the head of the occupant sufficiently to give him a complete range of vision. The suit is of delicate construction, and yet it will resist severe breakers and seas. The face is the only portion of the body exposed.

Fig. 1594 represents the swimmer in full outfit, and a sectional view to illustrate the construction.

Life Sig'nal. A provision on a life-saving buoy by which an inextinguishable light is given as soon as the buoy touches the water.

These chemical lights are now made in a variety of forms, and serve a useful purpose in giving a bright light upon the water when thrown overboard. One of the best of these contains chemicals that will not burn at any application of heat, but touched by water will evolve a bright flame. A small cylindrical box, ending above in a soft copper nib, is weighted below to keep it upright in the water, and filled with phosphate of calcium. When thrown into the sea, after the copper nib has been cut off, the water penetrates into the box, and the phosphureted hydrogen evolved escapes through a perforated tube leading to the open nib in a brilliant jet of light. Rain and spray only increases its brilliancy. Lieut. Cook's safety buoy is described under BUOY, p. 407, "*Mech. Dict.*" See also Fig. 2925, page 1301, *Ibid.*

Life Slide. See LIFE AND CURRENT SLIDE; CURRENT SLIDE. Fig. 748, p. 236, *supra.*

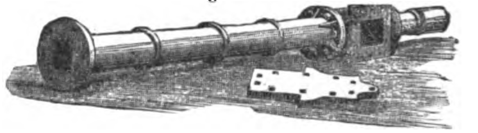
Lift. 1. The pump stock, or a portion thereof, of a deep well-pump. Perhaps especially one belonging to the Cornish system.

Fig. 1595 shows a portion consisting of a working barrel (11′), a door piece (6′) fitted with valve-seat and valve, an egg-ended wind-bore (9′) and the door-piece which has lugs for suspending it when the valve is to be examined.

2. A hand-hold attached to a window or window-blind, by which to raise or lower.

Cf. Lift Hydraulic on canals	"*Van Nostrand's Mag.*," xiv. 92.
Morris and Essex canal	Fig. 2665, p. 1176, "*Mech. Dict.*"
Great Western canal. Br.	Fig. 2932, p. 1304, "*Mech. Dict.*"

Fig. 1595.



Working Barrel of Cornish Pump.

Lifting Bridge.	
Scheldt, Antwerp . .	* "*Engineering*," xxv. 189.
Brussels	Fig. *a*, 2935, p. 1305, "*Mech. Dict.*"
Peronnet	Fig. *b*, 2935, p. 1305, "*Mech. Dict.*"
Bascule	* "*Mech. Dict.*," p. 241, Figs. 588, 489.
Lifting chock for threshers, *Clayton & Shuttleworth*	* "*Engineer*," xlii. 57.
Lift, double, *Weston*	* "*Iron Age*," xxiii., March 20, p. 9.
Lifting Jack, *Cornell*	* "*Scientific American*," xxxiv. 166.
"Magic"	* "*Iron Age*," xxii., Sept. 5, p. 9.
Rowland	* "*Scientific Amer.*," xxxviii. 297.
Smith	* "*Scientific Amer.*," xxxviii. 355.
Vibert	* "*Scientific American*," xxxiv. 274.

Lift'er. 1. The device on top of a drop press by which the hammer is raised, and which becomes detached to allow the hammer to drop. See DROP PRESS, "*Mech. Dict.*"

2. A form of extractor for tubing or boring bars in oil-wells. See Plate LXXIV., p. 2758, *Ibid.*

"*American Manufacturer*" . . . May 30, 1879, p. 16.

Lift'ing-back Saw. (*Surgical.*) One which has a hinged back to stiffen the blade when in use.

Lift'ing Gate. 1. A farm gate vibrating upwardly, being hinged to a horizontal pintle on the post. See instances on p. 958, "*Mech. Dict.*"

2. A form of water-gate used in the penstocks of water-wheels.

Lift'ing Jack. A portable contrivance for raising weights. See pages 1305, 1306, "*Mech. Dict.*"

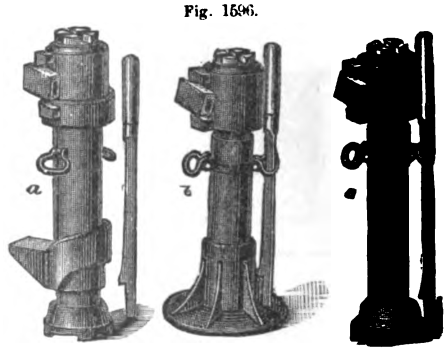
Among other forms may be found the following, which see: —

Bottle jack.	Screw jack.
Hydraulic jack.	Wagon jack.
Lever jack.	Jack screw.

See list of jacks on p. 1208, "*Mech. Dict.*"

Fig. 1596 shows several forms of hydraulic lifting jacks.

Fig. 1596.



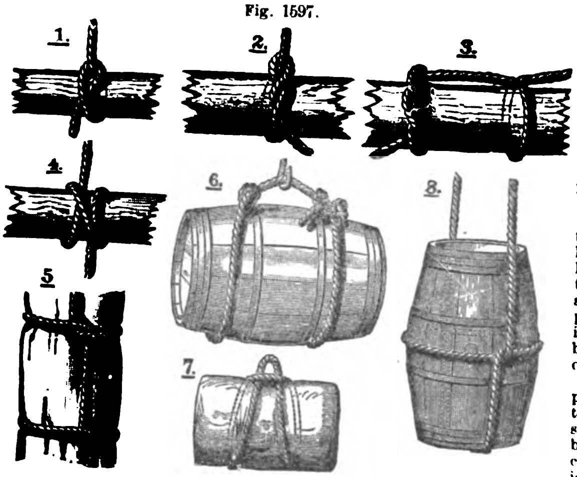
Hydraulic Jacks.

a. Lifting jack with low-down claw.
b. Wide base jack.
c. Ordinary hydraulic jack.

Lift'ing Hitch. A mode of slinging an article by a rope so that the object may be raised.

Fig. 1597 shows a number of hitches appropriate to the objects.

Fig. 1597.

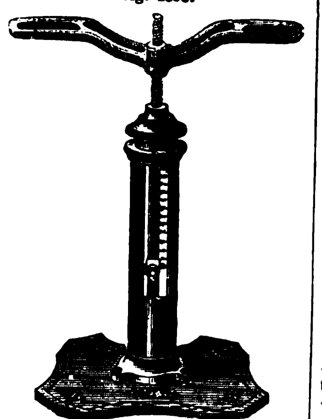


Lifting Hitches.

1. Half-hitch.
2. Timber hitch.
3. Half-hitch and timber hitch.
4. Clove hitch.
5. Hammock hitch.
6. Cask sling.
7. Bale sling.
8. Butt sling on end.

Lift'ing Ma-chine'. A form of dynamometer used in ascertaining the strength of a person in lifting; or by gradually increasing the load, to develop greater strength by exercise.

Fig. 1598.



Lifting Machine.

See also EXERCISING MACHINE; HEALTH LIFT.

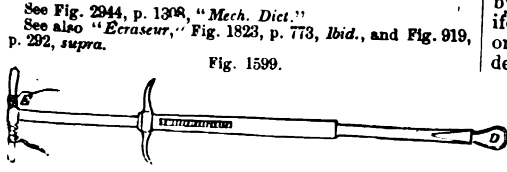
Lift Jig'ger. (*Nautical.*) A light tackle for swaying on the lifts of the yards.

Lift Latch. A lock in which the latch is lifted, not slipped.

Li-ga'tor. (*Surgical.*) An instrument to place and fasten a ligature.

See Fig. 2944, p. 1308, "*Mech. Dict.*"
See also "*Ecraseur*," Fig. 1823, p. 773, *Ibid.*, and Fig. 919, p. 292, *supra.*

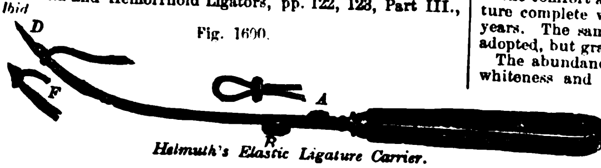
Fig. 1599.



Dr. Crooker's Ligator.

See also Artery Ligators, pp. 26–28, Part I. *Tiemann's* "*Armamentarium Chirurgicum.*"
Also Ovarian Ligators, pp. 92, 93, Part III., *Ibid.*
Fistula and Hemorrhoid Ligators, pp. 122, 123, Part III., *Ibid.*

Fig. 1600.



Helmuth's Elastic Ligature Carrier.

Dr. Crooker's ligator for the gradual removal of tumors is shown in Fig. 1599. The spring is retained in a compressed state, until the ligature has been passed around the tumor, and its free ends secured to the cross-bar; it is then released, and the removal of the tumor is accomplished gradually and with little danger of hemorrhage.

Lig'a-ture Car'ri-er. Ligature carriers, knot-tyers, and ecraseurs are shown in Fig. 2944, p. 1308, "*Mech. Dict.*"

Helmuth's elastic ligature carrier, adapted for the treatment of complete or incomplete fistula, has two buttons, *A B*, Fig. 1600, close up to the handle of the instrument. By pushing forward the button *A*, the blunt end of the instrument, as seen at *F*, opens. The elastic ligature is then put upon the stretch, and, while thus drawn out, is slipped into the notch, and the button *A* drawn back to its place, and the needle (if the case is one of complete fistula) is ready for use.

If the fistula be incomplete, the blunt end is passed firmly up to the end of the sinus, the button *B* is pushed forward, which protrudes the sharp point *D*; in other words, transforms the blunt into a sharp point. The fistula is then made complete by piercing the tissues; as soon as this is done, the point is retracted again within its sheath, thus leaving a rounded extremity in the rectum. By elevating the handle with the left hand, and drawing the blunt end down by means of the index finger inserted within the rectum, the ligature is brought out at the anus, taken hold of and held, while the button *A* is pushed up, which entirely liberates the thread. The instrument is then withdrawn, the ends of the ligatures are passed through a leaden ring, which is slipped into position and clamped by forceps.

Light. See the following references: —

From mechanical force.	
Barker	"*Scientific American*," xxxiv. 181.
Lighting devices . . .	"*Iron Age*," xix., May 3, p. 18.
Apparatus, *Dorscher* . .	* "*Scientific American*," xli. 339.
Lime light	"*Iron Age*," xxi., May 9, p. 24.
	"*Scientific American*," xxxviii. 58.
Electro chemical . . .	"*Scientific American*," xxxvi. 200.
Index of refraction.	
Mode of determining .	"*Scientific American Sup.*," 1366.
Intermittent light.	
Sir W. Thomson . .	"*Van Nostrand's Mag.*," xiv. 107.
Light registering appa.	
Prof. Roscoe . .	"*Scientific American Sup.*," 460.
Oxygen apparatus . .	* "*Scientific American*," xxxix. 73.
Oxygen retort	* "*Scientific American Sup.*," 1227.
Oxhydrogen light . .	"*Scientific American Sup.*," 93.

Light'er Staff. (*Grain Mill.*) A lever supporting and controlling the adjustable end of the bray-plank or bridge-tree, to which it is connected at one end by a stirrup while its other end receives the lighter screw, or sometimes, a counterbalance weight.

Light'house. The new Eddystone lighthouse is to be erected on the south rock of the group, about 120′ south of the present lighthouse, erected by Smeaton in 1757. The present lighthouse manifests no sign of weakness, but the "House Rock" on which it stands has been worn and probably undermined by the waves.

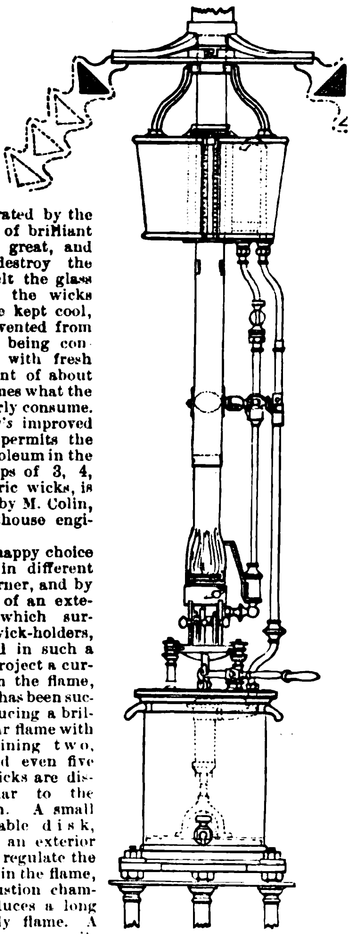
The Eddystone lighthouse is described on p. 1311 of the "*Mech. Dict.*" The new structure will be built to contain a light of more extensive radius and greater power. The old tower is 72′ above the level of high water; the new one is designed to be 130′ above the level of any spring tide, so that no matter what storm may rage, the light will be in no danger of being eclipsed. It will have a range of $17\frac{1}{4}$ miles, and is expected to overlap the electric light at the Lizard. Beside this, the tower will be considerably enlarged, giving nine rooms in place of the existing four, thus adding to the comfort and convenience of the keepers. The structure complete will cost £70,000, and be completed in four years. The same process of dovetailing the stones will be adopted, but granite is substituted for Portland stone.

The abundance and cheapness of petroleum oil, and the whiteness and brilliance of the flame it gives when consumed in properly constructed lamps, more than twenty years ago suggested its use for light-houses. The colza-oil lamps in use in light-houses have one wick for reflectors and small dioptric apparatus, and two, three, four, and even five wicks adapted to the different orders of dioptric apparatus, and the flames developed in these lamps are of greater size and brilliance than that of the four-wick lamps; for example, being nearly 4″ in diameter, by about the same in height, emitting a light equal to nearly 260 standard sperm candles. The heat generated by the four cylinders of brilliant flame is very great, and would soon destroy the burner and melt the glass chimneys, but the wicks and burners are kept cool, and the oil prevented from volatilizing by being constantly flooded with fresh oil to the extent of about three or four times what the lamp can properly consume.

Captain *Doty's* improved burner, which permits the burning of petroleum in the lighthouse lamps of 3, 4, and 5 concentric wicks, is thus described by M. Colin, a French lighthouse engineer: —

"It is by a happy choice of proportion in different parts of the burner, and by the application of an exterior cylinder which surrounds the wick-holders, and is arranged in such a manner as to project a current of air upon the flame, that Capt. Doty has been successful in producing a brilliant and regular flame with burners containing two, three, four and even five wicks. The wicks are distributed similar to the Fresnel system. A small central adjustable disk, combined with an exterior air cylinder, to regulate the currents of air in the flame, forms a combustion chamber which produces a long and very lively flame. A simple appliance permits the application of his system of burners to the ordinary overflow lamp, *i. e.*, the mechanical and moderator lamps."

Fig. 1601.



Funck's Float Lamp.

This invention at once places within the reach of lighthouse authorities lamps which do not require any structural rearrangement of the apparatus or lamps at present in use; new burners only require to be screwed or soldered on to the existing lamps, and the lighthouse management goes on as formerly, but with this difference, that the flames of the Doty burner show greater illuminating power.

Funck's float lamp for lighthouses is shown in Fig. 1601.

The float is in the chamber which is seen parallel with the burner and regulates the supply which descends from the elevated oil-chamber. The overflow passes into a lower chamber from whence it is again pumped into the elevated chamber, by means of a pump, the handle of which is shown protruding to the right.

Cf. Architecture.

"*The Builder*" . .	"*Van Nostrand's Mag.*," xviii. 17.
Burners	"*Iron Age*," xix., March 8, p. 18.
"Chickens," rock . .	* "*Engineer*," xlvii. 356.
Chipiona, Spain . . .	* "*Scientific American Sup.*," 2699.
Dhu heartach, Scotland	"*Scientific American Sup.*," 373.
Eddystone (new), . .	* "*Engineering*," xxiv. 209.
	"*Iron Age*," xxiv., Sept. 4, p. 5.
	"*Van Nostrand's Mag.*," xix. 379.
	"*Scientific American*," xli. 145.
Maj. Elliot's Rept. . .	* "*Van Nostrand's Mag.*," xiv. 97.
Eng'ing, "*Engineer*," .	"*Van Nostrand's Mag.*," xxi. 205.
Sein near Finisterre, Fr. .	"*Scientific American Sup.*," 1125.
Illuminating	"*Scientific American*," xxxv. 154.
Illumination, Engl. . .	* "*Scientific American Sup.*," 2338.
On lighthouses, *Wigham*	* "*Engineering*," xxvi. 185.
Little-Basses, Ceylon .	* "*Scientific American Sup.*," 945.
Iron, Mexico	"*Scientific American*," xlii. 80.
Rennie	* "*Engineer*," xlvii. 353.
Roche Douvres, Fr. . .	*Laboulaye's* "*Dictionnaire*," iii. *Cap. Serrurerie*, Fig. 101.
Souter Point, Engl. . .	"*Scientific American Sup.*," 945.
Smeaton	* "*Engineer*," xlvii. 353.
Stevenson	* "*Engineer*," xlvii. 353.
Tampico	* "*Iron Age*," xxv., March 25, p. 1.
Stones, *Weymouth*, Br. .	* "*Engineering*," xxx. 399.
Ships and shore Teleg. Communication . .	"*Telegraphic Journal*," iv. 113.
Walder	*Laboulaye's* "*Dictionnaire*," iii. *Cap. Serrurerie*, Fig. 100.

Cf. *Elliot's Report on* "*European Lighthouses.*"
"*Lighthouses*," by David Stevenson, Edinburgh.

Light Met'al. One having a specific gravity less than 5: water being 1.

Aluminium	2.6.
The metals of alkaline earths: —	
Barium	4.
Strontium	2.5
Magnesium	1.74
Calcium	1.6
The lightest are: —	
Potassium	0.86
Sodium	0.8
Lithium	0.6
Rubidium	?
Cæsium	?

Light Mod'e-ra-tor. (*Optics.*) Two circular pieces of flat glass are mounted on a stand, one blue and the other red, so combined as to give a white light when using the microscope with artificial light.

Light'ning Rod.

See arrester, *Eggington*	* "*Telegraphic Journal*," v. 192.
Investigations of, *Planté*	* "*Scientific Am. Sup.*," 971, 1052.
Conductor. "*English Mechanic*" .	"*Van Nostrand's Mag.*," xxii. 102.
Galvanometer for testing	* "*Telegraphic Journal*," iv. 279.
Discharger, *Rymer Jones*	* "*Telegraphic Journal*," vi. 489.
Protector, Telegraph .	* "*Scientific American Sup.*," 14.
Vases	* "*Scientific American Sup.*," 456.
	* "*Telegraphic Journal*," iv. 79.
Rods	"*Scientific American Sup.*," 6.
	* "*Scientific American*," xxxv. 164.
Rod discharging point., *Weston*	"*Scientific American*," xxxiv. 230.
Rods, on, *Kirchoff* . .	"*Van Nostr. Mag.*," xxiii. 491.
Rod, nickeled	"*Scientific American Sup.*," 48.
Rods, principles of . .	"*Scientific Amer.*," xxxvi. 385.

Light Reg'is-ter-ing Ap'pa-ra'tus. An automatic device by Prof. Roscoe to keep a record of the amount of light that falls at any particular spot during small fixed intervals.

Clockwork drives the apparatus, photographic paper is the sensitive agent used, and by mechanical arrangements certain small portions of the paper are exposed to the action of light for fixed intervals, which can be regulated at pleasure. The tinted photographic paper is compared by the eye with a conventional scale of tints.

Lig'nose. A Silesian blasting powder made of woody fiber charged with nitro-glycerine.

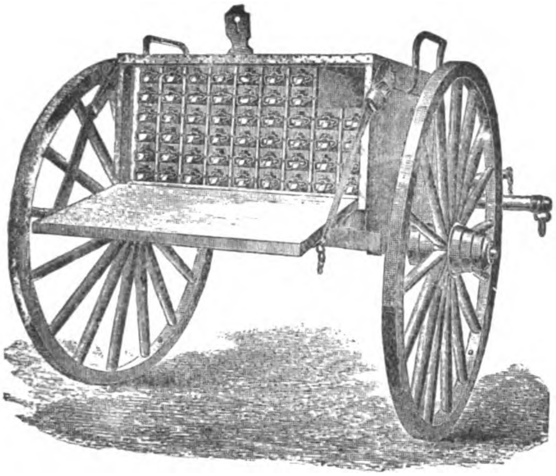
It is very light; burns slowly in a loose state; does not explode in contact with open fire; is three times as strong as an equal weight of black blasting powder, and less than one third the price. Mentioned in the "*Deutsche Industrie Zeitung.*" Made at Kieltsh by Baron von Trutzschbhler Falkenstein.

Lil'y I'ron. (*Fishing.*) The harpoon head, detachable from the stem, used in capturing swordfish. See also HARPOON.

Fig. 1602.

Lily Iron.

Fig. 1603.



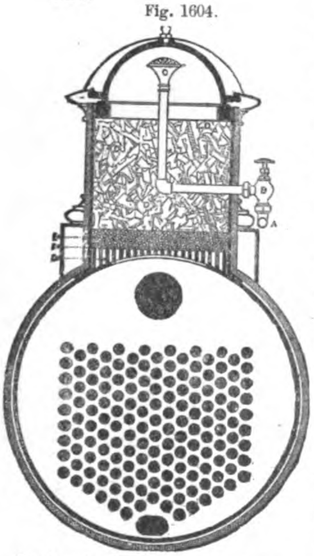
Limber for Gatling Gun.

Lim'ber. The ammunition carriage to which the trail of a field-piece is attached when in marching order.

Fig. 1603 shows the limber for the Gatling gun. The drawers hold cases of ammunition, 20 or 40 in a case; the case is slipped into the feed hopper of the gun, and the cartridges fall into the loading grooves of the gun as they successively present themselves when the barrels are rotated.

Lime Catch'er. A device placed between a feed-water pump and the steam boiler to intercept the lime.

Fig. 1604.



Feed-water Filter and Lime Catcher.

The device shown is in use on the Illinois Central Railway, and its purpose is to prevent the deposition of scale.

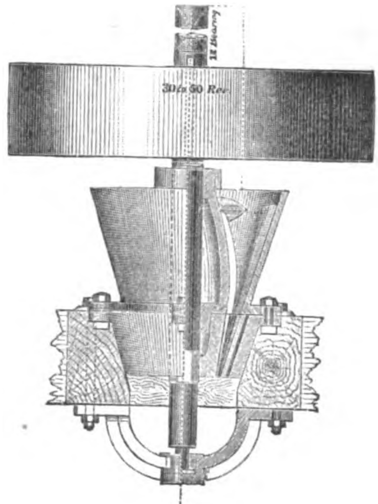
Instead of admitting the feed-water into the boiler in the usual manner (that is, on the side of the boiler, below the water level), the feed-water pipes are carried from the pumps, or injectors, to the top of the forward dome, either inside or outside of the dome, and deliver the water near the top of the dome from a rose, *C*, in the form of spray or thin sheets. From this point it falls into the body of the boiler by its own gravity, and in its descent is compelled to pass over and among pieces, *D D*, of metal, wood, charcoal, tile, oyster shells, etc., which are placed in the dome and are heated to the same temperature as the steam which surrounds them, and upon which the lime, magnesia, and other mineral impurities in solution in the water will deposit themselves. These pieces of metal, etc., are supported by a grating, *G*, over which is laid, if necessary, a piece of wire netting, *F*, to prevent the charcoal, *E*, from being washed through into the boiler.

The pieces of metal, etc., are renewed occasionally.

See also Feed Water Heater, Figs. 1000–1011, pp. 328, 329, *supra*.

Lime Crack'er. A mill for rough-grinding crude plaster and calcined limestone. The teeth

Fig. 1605.



Lime and Plaster Cracker.

are of chilled iron; those in the lower part of the pot are made in sections, which can be renewed separately when they wear out. The core is made in sections, also renewable. Used in cement works. With a motion of 30 revolutions per minute, a mill will reduce hard calcined water lime to a fineness suitable for grinding at the rate of 60 barrels per hour.

See also Cement Mill, Fig. 575, p. 183, *supra*; Fig. 1199, p. 510, "*Mech. Dict.*"; Mortar Mill, Figs. 3230, 3231, p. 1480, *Ibid.*, etc.

Lime Ex-tract'or. See Feed Water Heater, pp. 328, 329, *supra*; Lime Catcher, *supra*.

Lime'-glass. (*Glass.*) Known in England as *white* glass; not to be confounded with *flint*-glass, which has lead in it.

Bohemia is especially celebrated for its *white* glassware, making all articles usually made in *flint*-glass in England. The latter is the whiter and more brilliant; the *lime-glass* is the harder, and is blown into wooden molds. It is invaluable in the laboratory. Recipe: —

Pulverized quartz	100
Carbonate of potash	28 to 32.
Slaked lime	13 to 15.
Oxide of manganese	1
Arsenic	3

Saltpeter, borax, red lead, sometimes enter into the mixture in small proportions.

The French lime-glass, also known as *half-crystal*, is composed as follows: —

Sand	200
Carbonate of soda	66
Lime	50

Or —

Sand	3,000
Sulphate of soda	170
Slaked lime	75
Ground charcoal	10

A few hundredths of red lead are sometimes added.

Lime Kiln. Additional to what has been given on pp. 1319, 1320, "*Mech. Dict.*," some instances may be given of the calcination of lime combined with steam boiler heating, and the production of carbonic acid for use in sugar houses.

Cowan's (Br.) steam generating apparatus, combined with a kiln for calcining limestone, is shown in Fig. 1606.

The kiln is worked on the continuous principle, with coal and limestone alternately, and in regulated quantities. The escaping heat generates steam in boiler, which is partly jacketed around the kiln, and partly consists of a dome with vertical flues.

The plant for the purpose, to be added to the ordinary kiln, is included in the following schemes: —

Metallic fixture for lime-kiln of 175 cubic feet capacity.

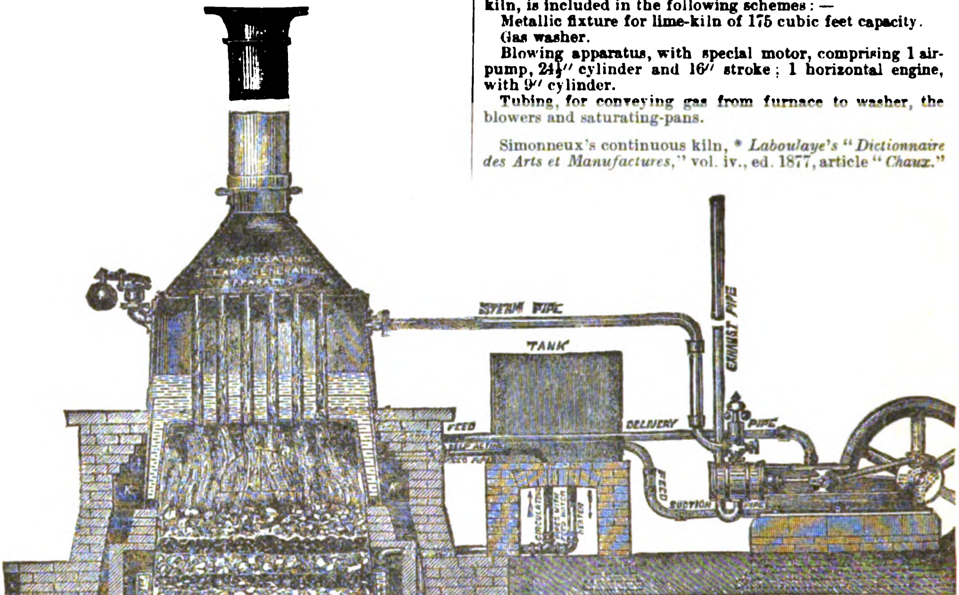
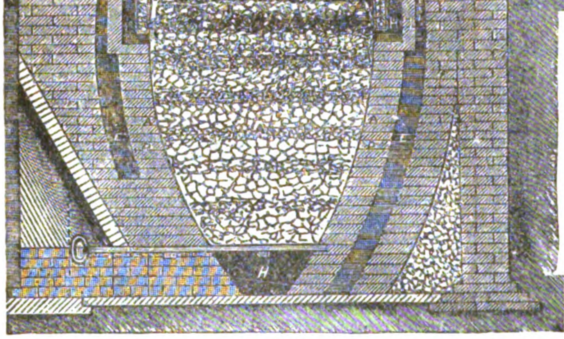
Gas washer.

Blowing apparatus, with special motor, comprising 1 air-pump, 24½″ cylinder and 16″ stroke; 1 horizontal engine, with 9″ cylinder.

Tubing, for conveying gas from furnace to washer, the blowers and saturating-pans.

Simonneux's continuous kiln, * *Laboulaye's "Dictionnaire des Arts et Manufactures,"* vol. iv., ed. 1877, article "*Chaux.*"

Fig. 1606.

Combined Lime Kiln and Steam Boiler.

A. Kiln furnace.
B. Boiler.
C. Feed water heater.
D. Fire-brick lining.
E. Air space or sand backing.
F. Masonry
G. Furnace door.
H. Draw hole for removing lime.
K. Flue round boiler.

French practice, * *Ibid.*, ii., article "*Mortier,*" Figs. 1874-1883.

Lime kiln heated steam boiler, *Cowan* * "*Sc. Am.*," xxxv. 307.

Lime kiln and steam boiler combined . * "*Sc. Am. Sup.*," 665.

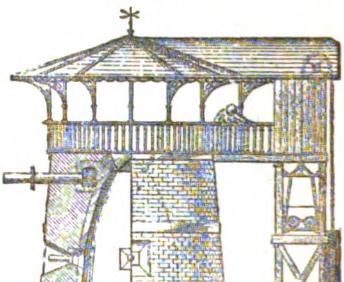
The calcination of limestone and chalk in kilns, for the production of carbonic acid, for use in the manufacture of beet sugar, is a prominent feature in European *sucreries*.

M. Derosne was the first to suggest quick-lime in the purification of the beet juice. His method was based upon three principal points: (1) the use of caustic lime; (2) the use of alum; and (3) the use of alcohol. The lime he adds to the fresh juice, of which he succeeded in expressing 63 per cent. of the weight of the root. The proportion added was 0.24 gram per liter of juice. After the addition of lime in a thick milk the juice was rapidly brought to boiling and the scums removed as they formed. The juice was then separated from the sediment, which settled and concentrated. It was then purified with alum and blood, and farther treated in the usual way. The proportion of sugar extracted by this method is stated to have been 4½ per cent., and was the highest result that had yet been attained. The beets from which this high yield was obtained were of the white Swedish variety, while the beets of the plain of Aubervillier did not yield as much by 2½ per cent.

Fig. 1607 shows a limestone calcining furnace specially devised for *sucreries*, and made by Chrétien, of Paris. It has steam elevator for the limestone, and a tube at the summit to conduct the carbonic acid to the pans in which the beet juice is saturated with the gas. This is described under CARBONATION PAN, p. 163, *supra*.

See also *Dr. McMurtrie's "On the Sugar Beet, and the Manufacture of Sugar Therefrom,"* Special Report, No. 28, Department of Agriculture, Washington, 1880.

Fig. 1607.



Lime Kiln for Beet Sugar Factories.

Lime Light. The Drummond light has been described at Fig. 1788, p. 757, "*Mech. Dict.*"

Fletcher's lime light consists of a block of lime, incased in a cylinder of porous ganister, and subjected to a flame from a Bunsen. At an opening in the pottery envelope the light is emitted. The ganister cover ismade of refractory clay 1 part; sawdust, 6 parts; burned; this makes a very porous material, like pumice; an excellent non-conductor of heat.

Line. 1. (*Fishing.*) *a.* The thread, twine, or cord used in baited-hook fishing. Known by various names indicative of size, quality, material, make, purpose, etc.; such as: —

Bottom set line.	Set line.
Braided silk.	Silk line.
China grass.	Silk-worm gut.
Cork line.	Silver gimp.
Cotton line.	Snood.
Float line.	Squid line.
Gut line.	Spilliard.
Hand line.	Surface line.
Harpoon line.	Tapered silk.
Land line.	Throwing line.
Linen line.	Toggle line.
Loaded line.	Trawl line.
Plaited line,	Trot line.
Rigged line.	Twisted silk line.
Seine line.	Waterproof.

b. Of a seine: —

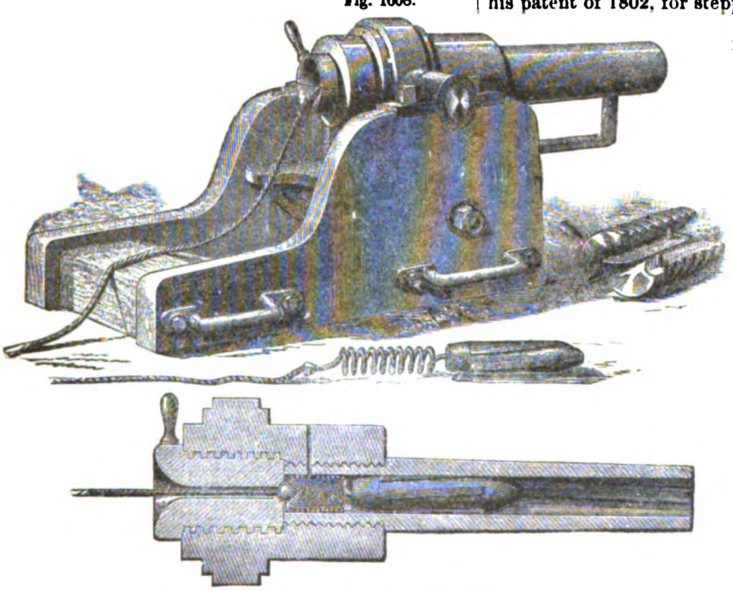
The *cork* line, or line of floats on the upper edge.
The *toggle* line, which in some seines runs along the line of leads.
The *land* lines, which pass from the ends of the seine to the sheave blocks on shore.

2. Mason's line, chalk line, etc.

Lin'ear Knife. (*Surgical.*) A delicate, sharp-pointed knife used in making the incision in operation for cataract. *Graefe's* and *Baader's,* straight and angular with the blade, are in *Tiemann's* "*Armamentarium.*"

Line Hook. (*Whaling.*) A hook for catching the harpoon line.

Fig. 1608.



Spencer's Line-throwing Gun.

Line-throw'ing Gun. A gun for throwing a line to vessels stranded or in distress off shore.

Fig. 1608 is Spencer's breech-loading line-throwing gun, which is mounted in the usual way, but has an axial aperture in the screw breech-plug for the passage of the line, which is attached by a spring to the base of the projectile to prevent the parting of the line at the instant of firing. The breech-plug is in two parts, divided longitudinally, to obviate reeving the line through the hole. The tail of the cord is attached to a life-line lying faked in a box near by. See Fake, Fig. 1000, p. 526, *supra.* See also Anchor Shot, Fig. 61, p. 33, *supra;* Grapple Shot, Fig. 1270, p. 421, *Ibid.*

Lin'ing Felt. A fabric of hair, or hair and asbestos, which may be saturated with a lime cement, and used as a non-conducting covering for steam boilers and pipes.

A mixture of fiber, animal or mineral, with cement wash, applied with the brush for the same purpose.

A felt inserted in a partition or siding, as a deadener of sound or non-conductor of heat.

Lin'ing Nail. A sharp upholstering nail with semi-spherical head, brass or nickeled.

Link Mo'tion. See * p. 1824, "*Mech. Dict.*"

Link-block, locomotion, *Alexander* * "*Sc. Amer.,*" xxxv. 230.
Link motion, *Marshall,* Br. . . . * "*Eng'ng,*" xxviii. 25.
On the link motion, *Smith* . . * "*R. R. Gaz.,*" xxiii. 2.

Peaucillier was the first to discover that a straight line can be accurately described by a combination of links. See his parallel motion. See Fig. 3548, p. 1630, "*Mech. Dict.*"

Lint. 1. (*South.*) Ginned cotton before baling.

2. (*Fishing.*) A fisherman's name for the netting of a pound or seine.

3. (*Surgical.*) Raveled or scraped linen. See p. 1325, "*Mech. Dict.*"

Lip. The helical blade on the end of an auger to cut the chip. The *spur* makes the circumferential incision.

A lip auger has *pod* and *lip;* in contradistinction to the *screw*-auger.

Lip Hook. (*Whaling.*) A grapnel for catching in the lip of the whale, to tow it to the vessel.

Lip Pro-tec'tor. (*Dentistry.*) A saddle-shaped shield laid upon the lip to protect from abrasion or pinching during dental operations.

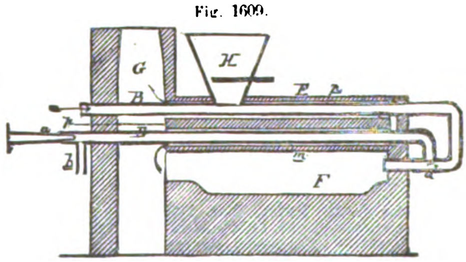
Liq'uid Bear'ing. Described by Bramah in his patent of 1802, for stepping vertical shafts. He went so far as to perform the vertical adjustment of the cutter spindles of his planing machine by pumping liquid into the step.

See Journal Bearing, Fig. 1499, p. 516, *supra.*
See also Palier Glissant; Hydraulic Pivot; Water-bearing, "*Mech. Dict.*"

Liq'uid Fu'el Fur'nace. A furnace utilizing petroleum or paraffine as the inflammable agent. (Fig. 1609.)

One form is shown in Fig. 2965, p. 1325, "*Mech. Dict.*" *Caldwell's* coal dust and petroleum furnace is adapted as a puddling or heating furnace, through the roof *E* of which, as well as through the chimney *G*, pass the two pipes *B* and *D*, the former for admitting air under pressure, and the latter for receiving a jet of steam from a nozzle, *a*, the jet inducting petroleum from an adjoining reservoir through the branch *b* into the pipe *D*. Both of the pipes *B* and *D* communicate with a short pipe or nozzle, *d*, which projects into the interior *F* of the furnace at the front end of the same.

Fig. 1609.

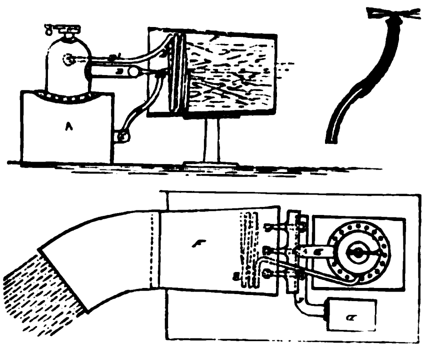


Coal Dust and Petroleum Furnace.

With the pipe B communicates a hopper H for containing coal-dust, more or less of which can be admitted to the pipe by means of a sliding damper. The petroleum injected into the pipe D in the form of spray by the steam-jet assumes a gaseous form before it reaches the nozzle d, where it unites with the supply of compressed and heated air which creates an intense heat in the furnace, and consumes the coal-dust which arrives by the air-pipe B, and is injected therewith into the furnace chamber F.

Fig. 1610 is Ramsden's hydro-carbon furnace (Br.), which is on the principle of the atomizer. Steam from a boiler is discharged in the form of spray from the outlets of horizontal tubes across the mouths of vertical tubes c, the lower ends of which are in a tank of petroleum. A vacuum is produced in the hydro-carbon tubes in the manner familiar in atomizers, and the consequence is a mingled spray of steam and hydro-carbon vapor which is conducted beneath the boiler.

Fig. 1610.



Hydro-carbon Furnace.

Blast	* "*Sc. Amer. Sup.*," 47.
Caldwell	* "*Sc. Amer. Sup.*," 125.
Ramsden	* "*Sc. Amer. Sup.*," 125.
Paper on, *Dickerson* in "*N. Y. Sun*"	"*Sc. Amer. Sup.*," 3784.

See also PETROLEUM FURNACE, *infra*, and "*Mech. Dict.*," p. 1674.

Liq'uid Ma-nure' Cart. A vehicle for conveying liquid fertilizer and showering it upon the ground.

Fig. 1611 is a French form, made by *Bodin*, of Trois-Croix, Rennes. It is provided with a pump for filling the reservoir from cisterns in the barnyards or stables.

Fig. 1611.

Bodin's Liquid Manure Cart.

A British form is shown at Fig. 2919, p. 1826, "*Mech. Dict.*"

See also IRRIGATOR, *supra*.

Liq'uid Meas'ure. Liquid meters of several forms are shown on p. 1327, "*Mech. Dict.*"

See also WATER METER, Figs. 7110-7119, pp. 2740-2742, *Ibid.*, and SPIRIT METER, Figs. 2426-2429, pp. 2227-2278, *Ibid.* Also MEASURING APPARATUS: MEASURING FAUCET; MEASURING FUNNEL, pp. 1413, 1414, *Ibid.*, and list under MEASURING APPARATUS, etc., *infra*.

Fig. 1612 shows *Wilkinson's* oil-tank with hand-pump which discharges into a glass vessel graduated to quarts, pints, etc. When the stop-cock is opened to draw off the fluid, a valve is also opened, and air is admitted to the top of the receptacle. When the measure is being filled by pumping the fluid into it, the air will open the upper valve and escape, the valve afterwards closing and preventing evaporation.

Fig. 1612.

Oil Can and Liquid Measure.

Liq'uid Weigh'er. A device in which a vessel is placed on a scale beneath a faucet, weights in the other scale representing the quantity required and the tare of the vessel. As the scale descends it trips a lever and turns off the spigot. — *Watts.*

Lis'sa-jou's Curves. The method of combining rectangular vibrations to form beautiful and instructive figures consisted in the first place of a pen connected with a pendulum swinging in one plane, and tracing lines upon a platform which reciprocated in a plane at right angles to that of the pen pendulum.

Next came a pen connected with two pendulums swinging in planes at right angles to each other, the tracing being a line, the result of the two impulses.

Shifting to the merely visual; two tuning-forks carrying small mirrors and vibrating at right angles to each other, threw pencils of light upon a screen and it was soon seen, though not unexpected, that the consonances and dissonances of sounds were admirably shown by the optical method, visible in an auditorium.

In the original method the dying action of the pendulums as they sank to rest diminished the amplitudes of the curves; differences in their rates curiously complicated the curves described; the center of gravity and therefore the time of oscillation of the pendulums being adjustable to any required amount, the proportions between the vibrations of the two could be brought to any desired ratio to represent harmony, unison, discord, or indeed to illustrate all the harmonic combinations of waves of sound and music.

An addition, whereby the paper may be slowly rotated by a clock-work movement, while the vibrations are going on, gives extraordinary figures, some of which illustrate the laws of interference and the polarization of light.

To avoid the characteristics due to the decression of motion of the pendulums, Hopkins devised apparatus vibrated by electricity. In one case two reeds or tongues vibrated by an electric current and connected with a single mirror, which latter receives a beam from a lantern and reflects the errant beam through a lens and upon a screen; the play of the curve being the resultant of the two rectangular vibratory movements. See ELECTRICAL DIAPASON, pp. 293, 294, *supra*.

A simple form, using two spring slips with apertures, and vibrating in planes at right angles, is described by Hopkins, * "*Scientific American*," xliii. 259. The length and weight of the slips determine the period of their vibration, the force applied in snapping them the amplitude of the vibrations.

"If the two springs are set in motion by snapping them simultaneously with the thumb and finger, the square aperture formed by the intersection of the slits in the two cards will move so rapidly as to appear like a band of light, *i. e.*, supposing the operator to be looking through the aperture toward the light. If the two springs vibrate in unison the band will either be perfectly straight, bisecting the angle formed by the two springs, or it will be elliptical or circular. By changing the period of the vibration of one of the springs so that the periods of the two springs will be to each other as 1 : 2, the band of light will assume the form of the figure 8. Make the vibrations as 2 : 3, and the figure representing the fifth will be formed, and so on throughout the whole range of compound vibrations.

"To project these figures on a screen all that is required is to place a lamp at one side of the slitted cards, and a magnifying glass of about 6″ focus on the other side. An easy way to hold the magnifying glass in position is to place the handle in a hole in a board, the latter resting on the top of the box. This rude device admits of moving the lens forward or backward, and to the right or left, as may be required" — *Hopkins*.

The subject may be pursued by reference to the following captions, and citations *passim* : —

See CURVE INSTRUMENT, p. 236: ELECTRICAL DIAPASON, p. 293: FLAME MANOMETER, Fig. 1046, p. 344: HARMONOGRAPH, p. 439; INTERFERENCE APPARATUS, Fig. 1159, p. 502, *supra;* and PENDULUM INSTRUMENT, *infra*.

List'ing Plow. A double-moldboard plow, used in listing; that is, throwing up the soil into ridges. A plan adopted in some cultures, such as beet, and some garden crops.

Lith'o-gram. A name given to the gelatine copying process. See COPYGRAPH, p. 220, *supra;* GELATINE COPYING PROCESS, pp. 396, 397, *Ibid.*, and references *passim*.

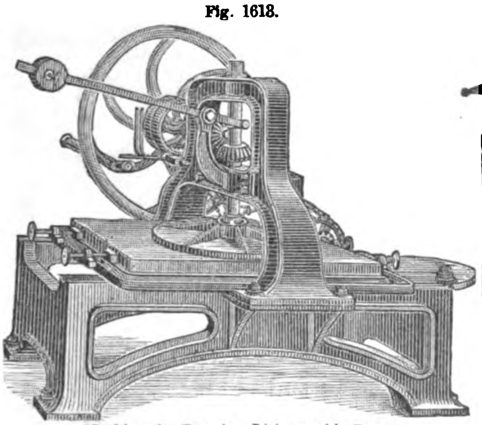
Lith'o-graph'ic Pa'per.

For Transfer Purposes: Chinese paper is much used, and is worked just as it comes from China, being rough in appearance, full of straws and imperfections. These imperfections are removed by the transferer while the paper is damp, as much as possible.

India Proof Paper: Chinese paper, smooth in appearance, different in shades of color or tints. These tints are selected by the lithographer according to the different subjects he may have to prove; for instance, a portrait of a lady of light complexion on light colored India paper; and the reverse when needed. It goes from China to France, and is there calendered and worked over, that the best printed results may be obtained therefrom, and is consequently much more expensive, costing at least three times as much as the Chinese transfer paper.

Lith'o-graph'ic Stone Dres'ser. A machine

Fig. 1613.



Machine for Dressing Lithographic Stones.

for facing lithographic stones. In *Jullien's* machine (Fr.), Fig. 1613, the stone lies upon the flat platen, face upward, and the circular wheel rotates above, while the stone is traversed backward and forward by means of a pitman connected to the platen and moved by wrist connection with a wheel beneath. The stroke of the platen is regulated by the adjustment of the wrist in a slot, towards or from the center of rotation, and the pressure of the wheel on the stone is regulated by means of a counterbalance weight on an arm which is seen projecting to the left.

In another form of machine, shown at the Vienna Exposition, for polishing off the faces of stone, preparing it for the engraver, the stone is laid upon a solid table, which is stationary, having a large iron platen suspended over it, and held by an arm extending back some 10′, and attached to a wheel lying horizontally and supported by a shaft 2′ long extending from below, where it is connected by cog-wheels to another shaft driven by pulleys and belting from the main shaft. This arm runs between two round blocks or loose pulleys placed in the center on either side of the arm, so that when set in motion this platen of iron moves backward and forward over the stone, while the blocks or pulleys in the center give it a side motion, at the same rate with that of the revolution of the wheel in the rear, thus making the iron platen travel more slowly over the surface of the stone, and giving it the same motion as when operated by hand. It covers the entire surface of a large stone with a uniform polishing. The stone is supplied with water from pipes properly attached, and an occasional supply of sand is furnished by the attendant.

Supply of lithographic stones "*Scientific Amer. Sup.*," 1292.

Lith'o-la-pax'y Ap'pa-ra'tus. (*Surgical.*) *Bigelow's* apparatus for rapid lithotrity with evacuation. It consists of a lithotritor and syringe, the former and the tube of the latter being introduced alternately through the urethra.

The lithotritor is shown at *a*, Fig. 2978, p. 1336, "*Mech. Dict.*" *Lithotritor* and *lithontriptor* seem to be synonymous terms. *Litholabe, lithoprione, lithoclast, lithorineur*, are terms belonging to special instruments of the same class, and approximately the same duty.

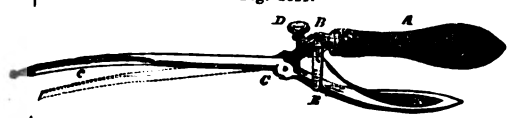
Lith'o-pone. Sulphide of zinc; used as a paint. P. Krupp's Patent.

Lith'o-tome. A bistoury or scalpel for making the incision in lithotomy. The instrument may have a special name derived from structure or mode of application: *gorget, bisector, bistoury-caché, cystotome.*

Hutchison's double-bladed lithotome is shown in Fig. 1614. The handle *A* holds a bistoury, *B*, curved on the flat, its cutting edge looking towards the right, the back being thick and terminating in a rounded probe-point to fit the groove of a lithotomy staff.

A second bistoury, *C*, is joined to the other by means of a screw, its beveled point resting against a section of the probe of the first one, and its cutting edge looking towards the

Fig. 1614.



Hutchison's Lithotome.

left. By this arrangement the blunt back of one blade conceals and protects the edge of the other, so that when the screw *D* is brought home the two blades become solid like a rounded staff. By approximating the wooden handle of the first and the steel lever of the second bistouries, the cutting edges are diverged, the extent of the incision being regulated by the screw *D* and measured by the index-plate *E*.

Li-thot'ri-ty and Li-thot'o-my In'stru-ments. (*Surgical.*) The list includes: —

Anklets and wristlets to secure the patient.
Forceps to grasp and crush the stone.
Lithoclast *b*, Fig. 2978, p. 1336, "*Mech. Dict.*"
Lithotrite *a*, *Ibid.*

The following are from Part III., *Tiemann's* "*Armamentarium Chirurgicum*" : —

Fenestrated forceps	Fig. 137.
Lithoclast	Fig. 158, 158 *b*, 173.
Maisonneuve's stone-crusher	Fig. 138.
Curved forceps	Fig. 140.
Straight forceps	Fig. 136, 156 *b*.
Goulay's lithoclast	Fig. 158.
Lithotomy staff	Figs. 131-135.
Blunt gorget	Fig. 189.
Gorget and staff	Figs. 149, 149 *f*.
Scalpels and bistouries	Page 40.
Lithotomes	Pages 40, 41.
Lithotomy scoop	Fig. 149 *e*.
Tenacula	Fig. 154.
Aponeurotome	Fig. 155.
Artery compressor	Fig. 156.
Hooked gorget	Fig. 152.
Dilators	Figs. 157, 157 *b*.
Hydro-hemostat	Fig. 157 *c*.
Evacuating apparatus	Figs. 159-164.
Catheters	Figs. 165-168.
Urethral forceps	Figs. 169-171.
Urethral scoop	Fig. 172.
Lithotome	Fig. 34, Sup.

Lit'mus Paper. Unsized paper colored with litmus (*Cryophora tinctoria*), and used as a test of the presence of acid or alkalies. It turns red with acids, blue with alkalies.

Lit'ter Cut'ter. A machine of the nature of a chaff-cutter, for cutting straw into lengths for bedding for animals.

Lit'tle Gi'ant. (*Mining.*) A jointed iron nozzle used in placer mining. See HYDRAULICKING, *supra.*

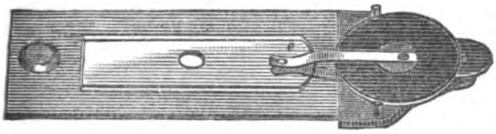
Live Ring. (*Bridge.*) A circular gang of wheels, as used in the turn-tables of draw-bridges, and in those for locomotives.

The *live-ring* of the Rock Island draw-bridge is composed of 34 wheels, each 30″ in diameter and 14″ face. The traveling weight borne by each of the wheels is 44,250 pounds.

Live Trap. (*Optics.*) A contrivance for keeping a live object in the field of a microscope without preventing its movement. This is done by making a hole in a piece of glass of the size of the field of view of the microscope and covering the same with two slips of thin glass. The parts of the apparatus can all be taken apart for purpose of cleaning.

It is accompanied with a glass trough into which one end of the live trap can be placed so as to supply the small aper-

Fig. 1615.

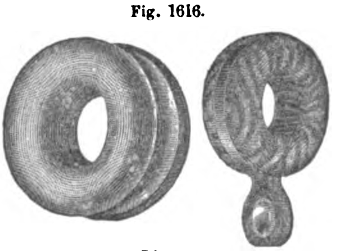


Live Trap.

ture with fresh water by capillary attraction when the object under examination is in water. The apparatus enables the object to be kept alive many days.

Liz'ard. (*Nautical.*) Otherwise known as a buntline bull's-eye. A large thimble worked into the foot-rope of a sail.

Fig. 1616.



Lizards.

a. Lizard.
b. Iron-strapped lizard for awning-blocks.

Lla'nos. (*Fabric.*) A French dress goods woven on a taffeta loom; it has a cotton warp and a weft of mohair, or mohair mixed with silk.

The warp is composed of 3 white threads; the weft is violet, blue, or black, which gives reflection to the stuff.

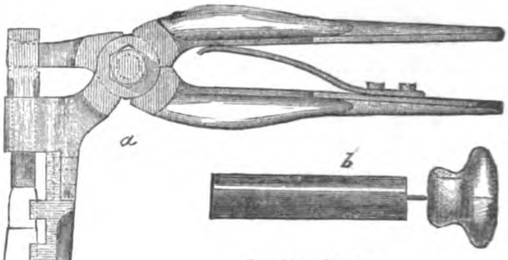
Load'er. An instrument for re-loading cartridge shells. (Fig. 1617.)

The instrument *a* has a prop for the shell and a plunger for the loading, the pressure being given by approaching the handles in manner of a forceps.

b is a powder or shot rammer, and at one end has a point which may be employed to dislodge the spent percussion shell.

a and *b* are manifestly not intended for the same shell. *a* is shown compressing the bullet into a bottle-shaped shell.

Fig. 1617.



Cartridge Loaders.

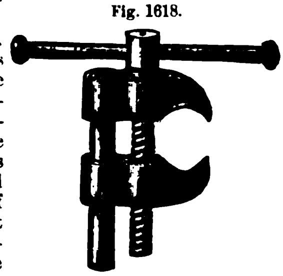
Load'ing Plug. A rammer for loading shells, which can also be used for extracting the caps from the spent capsules by changing ends with the removable head. *b* Fig. 1617.

Load'ing Ma-chine'. (*Cartridge.*) A machine for loading the shells of cartridges. The shells are fed in on a revolving wheel; 72 grains of powder are let in from above by a funnel from the can, and on revolving farther the bullet is pressed into the neck of the shell.

Loam and Sand Core. A dry-sand core, composed of sharp sand, loam, and horse manure. In these cores the loam is used in place of flour or other substances for giving strength and adhesiveness to the sharp sand.

Lob'ster Claw. A screw jack used in setting rigging. See RIGGER SCREW.

Fig. 1618.



Lobster Claw.

Lo'cal Ac'tion. (*Electricity.*) This takes place when the zincs require amalgamation. A hissing sound in the cells when the poles are not connected indicates a waste of battery material. It is remedied by re-amalgamating the zincs.

Lock. See for history and varieties, pp. 1338, 1342, "*Mech. Dict.*" A list is given on the last-mentioned page.

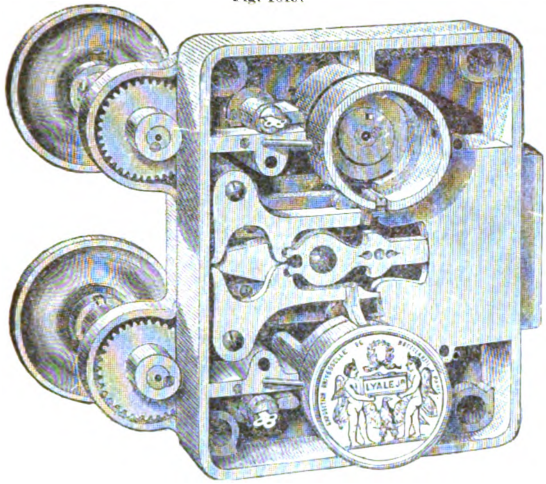
The Yale double-dial lock, Fig. 1619, is a double combination bank or safe lock having two dials, each operating its own set of tumblers and bolts, so that two persons, each in possession of his own combination, must be present in order to unlock it. It is evident that the two dials may be set on the same combination, or one person may possess the two combinations, if the double security be not desired, temporarily.

The *Time Lock* has a chronometer movement inside by which the bolt is permitted to unlock at predetermined times. Set to lock at 4 P. M., and to open at 9 A. M., for instance, the door being closed at the stated time (4), the unlocking mechanism cannot be operated until the 17 hours have elapsed. By a Sunday attachment, the recurrent 7th days an additional 24 hours is added to the 17 (=41 hours), during which the lock cannot be operated, nor the door opened.

Fig. 1620 shows the appearance of the lock, and enables its principles to be sufficiently explained.

The only parts of the lock which are not visible are the two chronometer movements which are concealed by the plate, and which cause the two dials to move in the directions indicated by the arrows. These dials are constructed with 24 pins representing the 24 hours, and colored white and black, to indicate the day hours and night hours. When these pins are pushed in they form a track on which the rollers of the yoke ride. The movement of the yoke up and down moves the lever, to which the yoke is pivoted, up and down also. It is necessary that both sides of the yoke should be pushed up by the revolution of the dials, in order

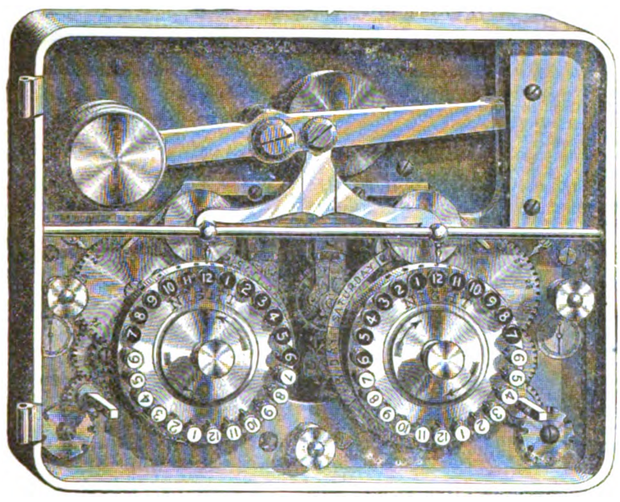
Fig. 1619.



Yale Double-dial Lock.

to push up the lever. When the pins of the dials are pulled out, the track on which the rollers of the yoke ride is broken away, and the yoke and lever are allowed to drop by gravity. At the left-hand end of the lever, as you look towards the cut, is shown a counterbalance weight, while the other end of the lever works in a slot in a movable dog or bolt. The sole object of the time lock is to cause this bolt to move up

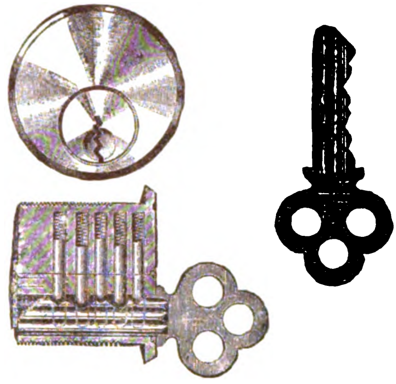
Fig. 1620.



Yale Time Lock with Sunday Attachment. (*Cover Removed.*)

and down at certain regular intervals. When the bolt is moved up it closes a hole in the case into which a projection on the string piece of the bolt work passes, when the bolt work is retracted. When the bolt drops the projection can pass freely into the hole and the bolt work be retracted. The construction of the bolt is such that pressure upon it causes no pressure whatever on the lever, but the pressure is resisted by a solid block backed up by the case of the lock. The operation of the lock is therefore as follows: The user selects the hour at which he wishes the lock to lock up, and pushes in that pin, and pushes in all the succeeding pins up to the hour when he wishes the lock to unlock, doing this on both dials, and setting the dials to the proper hour of the day by the pointer at the top of each. Now, so long as the movements are running, the pins, which are pushed in, will support the yoke, lever, and bolt, and keep the lock locked, while it will remain unlocked during all the hours represented by the pins which are pulled out. These periods can be varied at will. If the safe door is left open longer than usual, so that the projection from the bolt work is in the hole of the lock case when the hour comes at which the lock is set to lock, the rollers of the yoke will be raised, but the only effect will be to separate

Fig. 1621.



Yale Lock.

the yoke at the center, and to cause a spring which holds it together at that point to spread. When the bolt work is thrown forward, and the lever and bolt are free to rise, the spring will contract and push them up in the locked position. The lock is provided with what is called a Sunday attachment, that is, with a segment or track which comes under the rollers every seventh day and keeps the lock in a locked position over Sunday, during the hours when it will unlock on other days. This can be adjusted so as to lock up over a holiday also. To prevent the lock running down in the locked position so as to cause a lock-out, a supplemental unlocking device is provided, and consists of a coiled spring situated back of the lever. This is held coiled by two triggers which extend over the wheels, which indicate the number of hours that the movements are wound up to run. As the movements run down these wheels revolve with them, and just before either movement completely runs down a pin trips the trigger, and releases the spring which pushes down the lever and bolt, spreading the yoke apart.

Yale's pin lock, which is operated by a flat key, was a new departure, seen in position in the lock in the sectional view, Fig. 1621.

In the *Yale* lock the *escutcheon* or *tumbler case*, inclosing the pins upon which the bits of the key operate, is placed near the surface of the door, projecting slightly, so that a long key shank is dispensed with, the bow and bits brought closely together, and the depth of the escutcheon decides the length of the key, without regard to the thickness of the door.

The escutcheon cylinder is an exterior shell, containing in its lower part a smaller cylinder, from which rises a rib of metal containing the *pin chambers*, and within which is the *plug*, attached to the inner end of which is the cam that imparts motion to the bolt. This plug also contains the key hole.

The escutcheon contains five holes, or *pin chambers*, each formed partly in the shell and partly in the plug, therefore a pin which filled one of these holes would prevent the rotation of the plug, but, if the pin were cut in two, the joint corresponding with that between the plug and its hole, the plug could revolve freely, carrying with it one half of the pin, and leaving the other half in that part of the pin-chamber contained in the shell. Such is precisely the construction of the lock and its great element of security. The line of junction may be seen in the upper view, Fig. 1621.

Each pin is in two parts, — the upper termed the *driver*, the lower the *pin*, — and above each driver is a light spring, tending to press drivers and pins downwards. In this position the drivers intersect the joint between the shell and the plug, completely preventing the rotation of the latter. To open the lock, therefore, all the pins must be raised simultaneously to just the proper height, which can be done only by the right key, since a variation of one-fiftieth of an inch in the elevation of either of the pins will prevent the opening of the lock.

The width of the key admits of ten different *bittings*, or depth of notches, therefore a lock with but one pin could be variously *set up*, so as to be opened by ten different keys. In a lock with two pins the number of changes, or varieties of keys, will be 100; three pins, 1,000; four pins, 10,000; five pins, 100,000: six pins, 1,000,000; seven pins, 10,000,000. The least number of pins contained in any of the Yale locks is 4, as in drawer and desk locks; the night-latches have 5; the post-office, heavy store-door locks, etc., 6; and the "safe-deposit" locks — for inside doors of safes, vaults, etc. — have 7 pins.

The new Yale corrugated key consists of the original plate key altered by having its blade, or portion which enters the lock, corrugated in longitudinal lines. By special machines of great ingenuity, the lock has formed in it a key-hole of sinuous cross section conforming to that of the key. The key and its hole are interlocked throughout their entire length, and tilting of the key in its hole is impossible. The lock cannot be operated by any key but its own, nor can it be picked except by some tool which will raise the tumblers. The shape of the key-hole renders it impossible for any tool to raise the tumblers, because, even if one be made small enough to be inserted in the key-hole, it cannot be moved up and down.

See under the following heads: —

- Carriage spring-lock.
- Coach lock.
- Combination lock.
- Dead lock.
- Drawer lock.
- Gate latch.
- Jail lock.
- Janus-faced lock.
- Keyless lock.
- Letter lock.
- Night latch.
- Nut lock.
- Padlock.
- Sash lock.
- Scandinavian lock.
- Safe lock.
- Seal lock.
- Seat lock.
- Time lock.
- Window latch.
- Wagon lock.
- Yale lock.

Lock Bed'der. A machine for sinking a recess in a gun-stock for the lock.

The general appearance of this machine is similar to a revolving head gang drilling-machine containing five spindles with their cutters. The rifle stock is chucked in a fixed position; to the right of it, and also fixed, is an iron section of that part of the stock into which the lock is bedded: the iron section is used as a guide or former. The machine being started, the first operation is to drill two holes, the position of which is regulated by a pin which reaches the iron former a little in advance of the drill reaching the rifle stock, so that the position can be accurately determined. One hole being drilled, the spindles carrying the drill and the guide pin, which spindles are in the same frame and operate together, are raised, the machine head is swung one fifth of a revolution, and the first cutter comes in position to operate. On lowering the cutter spindle there descends with it, and slightly in advance of it, a guide pin in the iron former, and when the guide pin is well within the iron former the cutter reaches the surface of the wood, and is guided by the operator moving the head so that the guide pin travels all around the edge of the recess in the former. The motion of the guide pin and of the cutter being laterally identical, the operator has but to enter the cutter as far into the rifle stock as a stop provided for the purpose will admit, and then to move the frame carrying the guide pin and cutter so that the guide pin moves and touches all around the sides of the recess in the iron former. The recess in the rifle-stock will be then the exact counterpart, in size, form, and depth, of that in the pattern. The whole operation is but a repetition of the above, with the remaining cutters swung one after the other into position, the one iron former answering to regulate the lateral movement of them all. The speed at which the cutters revolve is about 8,000 revolutions per minute. As soon, however, as each drill or cutter is swung out of position, it stops running, which prevents wear and tear.

Lock Chain. A short chain by which a padlock is fastened to a door or car so as to be irremovable.

Lock Fau'cet. One the spigot of which can only be turned by a removable key.

Lock Gate. The gate of a bay in a canal lock.

Designs for hanging lock gates, and valve for locks. See Plates III. (*a*), III. (*b*), IV., "*Report of Chief of Engineers, U. S. Army*," 1876, vol. ii., Part II., p. 416 *et seq.*

A report "*On the Construction of Iron Lock Gates for the Harbors of the Weser River, Germany*" (translation), reproduced by the Corps of Engineers, U. S. Army, forms a quarto brochure, Washington, 1873.

Lock Hook. (*Fishing.*) A supplementary hook to spring upon and secure a fish which draws on the bait.

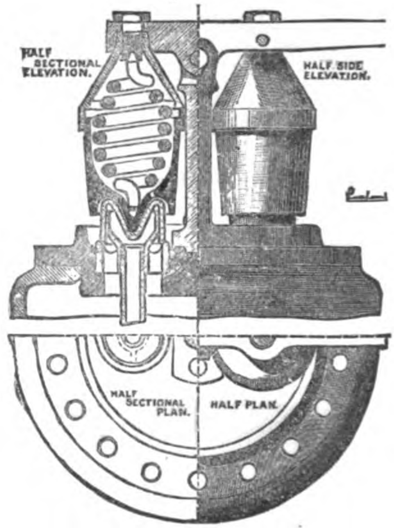
See "*Report of U. S. Fish Commissioners*," p. 275, Part I., 1873, and Fig. 2000, "*Mech. Dict.*" See also Fish Hook, p. 841, *supra*.

Lock'ing Plate. A nut-lock; see 45 illustrations, Fig. 3350, p. 1538, "*Mech. Dict.*"

In Finney's (Br.), a small pin is fixed a short distance beyond the nut. A circular plate, divided equally by 17 notches, fits easily over the nut in any of its six positions. The principle of the invention is the same as that of the vernier scale. As there are 17 notches in the plate it follows that three of them represent just one-seventeenth of one side of the hexagon nut; so that if the plate be moved round three notches, it will not fit unless the latter be moved round a distance equaling one-seventeenth of one side of the hexagon, or a distance which equals the one hundred and second part of a whole turn.

"*Iron Age*," xxii., August 1, p. 19.

Fig. 1622.



Lock-up Safety Valve.

Lock'-jaw In'stru-ment. (*Surgical.*) Apparatus for forcing open the jaws.

Goodwillie's operates by a screw which acts upon two hinged valves, introduced, wedge-fashion, between the teeth.

Westmoreland's has two parallel plates expanded by a screw.

Some of the heavier forms of *speculi oris* may be similarly used.

Lock Mor'tis-ing Ma-chine'. A machine for boring holes in the edges of doors to hold mortise locks.

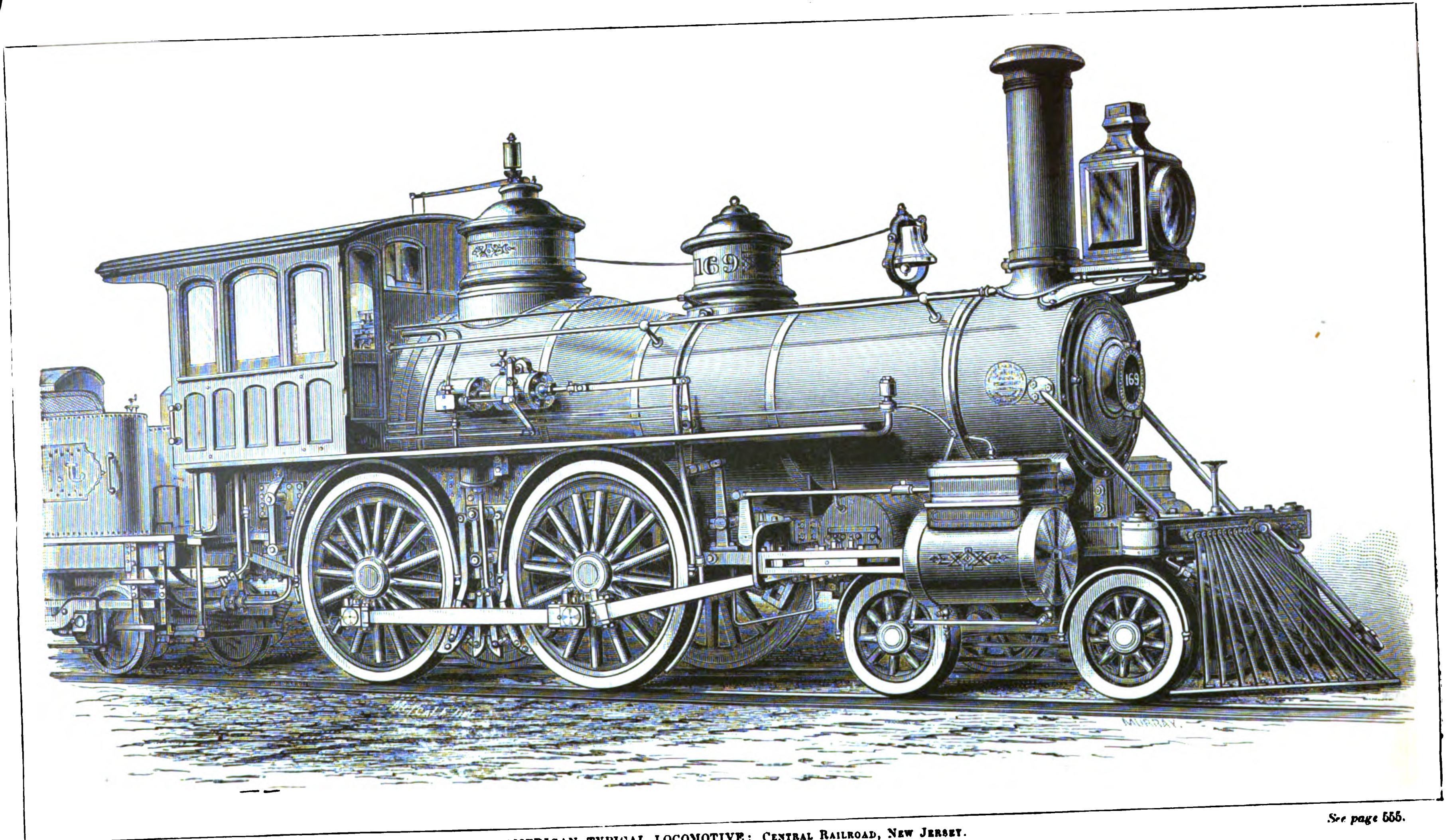
The machine is clamped to the door, spanning the edge at the height desired to set the lock; a bit of the width of the lock body is placed in the bit-holder, which works in guides to secure verticality, and is rotated by hand-crank and gearing. An adjustable stop on the bit-stock determines the depth.

Lock Nut. See Fig. 3350, p. 1538, for numerous varieties.

Locking plate.	
Finney, Br.	* "*Engineer*," xlv. 464.
Lock nut, *Ibbotson*, Br.	* "*Engineer*," xlvii. 352.
Stouffer	* "*Iron Age*," xxi., Feb. 28, p. 1.
Wile, Br.	* "*Engineer*," xliii. 276.
	* "*Engineer*," xlvii. 78.

Lock Seal. A piece of glass, lead, or paper over the key-hole of a padlock, so that the latter cannot be tampered with without defacing the seal. Used on cars containing goods *in transitu*, in bond, etc.

Lock Switch. A form of switch board used in telegraphy.



See page 555.

AMERICAN TYPICAL LOCOMOTIVE: CENTRAL RAILROAD, NEW JERSEY.

PLATE XXVI.

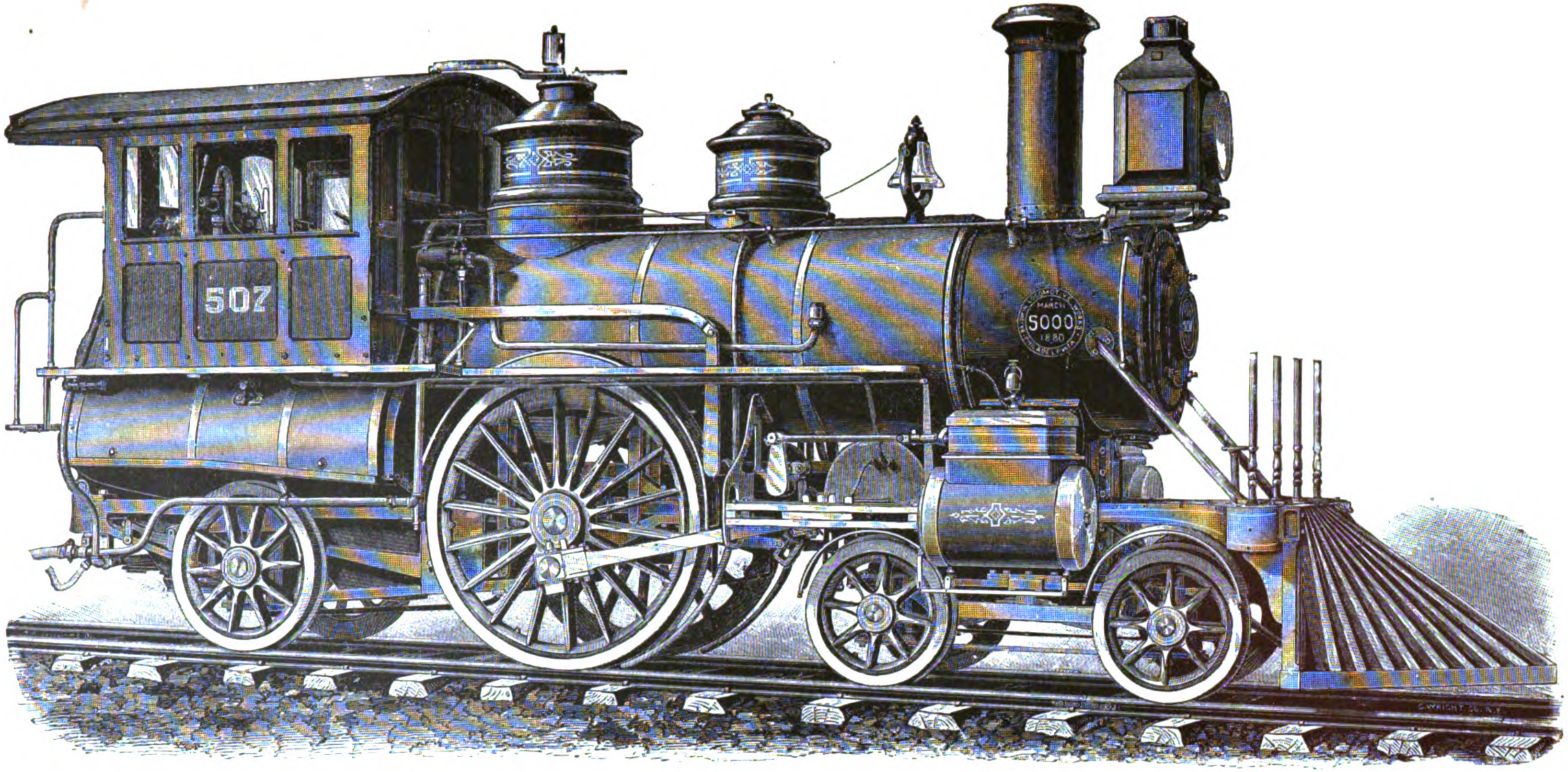


PLATE XXVII

FAST PASSENGER LOCOMOTIVE. BOUND BROOK LINE, NEW YORK AND PHILADELPHIA.

See page 555.

Two sets of brass bars are arranged at right angles to each other on opposite sides of a wooden frame. The connection is made between any two intersecting bars by a metallic peg, provided with a spiral spring, which, when the peg is inserted and secured in its place, presses against the two bars, forming an electric connection. See PIN SWITCH.

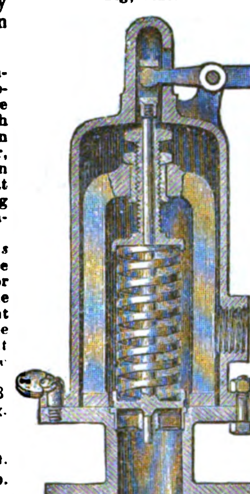
Lock′-up Safe′ty Valve. One in which the weight or spring is in a closed chamber which cannot be tampered with, or changed, except by one having possession of the key.

Fig. 1622 is *Wilson's* improvement on *Klotz's* safety valve. The springs are not accessible, although the engineer can ascertain by lifting the trying lever, whether the valves are in good order. Valve and seat are of gun-metal, having the same ratio of expansion.

Fig. 1623 is *Stone's* locked-up safety valve (Br.), in which the lever operates in a yoke on the valve-stem, being efficient in lifting, to prove the condition of the valve, but powerless to add pressure thereto.

See also Fig. 2983, p. 1343 "*Mech. Dict.*," and Fig. 4544, p. 2019, *Ibid.*

Fig. 1623.



Lock-up Safety Valve.

Lo′co-mo′tive. See "*Mech. Dict.*," pp. 1343–1348.

Plate XXVI. gives a view of a first-class, fast engine of the ordinary American type, with four connected driving wheels and a four-wheeled truck. It was built by the Baldwin Locomotive Works, for the Central Railroad of New Jersey, for fast passenger service. The special points of improvement in construction and proportion are carefully and elaborately detailed, accompanied by sectional views, in the "*American Machinist*," * v., pp. 1–3, January 7, 1882, to the publishers of which journal the author acknowledges his indebtedness for the plate.

"The train usually consists of five cars, viz., one baggage, one express, one Pullman drawing-room coach, and two ordinary passenger coaches. With this train, notwithstanding the fact that the smoke-stack is well inclosed within the smoke-box, to prevent throwing fire, plenty of steam is generated at all parts of the road. The regular schedule time between Jersey City and Bound Brook is 37 minutes. This distance has been run by No. 169 in 33 minutes. Three miles upon the route have been run in 2 minutes and 24½ seconds, — the same distance frequently covered in 2½ minutes. The quickest mile ever run by this locomotive was in 45 seconds, — timed between mile posts with a stop-watch." — "*American Machinist.*"

The following are some of the principal dimensions : —

Gage of road	4′ 8½″
Weight (running)	93,000 lbs.
Cylinder diameter	18″
Stroke	24″
Driving wheel, diameter	68″
Wheels, diameter	32″
Boiler, thickness, steel	⅜″
Diameter	52″
Fire-box, length	125¼″
Width	43⅜″
Tubes, number	200
Diameter	2″
Length	11′ 5½″
Grate, area, sq.	38′
Heating surface, box, sq.	145′
Tubes, sq.	1175′
Total, sq.	1320′
Steam power, normal	140 lbs.

A freight locomotive by Rogers, having four pairs of coupled drivers, is shown in Fig. 1624.

The original "Consolidation" locomotive was built in 1866 from the plans of Wm. Alex. Mitchell, at the Baldwin Works in Philadelphia. This type of locomotive has four pairs of drivers and a two-wheeled pony truck in front. It was originally built to overcome some steep grades on the Lehigh Valley Railway, and specially for the Mahoning Plain, which rises 133′ to the mile.

Plate XXVII., for which the author acknowledges indebtedness to the "*Railroad Gazette*," gives a view of locomotive 5000, built at the Baldwin Locomotive Works, Philadelphia, for the fast train between New York and Philadelphia on the Bound-Brook route. A careful description with sections and elevations is in the journal mentioned, * vol. xxiv., 246, 315.

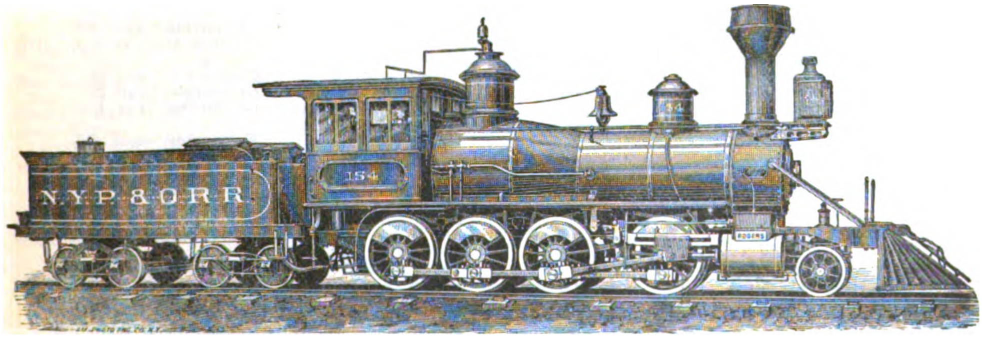
"This new locomotive has a single pair of driving wheels 6½′ in diameter, in place of coupled drivers of 5½′ in diameter. In the latter form of engines run at high speed there is danger that the coupling rods connecting the driving wheels will be broken by centrifugal force. The larger wheel also reduces the number of revolutions per mile of run. In the new locomotive the boiler has 1400′ square of heating surface and about 56′ square of grate surface. The dimensions are as follows : —

Diameter of cylinder, 18″.
Length of stroke, 24″
Diameter of driving wheel, 78″.
Wheel base, 21′ 1″.
Distance from center of driving wheel to center of trailing wheel, 8′
Boiler, 7-16″ steel . . . 52″ in diameter.
No. of tubes, 198 . . . 2″ in diameter and 12′ 2¾″ long.
Fire-box . . . . 96½″ by 84″.
Capacity of the tender . . . . 3,800 gallons.
When filled with water and coal, 70,000 pounds.

"The weight of the engine is 85,000 lbs., and is so disposed that by an alteration of fulcrum points additional weight can be thrown on the drivers at the time of starting.

"At a trial trip on May 14th, the engine was attached to a train of four cars, each weighing about 42,000 pounds, making the weight of the train complete, about 148 tons. The run was made at rates ranging from 27 miles an hour, between Ninth and Green and Wayne stations, to 62 miles an

Fig. 1624.



Freight Locomotive, "Consolidation" Type.

hour, between Trenton Junction and Bound Brook, the time from Ninth and Green to Jersey City (89.4 miles) being 98 minutes, or at the rate of 54¾ miles per hour. On the return trip the run was made in 100 minutes. In a former trip the engine developed a speed of nearly 79 miles an hour. In these trial trips the engine consumed 36 gallons or 300 pounds of water per minute." — *Le Van.*

Dimensions of Mogul Passenger Locomotive, No. 600, Built by Baltimore and Ohio R. R. Co.

Gage of road		4′ 8½″
Driving wheels, number		6
Diameter		60″
Truck wheel, number		2
Diameter		31″
Total wheel base		22′ 11″
Cylinders, diameter		19″
Stroke		26″
Steam ports		1¼″ × 15¼″
Exhaust		2¼″ × 15¼″
Throw of eccentrics		5½″
Boiler, diameter		50″
Fire-box, length inside		99 7-16″
Length outside		9′
Width on top		45⅞″
Width on bottom		34⅜″
Depth in front		4′ 8″
Depth in back		3′ 4″
Grate surface		23.7′ sq.
Heating surface in fire-box	122′ sq.	
Flues	1150′ sq.	
Total	——	1272′ sq.
Flues, length		11′ 10″
Number		165
Diameter		2¼″
Weight on truck wheels	13,850 lbs.	
Driving wheels	76,550 lbs.	
Total weight, running	————	90,400 lbs.

Locomotives for steep gradients are of several kinds, among which may be noticed the following: —

1. The Fell system, so called, in which a pair of horizontally rotating wheels or rollers embrace a central rail. This was used by him on Mt. Cenis and Mt. Washington. See also Vignoles and Ericsson's central rail (Fig. 1210, "*Mech. Dict.*"). This was patented by these parties in England in 1830, which is doubtless much older than Fell's invention. Kollman's English patent of 1836; Sellers' United States patent of 1835.

2. The Righi railway (Fig. 4124, "*Mech. Dict.*"), which has central rack engaged by spur wheel on the locomotive. This was patented in England by Blenkinsop in 1811, Snowden in 1824, Easton in 1825.

3. Coleman's (English patent 1845), in which a screw beneath the locomotive works into a line of rollers laid down midway between the rails.

4. James' (English patent, 1825), converting each wheel of the train into a driver. A horizontal shaft extending beneath the carriages from the locomotive throughout the train, rotated by the locomotive and having bevel wheel connection with the axle of each car. See p. 1861, "*Mech. Dict.*"

•5. Handyside's system, in which the locomotive, provided with a winding drum and wire rope, proceeds up the incline in advance of the train, and, after being anchored to the rails, draws up the train after it by the wire rope.

6. Appleby's system, in which a chain is laid between the rails and passed over by a chain wheel of the same diameter at the pitch-line as the wheels of the locomotive. The engine hauls by adhesion on the level and lays hold of the chain when going up or down steep grades.

For most of these engines vertical boilers have been used on account of the small foundation space they occupy, and because there is less uncovering of the flues when the boiler is on a heavy grade.

The locomotive attachment of *Wootten & Hazel* is designed to enable a locomotive on one track to impel an engine or car on another. A ram is pivoted to the locomotive and may be folded against the same or extended by an adjustable spring-brace rod, to a position to engage the car on a side track to move it forward.

The fast trip from New York to San Francisco was made in 83 hours, 34 minutes.

The "Uncle Dick" locomotive for the Atchison, Topeka and Santa Fé railway weighs 65 tons, and is 60′ long from the head-light to the rear of the tender.

Boiler, length	21′
Cylinder, diameter	20″
Stroke	26″
Drivers (8), diameter	42″
Restraining force of brakes	75 tons.

The largest locomotive at Vienna weighed 70 tons, and could draw 1000 tons at 30 miles per hour.

See also under various heads: —

Back-truck.	Mining.
Coal-dust burning.	Mogul.
Compound.	Narrow gage.
Compressed air.	Plantation.
Consolidation.	Pony-truck.
Farm.	Portable engine.
Fire engine.	Steam plowing.
Fireless.	Switching.
Geared.	Tank.
Ice.	Traction engine.
Logging.	Tramway.
Mahovo.	Waste burning.

See the following references: —

Air locomotive	page 16, *supra*.
Anthracite dust, *Wootten*	* "*R. R. Gazette*," xxiii. 155
	* "*Engineer*," xxvii. 67.
	* "*Scientific American Sup.*," 4012
Automobile, *Brunner*	* "*Technologiste*," xxxix. 88.
Austrian	* "*Engineering*," xxvi. 86.
Austrian boiler	* "*R. R. Gazette*," xxii. 454.
Austrian State Railway. (6 types)	*Thurston's* "*Vienna Report*," ii. 72–77.
Austrian, details of	* "*Engineering*," xxvi. 150, 230.
Austrian boiler. *Nord-Bahn*	* "*Engineering*," xxvi. 274.
Austrian State Ry.	* "*R. R. Gaz.*," xxii. 537, 549–559.
Aveling & Porter, Road and farm	* "*Scientific American*," xl. 102.
Baldwin	* "*Scientific American Sup.*," 595
"American"	* "*R. R. Gazette*," viii. 214.
"Consolidation"	* "*R. R. Gazette*," viii. 249
"Mogul"	* "*R. R. Gazette*," viii. 261.
Belgian, *Carel*	*Thurston's* "*Vienna Rept.*," ii. 70.
Comp. de Fives-Lille	*Ibid.*, ii. 62.
Belgian State Ry., combined with car	* "*Engineer*," xlvii. 1.
Boiler, *Funiack*	* "*Railroad Gazette*," xxiii. 263.
Boilers, *Verderber*, Hung.	* "*Engineering*," xxvii. 114.
	* "*Railroad Gazette*," xxiii. 110.
	* "*Scientific American Sup.*," 2736.
Brazil, Dom Pedro Ry.	* "*Engine'g*," xxii. 155; xxiii. 90.
	* "*Scientific American Sup.*," 659.
Balt. & O., No. 6, 1835, *Gillingham & Winans*	* "*Engineering*," xxii. 24.
British and Am. comp.	"*Scientific American Sup.*," 962.
Central Railway, N. Y.	* "*Engineering*," xxii. 98.
Centennial, at, (18) tables	"*Engineering*," xxii. 10.
Centennial, at, old time	"*Scientific American Sup.*," 324.
Charts and cuts	"*Scientific American Sup.*," 548
Chinese, first, *Ransome*	* "*Engineering*," xxii. 29.
& Rapier, Br.	* "*Scientific American Sup.*," 583.
Collision, embrace of	* "*Railroad Gazette*," viii. 254.
Compared with horses	"*Scientific American Sup.*," 2001.
Compound, *Mallet*, Fr.	* "*Engineering*," xxvii. 516; xxviii. 17, 58.
	"*Technologiste*," xxxvii. 114.
(21 Figs.)	* "*Engineer*," xlviii. 85.
	"*Van Nostrand's Mag.*," xv. 379; xxii. 6; xxiii. 418.
	* "*Iron Age*," xxiv., Aug. 7, p. 15.
	"*Scientific Amer.*," xxxvii. 260.
Compressed air. *Beaumont*, Br.	"*Scientific American Sup.*," 966, 1041, * 3943.
	"*Van Nostr. Mag.*," xxiii. 225.

See Compressed Air Engines, p. 215, *supra*.

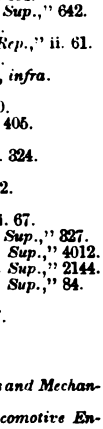
Consolidation, *Baldwin*	"*Scientific American Sup.*," 371.
Atchison, Topeka, &	* "*Engineering*," xxx. 189.
Santa Fé Ry.	* "*Railroad Gazette*," viii. 249.
Pa. Railway	* "*Railroad Gazette*," xxi. 28, 35.
Contractor's, *Soc. St. Leonard*, Belg.	* "*Engineer*," xlvii. 258.
Crane, *Black, Hawthorne & Co.*, Engl.	"*Scientific American Sup.*," 847.
Chretien	* "*Scientific Amer.*," xxxvii. 84.
Smith, Br.	* "*Engineering*," xxix. 491.
Cross-heads, *Borsig*	* "*Scientific American Sup.*," 1297.
Cylinder borer, *Sharpe, Stewart & Co.*, Br.	* "*Engineering*," xxv. 345.
Danforth Co.	* "*Engineering*," xxii. 25.
Ditching plow, *Buchanan*	* "*Engineering*," xxx. 166.
Double bogie. *Fairlie*, Festineog, (35½″ gage)	"*Engineering*," xxix. 453.
Double bogie, *Fairlie*	* "*Engineering*," xxv. 511.
	* *Anderson's* "*Report Paris Exp.*," 1878, iv. 452.
Economical, Old Colony Ry.	"*Scientific American*," xxxix. 181.
Eddy	* "*Scientific American Sup.*," 1585.
Elevated Ry. *Grant Works*, N. Y.	* "*Railroad Gazette*," xxii. 495.
Forney	* "*Railroad Gazette*," xxii. 517, 585.
	* "*Scientific Amer.*," xxxix. 319.
Elevated Ry., N. Y.	* "*Engineer*," xlvi. 333.
Forney	* "*Engineer*," xlvi. 443.
Express, *Alta-Italia Ry.*	* "*Engineering*," xxviii. 414.

Tank, 31½", *Cail*, Fr. . * "*Engineering*," xxix. 265.
24", *Hinkley* . . . * "*Manuf. & Builder*," x. 40.
Hohenzollern Locomotive Works, Ger. . * "*Engineering*," xxx. 130.
Hughes, Br. . . . . *Thurston's* "*Vienna Rept.*," ii. 61.
Irish . . . . . . * "*Railroad Gazette*." xxiii. 519.
Midland Railway, Br. * "*Engineering*," xxii. 342.
Nat. Ry., Switz. . . * "*Engineering*," xxix. 184, 220.
N. British Ry. . . . * "*Railroad Gazette*," xxiii. 833.
Paris & Orleans Ry. . * "*Engineer*," xlv. 368.
Rogers . . . . . . * "*Railroad Gazette*," xxiii. 167.
Schneider, Fr. . . . "*Engineer*," xlvi. 392, 410.
Six-coupled, Fr. . . * "*Engineering*," xxviii. 494.
Narrow gage, *Soc. Suisse* . . . . . * "*Engineer*," xlv. 385, 388.
Société Suisse . . . * "*Railroad Gazette*," xxii. 421.
Gothland, Sweden . . * "*Engineering*," xxvi. 393.
Swedish . . . . . * "*Scientific American Sup.*," 642.
Narrow gage, Sweden * "*Engineer*," xlii. 132.
Walker & Co., Br. . . *Thurston's* "*Vienna Rep.*," ii. 61.
Torpedoes . . . . . "*Engineer*," xliii. 259.
Traction engine . . . See TRACTION ENGINE, *infra*.
Tramway, *Lille & Haubourdin* . . . . . * "*Engineer*," xlix. 390.
Twin, *Brown* . . . . * "*Technologiste*," xli. 405.
Valve gear, *Brown*, Winterthur . . . . * "*Engineering*," xxiv. 324.
Volga-Don Ry. Urquhart, Br. . . . * "*Engineer*," xlix. 372.
Waste coal burning. *Wootten* . . . . . * "*Engineering*," xxvii. 67.
Water supply, *Howe* . * "*Scientific American Sup.*," 827.
Wootten's fire-box . . * "*Scientific American Sup.*," 4012.
Western Ry. of France . * "*Scientific American Sup.*," 2144.
* "*Scientific American Sup.*," 84.
Wheels, counterweighting, *Heaton* (1839), Br. * "*Engineer*," xlix. 77.

See *Forney's* "*Catechism of the Locomotive.*"
Colburn's "*Locomotive Engine.*"
Forney's "*Car-builders' Manual.*"
Norris's "*Handbook for Locomotive Engineers and Mechanics.*"
Dempsey's "*Rudimentary Treatise on the Locomotive Engine.*"
Roper's "*Handbook of the Locomotive*," London.

Lo′co-mo′tive Bal′ance. The spring on the safety valve beam of a locomotive. Preferred to a weight on account of steadiness and lightness.

Fig. 1625.



Locomotive Balance.

Lo′co-mo′tive Crane. A crane mounted on a car. A wrecking or construction crane. See RAILWAY CRANE, *infra*. Also, BALANCE CRANE, Fig. 176, p. 66, *supra*, and *j*, Fig. 1507, p. 643, "*Mech. Dict.*"

Lo′co-mo′tive Cup. An oiler for the cylinder of a locomotive.

Fig. 1626 shows the *Nathan & Dreyfus* oiler, which is self-acting.

While the engine is in motion, the steam passes up the tube to the upper part of the cup, where it condenses, and the water so produced, being heavier than the oil, sinks to the bottom and lifts an equal amount of the lubricant to the top, causing it to overflow through the side hole near the top of the tube to the parts where the lubrication is required.

At the end of the day, or when the oil or tallow is exhausted, water, acids, and other impurities which remain should be drawn off by the waste-cock, and the cup refilled with the lubricant.

Lo′co-mo′tive Pump. A self-propelling steam-power pump. The most familiar is a steam-driven fire-engine; a self-moving engine carrying a pump: the *locomobile pompe* of the French, with whom it is more common than with us.

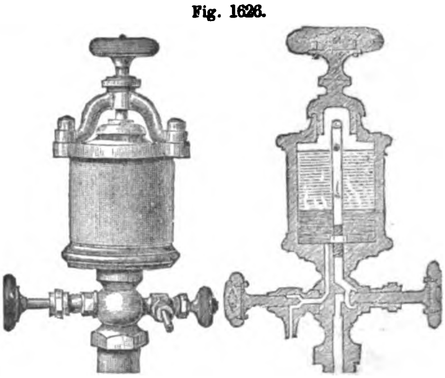
Lode. (*Mining.*) Aggregations of mineral matter containing ores in fissures.

Lodg′ing Car. A car fitted with bunks for hands at work on a railway line.

Log. A velocimeter; employed to ascertain the rate of a ship's motion. See p. 1348, "*Mech. Dict.*"

In Keelmay's electric log an electric circuit is applied to the ordinary patent log, so that a revolution of the vanes

Fig. 1626.

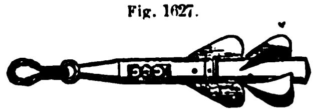


Cylinder Oiler.

will, by a make-and-break arrangement, actuate an indicator in the captain's cabin. The number of knots can be read off the indicator, and hauling in the log itself is not required.

Massey's log has spiral wings, propelled by the passing water, and the revolutions registered by wheel-work and dials inside.

Fig. 1627.



Massey's Log.

A French log is described as an instrument to be fixed either in the engine-room or in the captain's cabin. The water is conveyed to it by means of suitable valves, placed in the side of the vessel, and the impact of the water while the vessel is moving communicates motion to some clockwork, and the distance is recorded by means of a dial. There are four smaller dials within a large one which record the knots by units, tens, hundreds, and thousands, while the large dial tells the statute miles, so that measurement can be taken either in miles or knots.

Froude, Br. . . . . "*Van Nostrand's Mag.*," xviii. 344.
De Normanville, "*Engineer*" . . . . . * "*Scientific American Sup.*," 1522.

Log Beam. The traveling frame in which a log lies and travels in a saw-mill. Fig. 4629, p. 2043, "*Mech. Dict.*"

Log But′ter. A drag saw for *butting*, *i. e.*, cutting off square the ends of logs.

Log Frame. A name for a saw-mill, *i. e.*, DEAL FRAME, Fig. 1601, p. 680, "*Mech. Dict.*"; also Plate LIV., p. 2042, *Ibid.* Plate III, p. 72, *supra*.

Log′ging Lo′co-mo′tive. A light back-truck locomotive used on logging and plantation roads,

Fig. 1628.

Logging Locomotive.

where the track is usually uneven and the speed slow; also for shifting and switching, and for local passenger traffic on narrow-gage roads.

Log'o-graph. An instrument by Barlow (Br.) for giving a graphic representation of the vibratory motions of the air-waves of speech. It was thought possible it might become a substitute for short-hand writing. It depends for its action on the well-known fact, that, in articulating, the air is forcibly expelled from the mouth in jets of different character by different consonant sounds; this, irrespective of intensity, is due, in part, to the specific energy of expiration in the enunciation of the consonant; some of these, as is well known, commence with an energetic puff, and others in a much less decided manner. The instrument reproduces all these, and other peculiarities graphically.

It consists in a mouth-piece similar to that of a speaking trumpet, which is inclosed at one end by a thin india-rubber diaphragm about 2½″ in diameter. A small camel-hair pencil, moistened with ink and aniline dye, is attached to the center of the diaphragm so as to partake of its motions. A strip of white paper is caused to move uniformly past the point of the pencil-marker by clock-work. On speaking into the mouth-piece the diaphragm is violently agitated, and the hair pencil draws a fine, irregular line along the paper strip. This line is a delineation of the mechanical air motions produced by speech. The subject is considered, and illustrations of the sound tracings given, on pp. 2514, 2515, "*Mech. Dict.*"

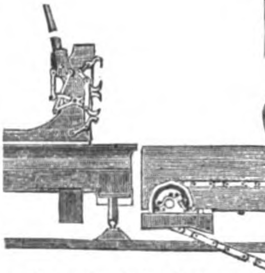
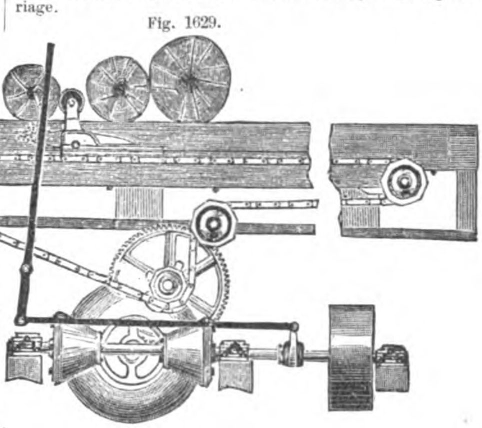
Cf. Paper by *Barlow* . * "*Jour. Soc. Tel. Eng.*," vii. 65.
* "*Scientific Amer.*," xxxvii. 376.
"*Scientific Amer. Sup.*," 1923.

Log Rail'way. One the track of which is formed of logs, laid to a gage and parallel. The upper surface is rounded to suit the concave surface of the truck wheels; or, a square scantling is pinned to the log, and the ordinary flanged wheel used with engines and trucks. — "*R. R. Gaz.*," xxiv. 105.

Log Rol'ler. A device in a saw-mill to convey logs from the log-deck or the log-way skids to the head-block.

By the motion of the lever the friction-gear is thrown into action, the chain traverses and the knees come against and push the log upon the carriage, bringing it squarely against the knees of the head-block. Motion of the lever in the other direction throws the other friction cone into connection with the wheel beneath the track, and, the chain being moved in the other direction, the knees retire, being forced down as they pass beneath the next log and then erect themselves behind it ready to push it in turn upon the log carriage.

Fig. 1629.

Emery's Log Roller.

Log Scale. A table which gives the quantity of lumber, one inch thick, board measure, which may be obtained from a round log, the length and the diameter below the bark being given.

TABLE FOR SCALING LOGS.

Length.	Diameter.																					
	12	13	14	15	16	17		19	20	21	22	23	24	25	26	27	28	29	30	32	34	36
10	40	50	62	75	90	105	122	140	160	180	202	225	250	275	302	330	360	390	422	490	562	640
11	44	55	69	83	99	116	135	154	176	198	223	248	275	302	333	363	396	430	465	539	619	704
12	48	61	75	91	108	126	147	168	192	217	243	270	300	331	363	397	432	469	507	588	675	768
13	52	66	81	98	117	137	159	183	208	235	263	292	325	358	393	430	468	508	549	637	731	832
14	56	71	88	106	126	148	171	197	224	253	283	315	350	386	423	463	504	547	591	686	787	896
15	60	76	94	115	135	158	184	211	240	271	303	338	375	413	453	496	540	586	633	735	844	960
16	64	81	100	121	144	169	196	225	256	289	324	361	400	441	484	530	576	625	676	784	900	1024
17	68	86	106	128	153	179	208	[illegible]	272	307	344	383	425	468	514	563	612	664	718	833	956	1088
18	72	91	112	136	162	190	220	253	288	325	364	406	450	496	544	596	648	703	761	882	1012	1152
19	76	96	119	143	171	201	232	267	304	343	384	429	475	523	574	630	684	742	803	931	1069	1216
20	80	101	125	151	180	211	244	281	320	361	404	452	500	551	605	661	720	781	845	980	1125	1280
21	84	106	131	158	189	222	257	295	336	379	425	473	525	579	635	693	756	820	887	1029	1181	1344
22	88	111	137	166	198	232	269	309	352	397	445	496	550	605	665	726	972	859	930	1078	1238	1408
23	92	116	144	174	207	243	281	323	368	415	465	519	575	632	695	760	828	898	972	1127	1295	1472
24	96	122	150	181	216	254	294	337	384	433	486	541	600	661	726	794	864	938	1014	1176	1352	1536
25	100	127	156	189	225	264	308	351	400	451	506	562	625	689	756	827	900	977	1056	1225	1408	1600

Log Turn'er. A device for turning a log on its carriage after slabbing, or to roll it on to the carriage. Fig. 1630.

A spiked bar on the end of a piston rod working in a steam cylinder beneath the log floor, is projected upward so that the teeth or spikes on its surface shall catch against the log and roll it. The steam cylinder can be oscillated on its gudgeons in order to act upon logs otherwise beyond its range, as seen in dotted lines.

B is a flexible steam pipe; *C* is the bar, with teeth *D*. *G* is a supplementary bar which is brought into action to hold the log from rolling back when the toothed bar retires for another hitch. The cylinder is caused to oscillate by putting the foot upon a treadle lever which acts against a transverse arm and tips the cylinder; the latter is restored to vertical position by the counter-weight *J*.

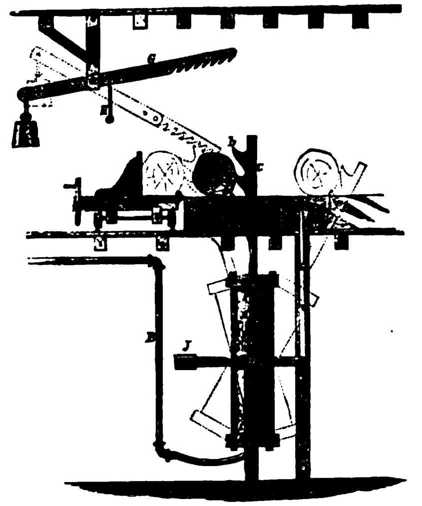
Long Rol'ling Splice. (*Nautical.*) A splice for lead lines, fishing lines, etc., in which the junction is very long and the splice rolled to make it round and symmetrical so as to run freely.

Long Splice. (*Nautical.*) The junction of two rope ends by intertwining the strands for a relatively long distance. See *h*, Fig. 5435; also *a e*, Fig. 5434, p. 2279, "*Mech. Dict.*"

Loom. See for history and instances Figs. 2996–3006, pp. 1351–1358, "*Mech. Dict.*"

Hair Loom, Pawtucket Hair Cloth Co. . . .	*Hayes'* "*Centennial Report*" v. 80, 81
Gulcher, "Buckskin" .	* "*Scientific American Sup.*," 2705.
Picker motion, *Ross* . .	*Thurston's* "*Vienna Report*," iii. 290.

Fig. 1630.



Log Turner.

Box, Revolving, French	* "*Scientific American Sup.*," 2130.
Positive motion, *Lyall*	* "*Scientific American*," xxxv. 175.
	* "*Manufact. & Builder*," ix. 88.
Stopper alarm, *Démard*	* "*Scientific American Sup.*," 1430.
Harness, *Crowell*	"*Scientific American Sup.*," 1648.

See also CARPET LOOM, *supra*; NEEDLE LOOM, *infra*.

Watson's "The Theory and Practice of the Art of Weaving by Hand and by Power."

Loop. (*Fire-arm.*) The projection under the barrel to which the fore end is fastened.

Loop Bolt. (*Vehicle.*) A bolt with ornamented head for securing the body-loop to the running gear of a carriage.

Loop Head. (*Vehicle.*) The swell and eye on the end of a body loop. See Fig. 358, p. 114, *supra*.

Loop Knot. (*Nautical.*) A form of hitch. See 27, Fig. 2777, p. 1240, "*Mech. Dict.*"

Loop Yoke. (*Vehicle.*) A loop for the strap by which the swaying of the body is limited. See *d*, Fig. 358, p. 114, *supra*.

Loose Box. (*Manége.*) A partitioned space in a stable where a horse may be confined without haltering.

Loose Hook Block. (*Nautical.*) A block the hook of which is secured by a loop to the eyes of the block-strap, instead of being rigid therewith.

Loose'-joint Hinge. One in which the leaves are detached by lifting the blind, door, casement-window, or what not.

Loose Pin Hinge. One in which the leaves are detached by lifting out the pintle.

Fig. 1631.

Loose Pin Butt-hinge.

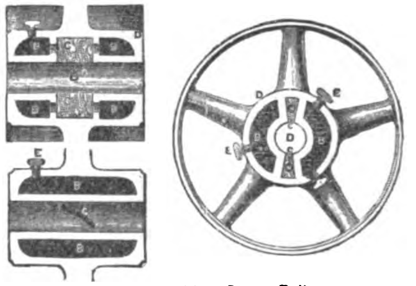
Fig. 1632.

Streit's Pulleys.

Loose Pul'ley. A pulley running free on a shaft, and to which the belt is transferred when the machinery is to be stopped.

The pulleys shown in Fig. 1632 are fast and loose, the latter being the smaller one which is loose on the shaft. From it extends a flaring flange which expands to the diameter of the fast pulley so as to enable the belt to be readily slipped from one to the other. The object is to have the belt run slack when not driving the machinery.

Fig. 1633.



Otis' Self-oiling Loose Pulley.

In the *Otis'* self-oiling loose pulley, Fig. 1633, the hub is cored out to form an annular oil chamber *B* surrounding the bore; this communicates indirectly with the shaft *D* by the intervening supply chambers *C*, which are filled with wick which leads the oil from the reservoir to the shaft. Oil is supplied by exterior opening closable by screw plugs *E*.

The *Oesterline* loose pulley has a somewhat similar arrangement.

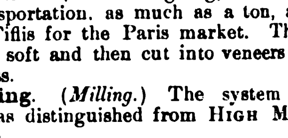
Davis, Br.	* "*Engineering*," xxx. 349.
Fay	* "*Scientific American*," xxxvii. 294.
Kitson	* "*Engineering*," xxvii. 243.

Lor'gnon. A single eye-glass, also known as a *quizzing* glass.

Lost Mo'tion. Looseness of fitting, incident to wear of parts.

Lou-chettes'. Spectacles, or rather goggles, for strabismus; to constrain the eyes to assume the normal position with eyes front.

Fig. 1634



Louchettes.

Loupe. Fr. A knot or burr on a tree from which veneers are cut for fancy furniture. Walnut, maple, oak, and other trees yield these curled excrescences. Remarkable specimens, some weighing, before dividing for transportation, as much as a ton, are shipped from Tiflis for the Paris market. They are steamed till soft and then cut into veneers by a shaving process.

Low Mil'ling. (*Milling.*) The system of close grinding as distinguished from HIGH MILLING, which see.

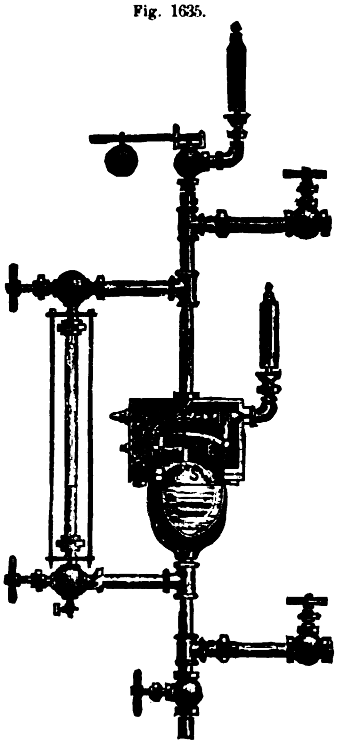
"The pointed or clipped grain is passed through stones at the nearest adjustment, by which it is at once ground to flour. It is practicable, however, by careful management of the working between the stones, to obtain a large part of bran and gluten-coats without disintegration, and to separate them from the flour by sifting, and this the more perfectly as by this process of milling finer sieves are employed. Still, it is not possible, at least it has not yet been shown, that this separation of the bran can be carried out so perfectly as to yield an *extract flour* of such fairness as is ordinarily obtained by the process of *high milling*. — *Horsford*.

See HIGH MILLING, pp. 457, 458, *supra*, where the question High Milling *v*. Low Milling is considered, and references are given to apparatus involved.

Low-wa'ter A-larm'. A device to sound an alarm when the water in the boiler sinks below the point of safety.

A number of devices, including those operating on the various principles, the float, the thermostat, and the fusible plug, are shown in Fig. 3008, p. 1359, "*Mech. Dict.*"

Fig. 1635.

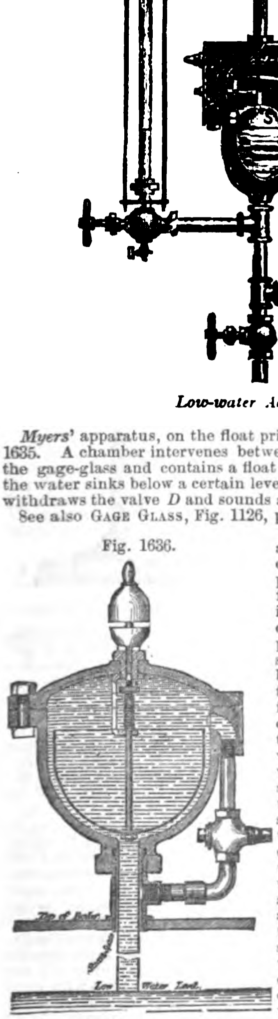


Low-water Alarm.

Myers' apparatus, on the float principle, is shown in Fig. 1635. A chamber intervenes between the boiler head and the gage-glass and contains a float *S* which descends when the water sinks below a certain level and by actuating levers withdraws the valve *D* and sounds a whistle.

See also GAGE GLASS, Fig. 1126, p. 365, *supra*.

Fig. 1636.



Kenyon's Low-water Alarm.

In *Kenyon's* low-water alarm, Fig. 1636, under ordinary conditions the pressure in the boiler forces the water up the inner pipe, and fills the outer vessel and suspended copper basin ; but should the water in the boiler get below the bottom of the pipe, the water falls out of the vessel excepting the portion retained within the basin, which, acting as a dead weight, overcomes the slight resistance of the upward spring and the steam pressure, and pulls the plug away from the opening to the whistle, when the steam, rushing up the pipe, sounds the alarm. The apparatus can at any time be tested by turning the handle of the steam-cock upward, which places the interior of the vessel in a state of equilibrium, when the water falls to the level of that in the boiler (excepting that contained in the basin, which cannot escape), and the whistle is sounded ; the vessel refills with water on closing the steam cock.

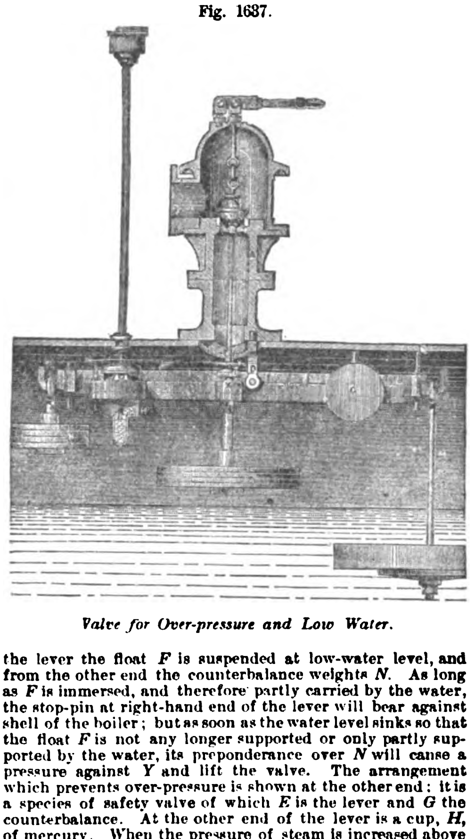
Hopkinson	* "*Scientific American Sup.*," 2192.
Kenyon	* "*Engineering*," xxi. 168.
	* "*Scientific American Sup.*," 319.
Myers	* "*American Miller*," vii. 97.
	* "*Iron Age*," xx., July 26, p. 1.

See also LOW-WATER VALVE.

Low-wa'ter Valve. A valve which opens when the water in the boiler sinks below the level of safety. See LOW-WATER ALARM, Fig. 3008, p. 1359, "*Mech. Dict.*," and Fig. 1636, *supra*.

In *Hopkinson's* valve, shown at Fig. 1637, the working parts are within the boiler. In the form shown, it is a combined over-pressure and low-water valve. From one end of

Fig. 1637.



Valve for Over-pressure and Low Water.

the lever the float *F* is suspended at low-water level, and from the other end the counterbalance weights *N*. As long as *F* is immersed, and therefore partly carried by the water, the stop-pin at right-hand end of the lever will bear against shell of the boiler ; but as soon as the water level sinks so that the float *F* is not any longer supported or only partly supported by the water, its preponderance over *N* will cause a pressure against *Y* and lift the valve. The arrangement which prevents over-pressure is shown at the other end : it is a species of safety valve of which *E* is the lever and *G* the counterbalance. At the other end of the lever is a cup, *H*, of mercury. When the pressure of steam is increased above a certain limit, a part of the mercury is displaced from the cup, and the lever, lightened at that end to that extent, rises and lifts the valve in the dome, allowing the steam to escape.

Lub'ber's Mark. (*Nautical.*) Of a compass. The black vertical mark in the compass-bowl in the direction of the ship's head, by which the angle between the magnetic meridian and the ship's course is shown.

Lu'bri-cant.

At a boiling heat stir together —

Petroleum	**1 liter.**
Graphite	**88 grams.**
Beeswax	**3 grams.**
Tallow	**9 grams.**
Caustic soda	**3 grams.**

Add to petroleum saturated solution of lime-water till the mixture becomes ropy, and then keep stirring till a drab color is acquired. 1 part may be added to the same amount of animal fat. — *Von Phul & Groat.*

Residuum of petroleum distillation, 160 ; compounded with pine tar, 15, boiled by steam heat and diluted with petroleum.

Petroleum, graphite, flour-sulphur, steatite, tallow, rock-salt, palm oil. — "*Amer. Manuf.*," "*Sc. Amer.*," xxxiv. 39.

Slaked lime, tar oil, resin oil, for slow-moving journals; caustic soda added for more rapidly moving objects. — *Newton*, Br.

Lu'bri-cant Al-loy'. An alloy of zinc, 7; copper, 4; tin, 1, resisted all turning tools till the edges were moistened with petroleum. The alloy then yielded readily. — "*Les Mondes*."

Lu'bri-cant Test'er. A machine to test the quality of oil used for lubricating purposes.

Most of the machines are founded upon the same principle. The better the oil, the less the frictional adherence of two surfaces moving relatively and in contact with a given pressure upon them.

This may be evidenced in either of several ways: —

By the power required to produce the motion.

By pressure in the nature of a Prony brake to bring the motion to a halt.

By heat generated by the friction.

Deprez & Napoli's apparatus gives for the various oils a distinctive trace on properly ruled paper.

It has a lower revolving plate and an upper one supported upon it in such a manner that when oil is placed between the points of support of the upper plate and the lower plate, the tractile force upon the upper draws upon a steel ribbon connected to a pulley mounted on points, and to the axis of which is secured a pendulum. The rod of the latter carries a roller which engages upon a vertical piece attached to a carriage mounted on wheels which traverse rails. The carriage carries a sheet of paper against which is pressed a pencil which has a very slow motion of translation proportioned to the number of turns of the lower plate before mentioned, and the direction of the said motion is perpendicular to that of the carriage.

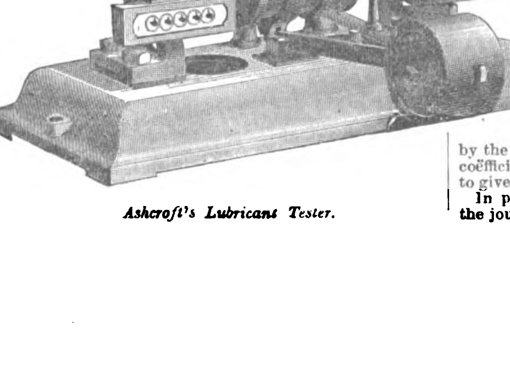
The curve traced on the paper by the composition of these two movements is the curve representing the value of the friction in terms of the number of turns made by the said lower plate.

The tractile force is so much the greater as the lubricating quality of the oil decreases. See "*Scientific American*," xxxvi., 214. A still better view of the same, or of a machine with similar functions, is given on p. 360, vol. xl., *"*Scientific American*." It appeared in "*Engineering*," and represents a machine employed by the Eastern Railway of France to ascertain the value of various lubricants, and was shown at the Paris Exposition of 1878.

An apparatus used by the Paris, Lyons, & Mediterranean Railway is shown at page 2794, *"*Scientific American Supplement*." Two pairs of wheels on their axles are mounted in a frame, one above the other. Axle-boxes having been charged with the lubricant to be tested, the springs are raised by an arrangement of screws and worm wheels so that the axles of the upper shaft are lifted from the load. The wheels being rotated the springs are brought down, and that lubricant is the best which allows the heaviest pressure without heating.

Ashcroft's lubricant tester, Fig. 1638, consists of a shaft mounted on centers, so as to rotate freely, upon which shaft a drum is fixed, and revolves with the shaft. To this drum brasses are neatly fitted, and held in position and pressed against the surface of the drum by levers and weights; and between the surfaces of the drum and of the brasses the oil is tested.

Fig. 1638.



Ashcroft's Lubricant Tester.

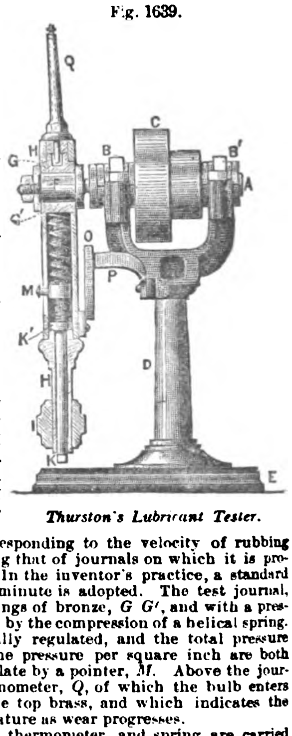
Upon the upper brass is a cup, which communicates with the surface of the drum, and into which the oil is dropped. The shaft is rotated by a belt and pulley, and the number of revolutions is registered by a counter device operated by gearing from the shaft. Attached to the upper brass is a reservoir of mercury, into which a thermometer is adjusted, which indicates the heat generated by the frictional surfaces as the trial of the lubricant proceeds.

The principle upon which this machine is based is that of submitting a given quantity of the lubricant to be tested to a frictional action between cylindrical concaved and convexed surfaces under a fixed pressure, and then measuring the quantity of motion required to use up the given lubricant, determining the time when this is accomplished by the temperature of the frictional surfaces, which increases rapidly as the lubricant becomes exhausted.

Four drops of the lubricant to be tested are dropped into the cup from a glass dropping-tube, the temperature noted, the machine set in motion and allowed to run until the thermometer indicates a given degree of temperature at which it would be safe to run the machine — say 200° Fah. — as a standard; when it is stopped, and the number of revolutions taken.

The better the quality of the oil, the longer the machine will run before reaching that temperature. After each experiment the machine is taken apart, thoroughly cleaned, and allowed to cool to the surrounding temperature.

Fig. 1639.



Thurston's Lubricant Tester.

In order to test the "gumming" qualities of the oil, it is allowed to cool before cleaning.

The speed is about 1,400 revolutions per minute. On tests of various kinds of oils, the revolutions given varied from 11,250 to 15,360 before reaching the given temperature.

In Professor Thurston's lubricant tester the oil or other lubricant to be tested is placed on the journal *F*, which is on the overhung extremity of a shaft *A*, mounted in bearings *B*, *B*, on a standard, *D*, mounted on a base plate, *E*. The shaft is driven by a pulley, *C*, at any desired speed. A counter may be placed at the rear end of the shaft to indicate the number of revolutions. The shaft is usually driven at a fixed speed, corresponding to the velocity of rubbing surfaces approximating that of journals on which it is proposed to use the oil. In the inventor's practice, a standard speed of 750 feet per minute is adopted. The test journal, *F*, is grasped by bearings of bronze, *G G'*, and with a pressure which is adjusted by the compression of a helical spring. This spring is carefully regulated, and the total pressure on the journal and the pressure per square inch are both shown on the index plate by a pointer, *M*. Above the journal is a thermometer, *Q*, of which the bulb enters a cavity in the top brass, and which indicates the rise in temperature as wear progresses.

The brasses, thermometer, and spring are carried in a pendulum, *H*, to which the ball *I* is fitted; and weights are adjusted in such a manner that the maximum friction of a dry but smooth bearing shall just swing it out into the horizontal line. The stem, *K K'*, of the screw, which compresses the spring, projects from the lower end of the pendulum and can be turned by a wrench. A pointer, *O*, traverses an arc, *P*, and indicates the angle assumed by the pendulum at any moment. This angle is very large with great friction, and very small with good lubricating materials. This arc is carefully laid off in such divisions that dividing the reading by the pressure shown on the index gives the corresponding coëfficient of friction. The machine can also be arranged to give the friction directly.

In practical use, a standard quantity of oil is placed on the journal. The bearings are slipped on and set up to the proposed pressure; the machine is started at the speed determined upon, and the observer notes the time, speed, pressure and temperature. These observations are repeated and recorded at regular intervals, and cease when a rapid rise of temperature to an objectionable or dangerous extent indicates that the lubricant has become destroyed.

See also Fig. 6330, p. 2539, "*Mech. Dict.*"

Another form, made by Bailey, of Salford, England, has a pendulum with a block on the end of a jointed arm, the block moving to and fro on a plate as the pendulum swings. The block and plate having been daubed with a definite amount of the lubricant, the pendulum is started in its oscillations, and the number of movements counted before it comes to rest. These will be fewer when the lubricant is the poorer.

Still another apparatus by Bailey is for testing the consistence of oils at given temperatures. A drop of oil is placed on the upper end of a slanting glass plate covering a heated tank. The distance which it will come down the glass is the measure of its consistence.

The form and size of a drop which drops from a pipette is an indication of quality at a given temperature.

Refer to: —

Ashcroft	* "*Railroad Gazette,*" x. 511.
Bailey	* "*Engineer,*" xlv. 372.
Bailey (2)	* "*Scientific American Sup.,*" 2541.
Comparison of methods	* "*Engineer,*" xlv. 372.
Crossley	* "*Engineer,*" xlv. 372.
Deprez & Napoli . . .	* "*Scientific American,*" xl. 360.
	"*Scientific American,*" xxxvi. 214.
Eastern Ry. of France .	* "*Engineering,*" xxvii. 234.
Electric tests	"*Railroad Gazette,*" xii. 242.
	"*Min. & Sc. Press,*" xxxviii. 351.
Evaporating point . .	* "*English Mechanic,*" xxiii. 86.
Flashing point	* "*Engineer,*" xlv. 372.
Friction brake	* "*Engineer,*" xlv. 372.
Hatcher	* "*Engineer,*" xlv. 372.
Hodgman	"*Railroad Gazette,*" xxii. 24.
Ingham & Stapfer . .	* "*Railroad Gazette,*" xxii. 24.
	* "*Engineering,*" xxiii. 28, 33.
McNaught	* "*Railroad Gazette,*" xxii. 24.
Metcalf, paper by Lieut.	* "*Ord. Report,*" 1878, App. No. 2.
Napier	* "*Railroad Gazette,*" xxii. 24.
Paper on	* "*R. R. Gaz.,*" ix. 266, 492; x. 23.
	"*Mining & Sc. Press,*" xxxiii. 7; * xxxv. 177.
	"*Am. Railroad Jour.,*" li. 397.
Paris, Lyons & Med. Ry.	* "*Engineering,*" xxvii. 110.
	* "*Scientific American Sup.,*" 2794.
Pease	"*Scientific American,*" xlii. 223.
Regray, E. Ry. of France	* "*Engineer,*" xlvi. 315.
	"*Iron Age,*" xxiii., Nov. 21, p. 15.
Tagliabue	* "*Railroad Gazette,*" xxii. 23.
Test for acids	"*Man. & Builder,*" ix. 240.
Tests for safety . . .	"*Manufact. & Builder,*" xii. 206.
Thermometrical . . .	* "*Engineer,*" xlv. 372.
Thompson	* "*Engineer,*" xlv. 372.
Thurston	* "*Engineer,*" xlv. 372.
	"*Railroad Gazette,*" xxii. 23-25.
	"*Mech. Dict.,*" * Fig. 6330, p. 2589.
	* "*Manuf. & Builder,*" ix. 59, 131.
	* "*Engineering,*" xxiii. 176.
Trickling	* "*Engineer,*" xlv. 372.
Bailey	* "*Scientific American Sup.,*" 2541.
Withycomb, L. S. & Mich. Southern . .	"*Railroad Gazette,*" xxi. 266.

For exhaustive information on this subject reference is made to a lecture by Professor Thurston reported in "*Railroad Gazette,*" xxii. 23, and well illustrated.

Lu'bri-ca'tor. 1. A device for greasing a journal, piston, or other moving part. Instances are given of *steam lubricators*, Fig. 3011, page 1361, "*Mech. Dict.*"; *axle-lubricators*, Fig. 3012, page 1362, and page 200, *Ibid.*; *hydrostatic lubricator*, Fig. 3013, page 1362, *Ibid.* See also PALIER GLISSANT, HYDRAULIC PIVOT; WATER BEARING; JOURNAL BEARING, etc. See also list of LUBRICANTS, page 1361, *Ibid.*

See LOCOMOTIVE CUP, *supra*; NEEDLE LUBRICATOR; OIL CUP; SHAFTING CUP; TALLOW CUP, *infra*.

2. (*Cartridge.*) A machine in which the bullets after being trimmed are waxed so as to clean the gun when firing. They are covered with Japan wax, which is in a vertical tube regulated by a heavy weight keeping it against the bullets which are fed in on a wheel. The bullets are pressed out carrying so much wax with them. See CARTRIDGE.

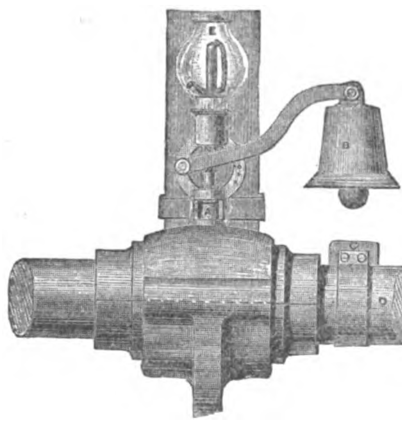
See Lubricant	"*Scientific American Sup.,*" 796.
Van Phul & Groat .	"*Scientific American Sup.,*" 692.
Lubricating oils . . .	"*Sc. Am.,*" xxxiv. 39; xxxvi. 79.
	"*Scientific American Sup.,*" 2541.
Lubricene, manuf. of .	* "*Scientific American,*" xl. 95.
Lubricator alarm signal.	
Alley	* "*Scientific American Sup.,*" 57.
Lubricator, steam.	
Baines, Br.	* "*Engineer,*" xlvi. 165.
De Limon, Ger. . .	* "*Engineering,*" xxx. 398.
Galvin	* "*Am. Man.,*" Feb. 14. 1879, p. 18.
Glydon, Br., steam .	* "*Engineer,*" xlvi. 368.
Harper, steam eng. .	* "*Iron Age,*" xix., April 19, p. 24.
Harrison, steam eng.	* "*Scientific American,*" xlii. 214.
Hoagland	* "*Railroad Gazette,*" xxi. 433.
Hughes, Br.	* "*Engineering,*" xxi. 492.
Hunt, Br.	* "*Engineering,*" xxiv. 399.
Johnson, cup . . .	* "*Min. & Sc. Press,*" xxxiv. 265.
Johnson	* "*Scientific American,*" xxxv. 386.
Locomotive wheel flanges	* "*Engineer,*" xlvii. 292.
Lonergan & McBride .	* "*Iron Age,*" xviii., Nov. 2, p. 5.
Parshall, cup . . .	* "*Manuf. & Builder,*" viii. 54.
Patrick, Ger. . . .	* "*Engineer,*" l. 165.
Paul	* "*Iron Age,*" xxiv., July 24, p. 1.
Paulson, Br., pulsating	* "*Engineering,*" xxvi. 295.
Paulson, Engl. . . .	* "*Scientific American Sup.,*" 2436.
Loose pulley	* "*Iron Age,*" xxiii., May 8, p. 16.
Reed, Steam cyl. . .	* "*Scientific American Sup.,*" 715.
Thurston, Paper on .	"*Scientific American Sup.,*" 1110.

See article "*Graissage,*" Laboulaye's "*Dictionnaire des Arts et Manufactures,*" tome iv., ed. 1877.

Lu'bri-ca'tor A-larm' Sig'nal. A device to give an alarm when a journal becomes heated from absence of lubricant.

Alley's alarm is shown in Fig. 1640. The mode of action is as follows: The bell *B* is held in an elevated position by the composition plug *A*. If the supply of oil ceases from

Fig. 1640.



Lubricator Alarm Signal.

any cause the bearing heats and melts the plug. The bell *B*, thus losing its support, drops into gear with kicker *C* on the shaft *D*, rings, and continues to ring until the bearing is cooled down, and the plug renewed. These plugs are formed of hard, fatty matter, which melts at 130° Fah., the lubricant not taking fire until the temperature of the metal reaches 300° Fah. The substance of the plug running into the bearings prevents the evil from increasing before steps can be taken to reduce the heat.

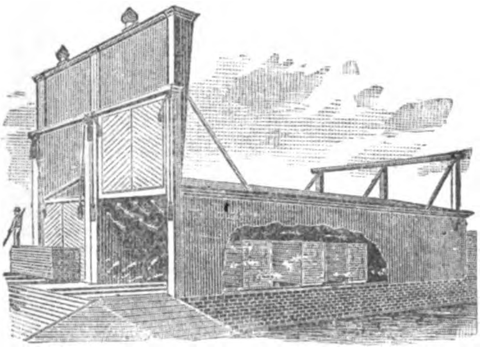
Luff Tac'kle. (*Nautical.*) A tackle with a double and single block and a fall. *d*, Fig. 6159, p. 2480, "*Mech. Dict.*"

Luff-tack'le Pur'chase. (*Nautical.*) A form of tackle having a double block and a single one, known as a treble purchase. See *d*, Fig. 6159, "*Mech. Dict.*"

Lum'ber Dry'er. A drying kiln in which sawed lumber is dried artificially. Instances are given in Figs. 3014, 3015, pp. 1363, 1364, "*Mech. Dict.*"

Figs. 1641, 1642 show the "Excelsior" lumber dryer, which is a steam-heated house into which the lumber on

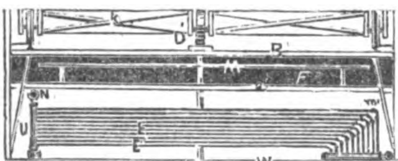
Fig. 1641.



"*Excelsior*" *Lumber Dryer.* (*Perspective.*)

trucks *D* is run upon rails. Underneath floor *B* of the lumber chamber is a dead-chamber, *F*, and still lower is the chamber heated by steam-pipes and coils *N, P, U, U′, E.*

Fig. 1642.

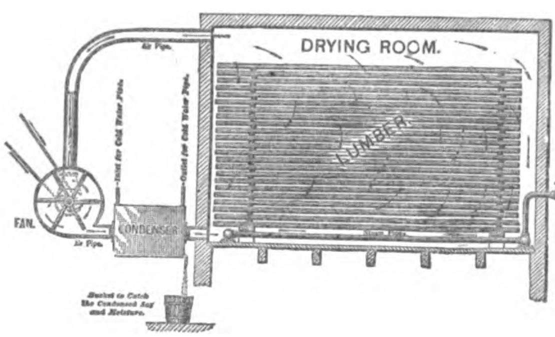


Lumber Dryer. (*Transverse Section.*)

The drying is by circulation of heated air which carries off the evaporated moisture.

Fig. 1643 shows Fuller's apparatus for drying lumber, in which the moisture is condensed; the room being tightly

Fig. 1643.

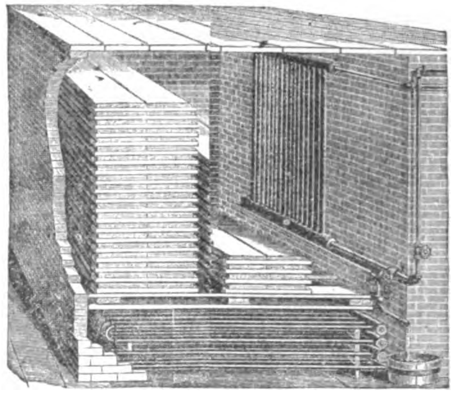


Fuller's Apparatus for Drying Lumber.

closed and steam-heated. The boards are placed in parallel rows with intervening spaces. A coil of steam-pipes is supported just above the floor of the room. From a point near the ceiling an air-duct leads to the fan; air is exhausted from the room and blown by the fan to the condenser, which is kept cool by a stream of cold water. The same air, deprived of moisture, is again driven into the lower stratum around the steam-pipes, and repeats its hydrophoric office.

Woods' lumber dryer, shown in Fig. 1644, has the artificial heater and the condenser in one tightly closed apartment, heated to 160° Fah., which in the illustration is shown as of very limited dimensions, but may hold ten or a dozen piles of lumber on the grated floor above the system of steam-pipes and coils in the basement. On the wall is seen the vertical system of water-pipes on which the moisture of the apartment condenses, and down which it trickles; being caught in a trough, it is conducted away. A stream of cold water constantly passes through the condenser pipes arranged against the wall.

Fig. 1644.



Woods' Lumber Dryer.

Lu'mi-nous Di'al. Recordon, of Paris, illuminates watches and clock dials by passing an electric discharge through a Geisler tube filled with a gas which yields a bright light. For a watch; a thimble cell of Trouvé is, together with a small induction coil, hung at the watch-chain. Pressing a spring completes the circuit and illuminates the dial.

A number of compositions of phosphorescent salts are given under Dial, p. 254, *supra.*

Lu'mi-nous Buoy. 1. One which is luminous by night, to warn mariners from shoals.

2. One which is thrown into the sea and is self-lighting, or covered with a phosphorescent substance, as a guide to a person overboard.

A mode of automatic electric lighting of buoys, invented by M. de Lussex, of Belgium, consists in the employment of a Ruhmkorff coil in connection with a vacuum tube on the buoy as a lantern. The battery power is furnished by large plates of zinc and carbon, the sea-water acting as the exciting liquid. The induced current thus generated is said to be sufficient to light up the tube lantern so that it renders the buoy useful at night. — "*Engineering News.*"

Pintsch's buoy, for the same purpose, has a reservoir containing a quantity of condensed rich gas. Electric lighting apparatus is used. See Buoy, p. 147, *supra.*

Lieut. Cook's safety buoy is mentioned, p. 147, *supra*: also in "*Mech. Dict.,*" p. 407. See also Life Saving Apparatus, *supra.*

Lu'mi-nous Paint. A phosphorescent paint to render an object visible at night.

English Patent 4,152, of 1877. Method of rendering paints, whitewashes, and temperings luminous, consists in introducing into ordinary paints, varnishes, or washes, a phosphorescent substance, with or without colors. The compound consists of lime and sulphur, or carbonate of lime and sulphur heated together. It is then mixed with colorless varnish, and may be applied to various articles by brush or by dipping, and to protect from weather is glazed over with a flux, as in enameling. Inventor mentions clock faces, thermometers, mariner's compass, cards, insides of railway cars, etc.

W. A. Caron, 121,703, Dec. 12, 1871. Door-plates having the letters of the name surrounded by an opaque surface, themselves being transparent (or *vice versa*). A stick of phosphorus held against the rear of the plate by a spring, and packed in cement, so as to admit but a limited amount of air for the slow combustion of the phosphorus. Plate luminous by night.

Jules Peiffer, French *brevet*, Aug. 22, 1877. Certificate added Aug. 19, 1878. Application to various articles, under the name of "*Fulgore,*" of phosphorescent substances to produce various colors in the dark after having been exposed to natural or artificial light. The *Fulgore* is made from the sulphides of barium, strontium, calcium, etc.

An English patent has a composition of carbonate of lime, phosphate of lime, hydrate of lime, sulphur, sea salt, and almost any mono-sulphuret. Another has calcined shells, sulphur, arseniate of baryta, gum tragacanth, or sulphides of strontium, or barium with magnesia. See "*Sc. Am.*," xli. 248.

W. Trotter, No. 246,841, Sept. 6, 1881. Paint or composition of sulphide of calcium, and a vehicle consisting of a varnish made with gum mastic or other resinous body, and turpentine or other spirit, or gelatine. May be mixed with various colors; is translucent and phosphorescent, and is intended to be applied to windows, to emit during the night the light stored up during the day.

Balmain's paint is a preparation of sulphide of calcium. See "*Engineering and Mining Journal*," xxix. 408.

On photographic paper weights. See "*Scientific American*," xlvi. 249. See also DIAL, p. 254, *supra*.

Lump. (*Fire-arm.*) The iron piece soldered on to the barrel, and which descends into the action (in break-joint breech-loaders) where there is a recess prepared for it.

Lu'na-tel'lus. An orrery showing the astronomical relations of the earth and moon.

Lung Test'er. A spirometer: an instrument for testing the capacity of the chest. Fig. 5431, p. 2279, "*Mech. Dict.*"

Burt . . . . . * "*Scientific American*," xxxv. 242.

Lus'ter. 1. (*Ceramics.*) Lusters are thin metallic surfacings to pottery which require no burnishing and in some cases have iridescent effects. They are placed on the ware with camel's hair pencil and the ware is fired in a muffle. They offer a cheap and brilliant effect with but little permanence. The following are the more usual: —

Gold luster is prepared by precipitating with ammonia the regal solution of gold, diluting the humid precipitate with turpentine and applying it without flux.

Platinum luster is obtained by a concentrated solution of chloride of platinum mixed with an essential oil.

Mother-of-pearl luster is obtained by precipitating by a weak acid a double sulphate of gold and potassium and grinding the precipitate with a little flux and essence of lavender.

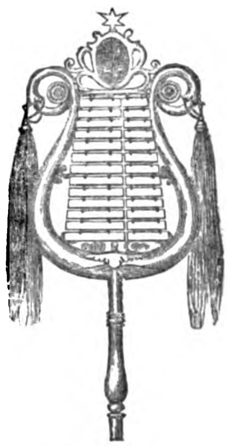
The *copper luster* of Spain is supposed to be produced by the silicate of the protoxide of copper; it is conjectured that the oxide is thrown into the furnace when the ware is fired.

Cantharides luster is obtained with a mixture of lead-glass and a little oxide of bismuth and chloride of silver. It is put on with the brush, the ware fired in the muffle from which it is withdrawn while red hot.

2. (*Fabric.*) A taffeta woven goods with cotton chain and long luster wool weft. A grade of alpaca.

Ly'ra. (*Music.*) An instrument with jingling plates. That shown in Fig. 1645 has two sets of steel bars, embracing two chromatic octaves. For references to the various instruments which have bars in series sounded by percussion, and consisting of wood, metal, glass, stone, etc., see MARIMBA.

Fig. 1645.



Conn's Lyra.

Ly'sim'e-ter. A rain gage; pluviameter; ombrometer; udometer. See pp. 1871–1873, and Figs. 4145, 4146, "*Mech. Dict.*"

The lysimeter is designed to determine the amount and quality of the water which percolates through a certain depth of soil. By it a certain body of soil is so isolated without disturbing its natural condition that all the water percolating can be measured, and the heavy rains which in part flow over the surface of the soil may also flow over the lysimeter and not enter into the measure of effective rain. It consists of a box inclosing an undisturbed cube of earth, and a light bottom with a slant which directs the water to a measure placed below the drip, in a pit excavated at the side of the box. This method is in use at Rothamstead, England, and at "Houghton farm," Orange Co., N. Y.

Gage for temperature of rain, *Colladon* . . . * "*Scientific American Sup.*," 2746.
Rainfall . . . . . . * "*Scientific American Sup.*," 1606.
Rain gage . . . . . * "*Scientific American*," xxxvi. 257.

M.

Ma-chine'. As distinct — on the one hand — from an engine: An instrument which fashions, or operates mechanically upon, objects or materials, and does not contain its own motor. It is driven by an engine or other motor, or by hand.

As distinct from a tool: It contains its own guide for operation.

A tool is a manual instrument depending for its efficiency upon the strength and skill of the operator.

A machine-tool is one which supersedes the hand tool formerly employed.

Instrument is a qualitative term, applied to tools and apparatus of delicacy and precision.

Some irregularities exist in the placing of these terms.

See under the following heads: —

Accumulator.
Adding machine.
Adjustable bed press.
Air compressing machine.
Air pump.
Air refrigerating machine.
Amalgamator.
Angle car-boring machine.
Angle cutting saw.
Angle-iron bending machine.
Angle shear.
Angle shearing machine.
Annealing machine.
Anvil.
Aplatisseur.
Apple grinder.
Arbor.
Arbor, expanding.
Arch screw-press.
Arm-boxing machine
Army mill.
Artesian well machine.
Aspirator.
Aspirator winnowing mach.
Attrition mill.
Atmospheric hammer.
Axe-handle lathe.
Axle lathe.
Bait mill.
Balance-wheel turning mach.
Baling press.
Ball grinder.
Balling machine.
Ball trimmer.
Baluster lathe.
Band and jig saw.
Banding machine.
Band saw.
Band-saw mill.
Band-saw re-sawing machine.
Band-saw setter.
Band-saw setting machine.
Band-saw setting and filing m.
Band-saw sharpening frame.
Bar cutting machine.
Barking machine.
Bark-mill.
Bark-rossing machine.
Baromotor.
Barrel-boring machine.
Barrel-chamfering machine.
Barrel crozing machine.
Barrel facing machine.
Barrel head.
Barrel head rounder.
Barrel hoop.
Barrel leveling machine.
Barrel leveling and trussing m.
Barrel machine.
Barrel pitching machine.
Barrel saw.
Barrel setting-up machine.
Barrel trussing machine.
Barrel turning lathe.
Barrel turning machine.
Barrel washer.
Barrel windlass.
Bar shear.
Beader.
Beaming machine.
Beam mill.
Bearing feeler.
Beating-out machine.
Beetling machine.
Beet grater.
Beet press.
Beet-root digger.
Beet-root machines.
Bell chuck.
Bench drill.
Bench-drilling machine.
Bending and straightening m.
Bending machine.
Bevel felly planer.
Bevel-gear cutting machine.
Bevel-gear wheel cutter.
Bevel rest for band-saw cut'g.
Bevel sawing machine.
Bevel-wheel cutter.
Binding machine.
Binding reaper.
Biscuit machine.
Blacking-box press.
Blacksmith's lathe.
Blank-work folder.
Blanking press.
Blind-lath punching mach.
Blind-relishing machine.
Blind-slat crimping machine.
Blind-slat mortising mach.
Blind-slat planer.
Blind-slat router.
Blind-slat tenoning machine.
Blind-stile borer and mortiser.
Blind-stile boring machine.
Blind-stile mortising mach.
Blind wiring-machine.
Blocking machine.

Block ironing machine.
Block-making machine.
Blower.
Blubber mincing machine.
Board-cutting machine.
Board-seasoning machine.
Boiler-plate clipper.
Boiler prover.
Boiler-shell drilling machine.
Boiler smith.
Bolt clipper.
Bolt-cutting machine.
Bolt die.
Bolt-forging machine.
Bolt-heading machine.
Bolt holder.
Bolt-pointing machine.
Bolt-trimming machine.
Bolt-turning lathe.
Bone mill.
Book-backing machine.
Bookbinding press.
Book-sawing machine.
Book-sewing machine.
Book trimmer.
Boot-cleaning machine.
Boot machine.
Boot-sewing machine.
Boring-and-turning mill.
Boring machine.
Boring mill.
Bottle washer.
Bottling machine.
Box-board machine.
Box-board matching mach.
Box-forming machine.
Boxing machine.
Bracket cutting-off saw.
Braiding machine.
Bran duster.
Brass-finisher's lathe.
Breaking-down machine.
Break lathe.
Brick machine.
Brick press.
Brick re-pressing machine.
Brim-pouncing machine.
Brim stretcher.
Broaching press.
Broadcast seeder.
Bronzing machine.
Broom-corn scraper.
Broom-handle lathe.
Broom-sewing machine.
Broom trimmer.
Broom winder.
Brush-finishing machine.
Brushing machine.
Brush machine.
Buckwheat huller.
Buckwheat shucker.
Buffing lathe.
Buffing machine.
Bullen nail machine.
Bullet machine.
Bullet patching machine.
Bung lathe.
Bung machine.
Burring engine.
Burring picker.
Butter worker.
Butt lathe.
Buzzer.
Buzz planer.
Cable-testing apparatus.
Cacao sorter.
Cake breaker.
Cake grinder.
Calculating machine.
Calendering machine.
Calender rolls.
Calico-printing machine.
Caliper machine.
Cambering machine.
Cam-cutting machine.
Cameo press.
Cam loom.
Cam press.
Can-body former.
Candle machine.
Candle-polishing machine.
Candy-rolling machine.
Candy slicer.
Cane mill.
Can-labeling machine.
Canting table.
Capstan.
Car-axle lathe.
Car boring machine.
Car-box drill.
Car-box grinding machine.
Carburetor.
Card and ticket cutter.
Cardboard cutter.
Cardboard machine.
Card grinder.
Cardigan-jacket machine.
Carding machine.
Car gaining machine.
Car-journal-bearing boring m.
Car mortising machine.
Carpet loom.
Carpet match'g & meas'g m.
Carpet winder.
Carriage cutting-off saw.
Carrier.
Car sill dressing machine.
Car sill machine.
Car tenoning machine.
Cartridge heading machine.
Cartridge head tester.
Cartridge loading machine.
Cartridge varnishing machine.
Car-truck-frame drilling m.
Carving lathe.
Carving machine.
Car-wheel balancing apparat.
Car-wheel borer.
Car-wheel chuck.
Car-wheel grinding machine.
Car-wheel press.
Car washing machine.
Case trimmer.
Cash recording machine.
Cask leveling machine.
Cement chuck.
Cement mill.
Cement testing machine.
Centering chuck.
Centering lathe.
Centering machine.
Centering tool.
Center plate.
Center sawing machine.
Centrifugal machine.
Chaff cutter.
Chaff sifter.
Chain cable shear.
Chain loom.
Chain testing machine.
Chair mortiser.
Chamfering machine.
Change wheels.
Charcoal grinding mill.
Charcoal washer.
Chaser.
Chasing lathe.
Cheese press.
Chemical fire engine.
Chilian mill.
Chocolate machine.
Chocolate mixer.
Chopping mill.
Chop separator.
Chromo-lithographic machine.
Chucking lathe.
Chucking machine.
Cider mill.
Cider press.
Cigarette machine.
Cigar mold.
Circular knitting machine.
Circular resawing machine.
Circular ribbing machine.
Circular saw.
Circular saw mill.
Clamp milling machine.
Clapboard machine.
Clay mill.
Clipping machine.
Clipper.
Clod crusher.
Closing machine.
Cloth cutting machine.
Cloth dressing machine.
Cloth drying machine.
Clothes wringer.
Cloth finishing machine.
Cloth folding machine.
Cloth measuring apparatus.
Cloth press.
Cloth pressing machine.
Cloth shearing machine.
Cloth stretching machine.
Cloth testing machine.
Cloth wind'g and measur'g m.
Clover huller.
Coal cutting machine.
Coal mining machine.
Coal testing machine.
Coal tipping machine.
Coal washer.
Cockle separator.
Cocoon winder.
Coffee cleaner.
Coffee cooler.
Coffee dryer.
Coffee huller.
Coffee grinder.
Coffee mill.
Coffee roaster.
Coiling apparatus.
Coiling machine.
Cold air machine.
Cold saw.
Collar machine.
Combing machine.
Composing machine.
Compound cotton press.
Compound lathe.
Concasseur.
Cooperage machine.
Cop reel.
Cop winding machine.
Copying lathe.
Copying machine.
Cordmaking machine.
Cork-cutting machine.
Corking machine.
Cork machine.
Corkscrew machine.
Corn cleaner.
Corn cracker.
Corn cutter.
Corn drill.
Corn husker.
Cornice machine.
Corn mill.
Corn planter.
Corn sheller.
Corn stalk cutter.
Corset loom.
Corundum wheel.
Cotton gin.
Cotton opener.
Cotton picking machine.
Cotton planter.
Cotton press.
Cotton seed huller.
Coupon numbering machine.
Coupon ticket machine.
Crab.
Cracker cutting machine.
Cracking machine.
Cranberry picker.
Crane.
Crank lathe.
Crank-pin driver.
Crank-pin jack.
Crank-pin turner.
Creeper.
Crimp brake.
Crimper.
Crimping machine.
Cross-cut circular saw.
Cross-cut saw.
Cross gaining machine.
Cross raising machine.
Crown pouncing machine.
Crozing machine.
Crusher
Crushing mill.
Cube sugar machine.
Cuff frame.
Cultivator.
Cupping machine.
Cushioned hammer.
Cut-off saw
Cutter grinder.
Cutting and drawing press.
Cutting and screwing mach.
Cutting and stamping press.
Cutting-off lathe.
Cutting-off machine.
Cutting-off saw.
Cutting-off shear.
Cut-off saw.
Cutting press.
Cylinder boring machine.
Cylinder boring and facing m.
Cylinder fixing apparatus.
Cylinder forging mill.
Cylinder grinding mill.
Cylinder saw.
Cylindrical saw.
Darning machine.
Dead-stroke hammer.
Decorticator.
De-gumming machine.
Dental engine.
Diagonal planing machine.
Diamond drill.
Dielectric machine.
Die-sinking machine.
Diffusion apparatus.
Dimension saw.
Dirt scraper.
Disintegrator.
Disking machine.
Ditching machine.
Dividing engine.
Dobby machine.
Domestic motor.
Door and sash tenoning mach.
Door clamp.
Door mortising machine.
Door relishing machine.
Double cutting-off machine.
Double edging machine.
Double-face milling machine.
Double pitman press.
Double planing machine.
Double seamer.
Double surfacing machine.
Double traverse drill.
Double-tub press.
Double wheel lathe.
Double winding machine.
Dough brake.
Dough kneader.
Dough mixer.
Dovetailing machine.
Dowel machine.
Drain-tile machine.
Drawing frame.
Drawing machine.
Drawing press.
Dredging machine.
Drill grinder.
Driller and slotter.
Drilling machine.
Drill press.
Drop hammer.
Dropper.
Drop press.
Drug mill.
Drying machine.
Duplex boring and facing m.
Duplex boring and turning m.
Duplex planing machine.
Duplex punch.
Duplex slide rest.
Dusting machine.
Dye-wood cutter.
Dye-wood grinder.
Dynamo-electric machine.
Dynamometer.
Earth borer.
Earth scraper.
Eccentric chuck.
Eccentric lathe.
Eccentric mill.
Economizer.
Edge molding and shaping m.
Edge molding machine.
Edge planing machine.
Edger.
Edge setter.
Edge trimmer.
Edging machine.
Edging saw.
Electrical machine.
Electro-magnetic machine.
Electrotype molding machine.
Embossing machine.
Embossing press.
Embroidering machine.
Emery grinder.
Emery planer.
Emery wheel.

Emery wheel dresser.
Endless-bed planer.
Endless belt grinder.
Endless saw.
Engine lathe.
Engraving machine.
Ensilage cutter.
Envelope machine.
Envelope printing press.
Epicycloidal milling engine.
Evaporator.
Excavator.
Exercising machine.
Exhaust fan.
Expanding mandrel.
Expansion boring tool.
Face lathe.
Facing machine.
Faller machine.
Fancy broad loom.
Fanning mill.
Farm mill.
Feed cutter.
Feed mill.
Feed regulator.
Felling saw.
Felly bending machine.
Felly boring machine.
Felly-rim planing machine.
Felly rounding machine.
Felly saw.
Felting machine.
Fencing machine.
Fertilizer distributor.
Fertilizer mill.
Fertilizer sower.
Filter press.
Finishing press.
Fire engine.
Fire-hole ring riveter.
Fire pot.
Fish dressing machine.
Flanging machine.
Flat rib knitting machine.
Flax braking machine.
Flax loom.
Floor boring machine.
Flour bolt.
Flouring mill.
Flour packer.
Flue cutter.
Fluting machine.
Flying sounder.
Fodder cutter.
Fodder mill.
Folder.
Folding machine.
Folding and perforating m.
Foot band-saw.
Foot die machine.
Foot drill.
Foot lathe.
Foot press.
Foot punching press.
Forage cutter.
Forage press.
Force.
Forge.
Forge hammer.
Forging, hydraulic.
Forging machine.
Forming machine.
Forming press.
Foulard machine.
Four-high mill.
Four-spindle drill.
Four-screw chuck.
Frame drilling machine.
Frame planing machine.
Frame slotting machine.
Fret saw.
Fret scroll saw.
Friction machine.
Friction-roller drop.
Fruit press.
Fruit separator.
Fulling mill.
Fur blowing machine.
Fusing disk.
Gage lathe.
Gage table-shears.
Gang drill.
Gang edger.
Gang plow.
Gang ripping saw.
Gang saw.
Gap-bed lathe.
Gap lathe.
Gas machine.
Gate saw.
Gear cutter.
Gear-wheel dresser.
Geometric lathe.
Gibbed engine-lathe.
Gilding press.
Gingham loom.
Girder riveter.
Girder tester.
Glass-polishing machine.
Glass press.
Glove making machine.
Glove sewing machine.
Gorse cutter.
Grader.
Grading plow.
Grain cleaner.
Grain crusher.
Grain cutter.
Grain drill
Grain dryer.
Grain mill.
Grain scourer.
Grain screen.
Grain separator.
Grain sifter.
Grain smutter.
Grain sorter.
Grain steamer.
Grain toller.
Grain washer.
Grain weigher.
Granulating machine.
Grape crusher.
Grape mill.
Grape press.
Grapple dredging machine.
Grinder.
Grinding lap.
Grinding machine.
Grinding mill.
Grinding wheels.
Grindstone turning device.
Grist mill.
Grits grading machine.
Grits mill.
Grits purifier.
Grooving and beading mach.
Grounding machine.
Gummer grinder.
Gumming machine.
Gun stocking machine.
Hand bolt cutter.
Hand loom.
Hand mortising machine.
Hand planer.
Hand rock-drill.
Hand-strap apparatus.
Hand milling machine.
Hand plan.
Hank dyeing machine.
Hardening machine.
Harvester.
Hat blocking machine.
Hat finishing lathe.
Hat forming machine.
Hat lining sewing machine.
Hat press.
Hat shaping machine.
Hat shaving machine.
Hat stiffening machine.
Hat stretcher.
Hay loader.
Hay press.
Hay rake.
Hay tedder.
Head beveling and turning m.
Heading clipper.
Heading dresser.
Heading jointer.
Heading machine.
Heading planer.
Heading rounder.
Heading saw.
Heading turner.
Headstock.
Heel attaching machine.
Heel breasting machine.
Heel building machine.
Heel burnishing machine.
Heel cutter and shaper.
Heel filing machine,
Heel jack.
Heel machinery.
Heel scouring machine.
Heel trimmer.
Helve hammer.
Hemp softening machine.
Hoeing machine.
Hogshead machinery.
Hoisting apparatus.
Hollow spindle lathe.
Hominy machine.
Hominy mill.
Honey extractor.
Hoop.
Hoop and splint machine.
Hoop banding machine.
Hoop making machine.
Hoop-pole river.
Hoop punch'g, flar'g, etc., m.
Hoop punching machine.
Hop picker.
Horizontal boring machine.
Horizontal boring mill.
Horizontal mortising mach.
Horizontal saw mill.
Horizontal slot boring mach.
Horn press.
Horse groomer.
Horse hay-fork.
Horse hoe.
Horse power.
Horse rake.
Hosiery seaming machine.
Hot curving machine.
Hot-iron saw.
Hot press.
Hot saw.
Hot straightening machine.
Hub boring machine.
Hub boxing machine.
Hub mortising machine.
Huller.
Howeling machine.
Hydraulic bender.
Hydraulic boring machine.
Hydraulic coal miner.
Hydraulic crane.
Hydraulic electric machine.
Hydraulic elevator.
Hydraulic engine.
Hydraulic forging.
Hydraulic punch.
Hydraulic press.
Hydraulic riveter.
Hydro-extractor.
Hydrostatic weighing mach.
Ice machine.
Impression machine.
Impression stitch machine.
Inclined press.
Incorporating mill.
Incubator.
Index milling machine.
Independent drill.
Ink grinding machine.
Insect destroyer.
Inside molding machine.
Intermediate spinning frame.
Iron cutter.
Iron cutting saw.
Ironing machine.
Iron saw.
Iron shears.
Jacquard loom.
Jigging machine.
Jig saw.
Joiner.
Jointer.
Jute machinery.
Keg jointer.
Keg leveling and trussing m.
Keg machine.
Key grinder.
Key seat cutting machine.
Key way cutter.
Kibbling mill.
Kneading machine.
Knife-grinding machine.
Knitting machine.
Labeling machine.
Laboratory lathe.
Lag machine.
Lap doubling machine.
Lap machine.
Lard press.
Lathe.
Lawn mower.
Lead-pipe machine.
Leather finishing machine.
Leather glazing machine.
Leather pebbling machine.
Leather raising, etc., mach.
Leather scouring machine.
Leather splitting machine.
Leather stamping machine.
Leather stretching machine.
Leather whitening machine.
Lever drill.
Lever press.
Lever punch.
Levigating machine.
Lifting machine.
Lime cracker.
Lime mill.
Lithographic press.
Lithographic stone dresser.
Lithog. stone polish'g mach.
Litter cutter.
Loading machine.
Lock mortising machine.
Log butter.
Log frame.
Log roller.
Loom.
Lozenge machine.
Lubricant tester.
Lubricator.
Magneto-electric machine.
Main tapping machine.
Maize cutter.
Maize mill.
Malaxator.
Malt crusher.
Mandarining machine.
Mandrel press.
Mangle.
Marking machine.
Masticator.
Matcher and jointer.
Matcher setter.
Matching machine.
Match-making machine.
Matrix rolling machine.
Meal cooler.
Measuring machine.
Meat chopper.
Meat stuffer.
Medal lathe.
Metal saw.
Middlings grinder.
Middlings mill.
Middlings purifier.
Middlings softening machine.
Milk skimming machine.
Mill.
Mill dog.
Mill grinder.
Milling machine.
Milling rollers.
Mill-pick sharpener.
Mill-stone dresser.
Mill-stone facing machine.
Mineral dresser.
Mining machine.
Mitering machine.
Mixing machine.
Mixing mill.
Molding machine.
Molding-iron grinder.
Molding, shaping, etc., mach.
Monogram machine.
Monogram press.
Monte-jus.
Mortar mill.
Mortar mixer.
Mortising chisel.
Mortising machine.
Mouthing machine.
Mulay-saw mill.
Mule.
Multicolor printing press.
Multiple drilling machine.
Multiple wheel tool grinder.
Nail picker.
Nail polishing cylinder.
Nap meter.
Navigational sounding mach.
Needle making.
Needle straightener.

Net machine.
Notching machine.
Nut tapping machine.
Oat mill.
Oat separator.
Oil-cake breaker.
Oil cake mill.
Oil press.
Oil testing machine.
Olive press.
Open back press.
Open die machine.
Opener-tapper.
Opening machine.
Ore breaker.
Ore crusher.
Ore dryer.
Ore grinder.
Ore mill.
Ore separator.
Ore sifter.
Ore washer.
Organ blower.
Outside molding machine.
Outside tacking machine.
Oval lathe.
Oval tenon machine.
Overpick loom.
Overshot separator.
Pail and tub machinery.
Painting machine.
Paint mill.
Panel-board molding mach.
Panel machine.
Panel molding machine.
Panel planer.
Panel raiser.
Panning machine.
Pantographic cutter-former.
Pantographic engrav. mach.
Paper bag machine.
Paper calendering machine.
Paper clipping machine.
Paper collar machine.
Paper coloring machine.
Paper cutting machine.
Paper cutter and winder.
Paper glazing machine.
Paper knife grinder.
Paper press.
Paper pulp machine.
Paper rolling machine.
Paper testing machine.
Pasteboard cutter.
Pattern maker's lathe.
Peat machine.
Pebble-powder machine.
Pebbling machine.
Pellet-powder machine.
Pegging machine.
Pendulum press.
Perambulator.
Perfecting press.
Perforating machine.
Picket heading machine.
Picket sawing machine.
Pig-iron breaker.
Pile driver.
Pile driving engine.
Pillar drilling machine.
Pillar shaper.
Pin making machine.
Pipe bender.
Pipe cutting machine.
Pipe elbow-bender.
Pipe prover.
Pipe screwing machine.
Pistol rifling machine.
Pitman press.
Pivot polisher.
Plaiting machine.
Planing machine.
Planing, chamfering etc., m.
Planishing hammer.
Planter.
Plastering machine.
Plaster mill.
Plate-bending machine.
Plate machine.
Plate pickling machine.
Plate press.
Plate shearing machine.
Plate welding hammer.
Plow. (Varieties: see list.)
Plow grinder.
Plow-handle bending mach.
Plow-handle lathe.
Pneumatic excavator.
Pointing machine.
Polishing machine.
Portable cider press.
Portable circular saw mill.
Portable drilling machine.
Portable grist mill.
Portable mill.
Portrait lathe.
Positive motion loom.
Post drill.
Potato bug destroyer.
Potato digger.
Potato planter.
Potter's wheel.
Pottery mill.
Pouncing machine.
Powder-pressing machine.
Power press.
Power shears.
Press drill.
Pressing machine.
Pressure bar.
Pressure block.
Pressure blower.
Priming machine.
Printing machine.
Printing press.
Print washing machine.
Profiling machine.
Proof press.
Puddling machine.
Pug mill.
Pulley boring machine.
Pulley grinding machine.
Pulley-head mortising mach.
Pulley lathe.
Pulley turning machine.
Pulverizer.
Pulverizing mill.
Pump. (Varieties, see list.)
Pump joint machine.
Punch and shear.
Punching machine.
Punching press.
Pusher.
Quick-speed drill.
Race.
Rack cutting machine.
Radial drilling machine.
Radius cross-cut sawing m.
Radius planer.
Rag duster.
Rag and waste picker.
Rag picker.
Rag washer.
Rail bender.
Rail borer.
Rail shears.
Rail slitter.
Railway crane.
Railway cutting-off saw.
Railway speed recorder.
Ramie fiber machine.
Rand breasting machine.
Rand turning machine.
Ratchet drill.
Reciprocating planing mach.
Reducing press.
Relishing machine.
Re-pressing brick machine.
Re-pressing machine.
Re-sawing band saw.
Re-sawing machine.
Revolving head screw mach.
Revolving tool-head screw m.
Rheostatic machine.
Rib fabric knitting machine.
Rib-top machine.
Rice drill.
Rice huller.
Rice thresher.
Riddle sorter.
Ridge-stone cutting machine.
Rifling machine.
Rim planer.
Rim-saw machine.
Ring and traveler frame.
Ring saw machine.
Rinsing machine.
Ripping saw.
Riveting machine.
Riveting machine, hydraulic.
Riveting press.
Road locomotive.
Road roller.
Road scraper.
Rock borer.
Rock breaker.
Rock crusher.
Rock drill.
Rocking saw-table.
Rod machine.
Rod, pin, and dowel machine.
Rod planer.
Roller mill.
Rolling machine.
Rolling mill.
Root cutter.
Root grinder.
Root puller.
Root pulper.
Root shredder.
Root slicer.
Root washer.
Rope molding machine.
Rosette cutter.
Rosette lathe.
Rossing machine.
Rotary-bed planing machine.
Rotary mortising machine.
Rotary shaper.
Rotator.
Rounding machine.
Routing machine.
Roving frame.
Rule and lead cutter.
Ruling machine.
Sabot machine.
Sail sewing machine.
Sand-papering machine.
Sash machine.
Sash molding machine.
Sash mortising machine.
Sash relishing machine.
Sash sticking machine.
Satinet loom.
Sausage stuffer.
Saw filer.
Saw gummer.
Saw gumming emery wheel.
Saw gumming press.
Sawing and boring machine.
Sawing engine.
Sawing machine.
Saw jointer.
Saw mill.
Saw sharpening machine.
Saw toothing machine.
Scarifier.
Scrap-cutting machine.
Scraper.
Scraping machine.
Screw and nut machine.
Screw cutting lathe.
Screw cutting machine.
Screw finishing machine.
Screw hoist.
Screwing machine.
Screw machine.
Screw nicking machine.
Screw polishing machine.
Screw press.
Screw shaving machine.
Screw slotting machine.
Screw soling machine.
Screw-thread forging mach.
Screw-wire soling machine.
Scroll lathe.
Scroll saw.
Scrubbing machine.
Sculpture machine.
Seal-embossing press.
Seaming, etc., machine.
Seaming machine.
Sectional mill.
Seed drill.
Seeding machine.
Segment saw.
Self-acting drilling machine.
Self-acting lathe.
Semolina machine.
Semolina separator.
Separator.
Serpentine molding machine.
Sewing machine.
Shaft boring apparatus.
Shaft excavator.
Shaft straightener.
Shaper.
Shaping machine.
Shaving machine.
Shawl loom.
Shearing machine.
Shear, punch, and upsetter.
Sheep-shearing machine.
Sheet calender.
Shingle machine.
Shingle and heading machine
Shingle buncher.
Shingle sawing machine.
Ship-timber saw.
Shirt frame.
Shirt knitting machine.
Shoddy machine.
Shoe embossing machine.
Shoe sewing machine.
Shoe nail machine.
Shoe pegging machine.
Shoe soling machine.
Shoot board.
Shuttle race milling mach.
Sickle grinder.
Side planing machine.
Sifting machine.
Silk de-gumming machine
Silk dyeing machine.
Silk loom.
Silk reel.
Silk softening machine
Silk spinner.
Silk spooling machine.
Silk stretching machine.
Silk testing machine.
Silk washing machine.
Silk winder.
Singeing machine.
Single speed drilling mach.
Skein setter.
Skein torsion machine.
Skin-beating machine.
Skiving machine.
Slabbing machine.
Sleeper recessing machine.
Sleeve machine.
Slitting mill.
Slitting saw.
Slitting shear.
Sliver lap machine.
Slot-boring machine.
Slot-drilling machine.
Slotting machine.
Slubbing frame.
Smashing press.
Smoothing machine.
Smut machine.
Smutter.
Snap machine.
Soap machine.
Soda water machinery.
Soil pulverizer.
Solder cutter.
Soldering machine.
Sole cutter.
Sole cutting press.
Sole forming machine.
Sole-leather roller.
Sole-leather stripping mach.
Sole molding machine.
Sole press.
Sole riveting machine.
Sole rolling machine.
Sole screwing machine.
Sounding apparatus.
Specific gravity machine.
Speed indicator.
Speed lathe.
Sphere-turning lathe.
Spice mill.
Spinning head.
Spinning lathe.
Spinning machine.
Spinning mule.
Spiral spring coiling machine.
Splining machine.
Splint cutting machine.
Splitting machine.
Splitting saw.
Spoke driving machine.
Spoke facing and jointing m.
Spoke lathe.
Spoke polishing machine.
Spoke setting machine.

Spoke tenoning machine.
Spoke tenon trueing mach.
Spoke throating machine.
Spoke turning lathe.
Spooling machine.
Spool printing machine.
Spool winding machine.
Spraying machine.
Spring adjuster.
Spring shaping machine.
Spring steam hammer.
Spring testing machine.
Square arbor lathe.
Squaring-off saw.
Squaring shear.
Squeezer.
Stalk cutter.
Stamping and cutting press.
Stamping machine.
Stamping mill.
Stamping press.
Staple machine.
Starching machine.
Stationary bed planer.
Stave cutter.
Stave dressing machine.
Stave ending machine.
Stave bolt equalizer.
Stave equalizer.
Stave jointer.
Stave machine.
Stave planer.
Stave saw.
Steam capstan.
Steam crane.
Steam hammer.
Steam plate press.
Steam plow.
Steam reaper.
Steam riveting machine.
Steam stamp.
Steam winch.
Stearine press.
Steel hammer.
Stereotype beveling machine.
Stiffening machine.
Stock turning lathe.
Stone boring and facing m.
Stone breaker.
Stone channeling machine.
Stone clearer.
Stone cleaving machine.
Stone crusher.
Stone cutting machine.
Stone dressing machine.
Stone drill.
Stone molding machine.
Stone planing machine.
Stone sawing machine.
Stone splitting machine.
Stoping drill.
Stove-plate dressing mach.
Straight cutter planing m.
Straightening machine.
Straw cutter.
Street sweeper.
String binder.
Stripper.
Stripping machine.
Stud turning lathe.
Stuffing machine.
Stump extractor.
Submarine excavator.
Sugar-cane mill.
Sugar dryer.
Sugar evaporator.
Sugar filter.
Sugar-top cutter.
Surface grinding machine.
Surface molding and edg'g m.
Surface planing machine.
Surfacing lathe.
Surfacing machine.
Sweat-rolling machine.
Sweat sewing machine.
Sweeping apparatus.
Sweet potato digger.
Swing saw.
Tack machine.
Tacking machine.
Tailor's pressing machine.
Talc mill.
Tanite machine.
Tan press.
Tapering and crimping mach.
Tap groove sharpening mach.
Tap grooving machine.
Tapping machine.
Tea preparing machine.
Teaseling machine.
Tedder.
Tenoning machine.
Tentering machine.
Testing machine.
Thatch-making machine.
Thread cutting machine.
Thread dressing machine.
Threading machine.
Thread waxing machine.
Three-spindle drilling mach.
Threshing machine.
Tile machine.
Tip stretcher.
Tire bender.
Tire grinding apparatus.
Tire grinding lathe.
Tire setter.
Tire shrinker.
Tire upsetter.
Tobacco-cutting machine.
Tobacco granulating mach.
Tobacco press.
Tobacco spinning machine.
Tobacco stripper.
Toggle press.
Tolling machine.
Tool-grinding machine.
Tool-sharpening machine.
Tooth cleaner.
Track-laying machine.
Transfer lathe.
Transverse planing machine.
Traveling-bed planer.
Traverse drill.
Traverse planer.
Traverse slotting machine.
Traversing sawing machine.
Treadle circular saw.
Treadle drilling machine.
Tread power.
Trimmer.
Trip hammer.
Truss-hoop driver.
Trussing machine.
Trying-up machine.
Tube drawing machine.
Tunneling machine.
Turbine.
Turning mill.
Turning-off machine.
Turn-over gear.
Turret lathe.
Turret screw machine.
Twin power press.
Twist drill grinding machine.
Two-box loom.
Two revolution press.
Two spindle shaper.
Tying-in machine.
Type machine.
Type making and setting m.
Type writer.
Unhairing machine.
Universal borer.
Universal emery grinder.
Universal lathe.
Universal milling machine.
Universal wood-worker.
Upright drill.
Upright molding machine.
Upright shaper.
Upsetting machine.
Valve refitter.
Valve-seat planer.
Vanning machine.
Vegetable cutter.
Veneer cutter.
Veneer sawing machine.
Ventilator.
Vertical boring machine.
Vertical-buhr mill.
Vertical car-boring machine.
Vertical car tenoning mach.
Vertical drilling machine.
Vertical mill.
Vertical molding machine.
Vertical re-sawing machine.
Vertical-stone mill.
Wall drilling machine.
Wall paper machine.
Wall-paper polishing mach.
Wall-paper sticking mach.
Warping machine.
Warp tying machine.
Washing machine.
Waste picker.
Watchmaker's lathe.
Water aërating apparatus.
Water motor.
Wave molding machine.
Wax-thread sewing machine.
Web printing press.
Wedge cutter.
Weighted-carriage lathe.
Welding press.
Well drill.
Welt machine.
Wheat brush.
Wheat cracker.
Wheat damper and dryer.
Wheat grader.
Wheat heater.
Wheat scourer.
Wheat separator.
Wheat steamer.
Wheel-cutting machine.
Wheel hoe.
Wheel jointer.
Wheel making machine.
Wheel molding machine.
Wheel press.
Wheel-turning lathe.
Wheelwright's machine.
Whitening machine.
Wig-wag.
Windlass.
Windmill.
Wine press.
Winnower.
Wire covering machine.
Wire cutting and forming m.
Wire forming machine.
Wire handle machine.
Wire meas., form. and cut. m.
Wire-rolling mill.
Wire spring machine.
Wire straightening machine.
Wire testing machine.
Wiring press.
Wood bending machine.
Wood facing machine.
Wood lathe.
Wood rasping machine.
Woodworker.
Wool burring machine.
Wool combing machine.
Wool oiler.
Wool scouring machine.
Wool washing machine.
Worm gear hoist.
Wringing machine.
Yarn flocking machine.
Yarn printing machine.
Yarn reel.
Yarn washing rollers.
Yarn winder.
Yucca grater.

Ma-chine′ Bolt. A bolt with a thread, and a square or hexagonal head.

A machine *screw* is similar except as to the head, which has a slit for the insertion of the screw-driver.

Ma-chine′ Gun. One in which the loading and firing are executed by mechanical means; the power being usually applied by means of a hand-crank.

The subject is considered under BATTERY GUN, * pp. 249-251, "*Mech. Dict.*," where the following are described or referred to: —

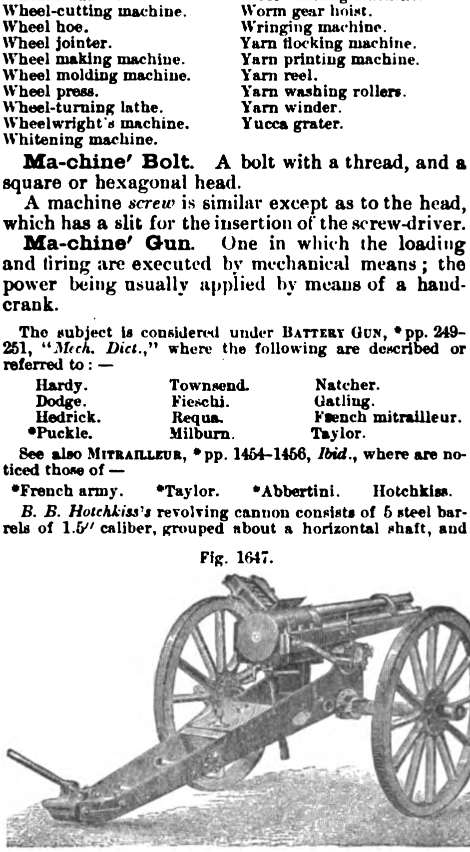
Hardy.	Townsend.	Natcher.
Dodge.	Fieschi.	Gatling.
Hedrick.	Requa.	French mitrailleur.
*Puckle.	Milburn.	Taylor.

See also MITRAILLEUR, * pp. 1454-1456, *Ibid.*, where are noticed those of —

*French army. *Taylor. *Abbertini. Hotchkiss.

B. B. Hotchkiss's revolving cannon consists of 5 steel barrels of 1.5″ caliber, grouped about a horizontal shaft, and

Fig. 1647.

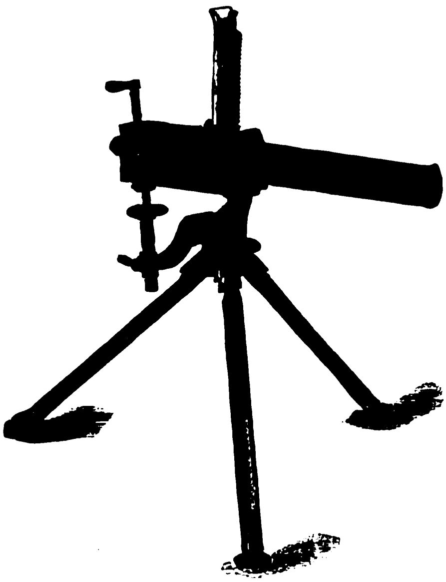


Hotchkiss Cannon Revolver.

revolving in front of a breech-block, which has openings to receive the cartridge and empty shell. The gunner, by turning a crank extending from the stationary breech, causes the shaft and barrels to revolve, and, while this rotation is in progress, mechanism is operated which shoves fixed ammunition into the rear of each barrel, and then, as the loaded barrels continue their revolution, a spring plunger strikes each cartridge in succession, and each barrel is thus discharged in turn. The projectiles are percussion conical shells, weighing about one pound each, and the rapidity of fire has exceeded 100 shots per minute. As each shell on striking bursts into an average of 17 effective pieces, the above volley is equal to 1,700 bullets striking within an area of 260 square feet in the above period of time. The range far exceeds that of any small arm. The revolving cannon is made by the inventor for the French government at St. Denis, near Paris, and is stated to be effective and accurate at 5,000 yards.

The *Gardner* machine gun (Fig. 1648) is mounted upon tripod or upon carriage; is automatic, transferring the cartridge from the feed-port to the barrel, firing, extracting, and ejecting the empty shell, consecutively to each barrel.

Fig. 1648.

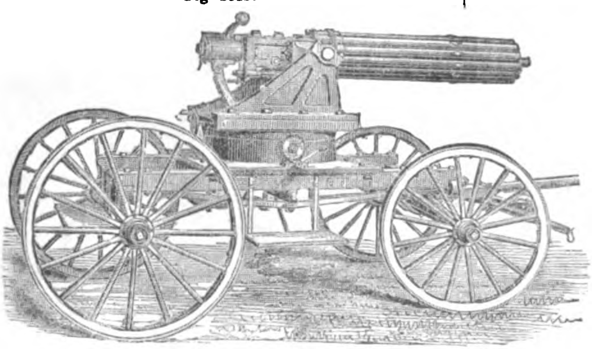


Gardner Machine Gun.

The barrels are stationary. The mechanisms for feeding and firing each barrel are independent; those for loading cartridges and ejecting shells are positive. The cartridges are fed automatically from a vertical magazine: the movements are derived from a hand-crank. The gun has traverse motion on its vertical axis in the stand, and adjustment for altitude by hinge and screw.

The *Taylor* machine gun has 12 barrels of 2″ caliber, each having a magazine capable of holding 12 cartridges. The magazines revolve, the loading is automatic, and the gun worked by one person by means of the lever on the tail-piece.

Fig. 1649.



Taylor Machine Gun.

The *Bailey* gun has a circular cluster of parallel barrels, and is worked by a revolving crank, the cartridges descending in a case which is stuck into the hopper so as to feed automatically. It has one lock, made in two pieces, which works all of the barrels.

See also *Parkhurst's* machine gun. Patent No. 228,777.

Coloney's patents:	225,461.	225,466.
	225,462.	231,652.
	225,465.	231,653.

Farwell's machine gun consists of 10 steel barrels of .45″ caliber, arranged parallel to each other in a metallic frame. From center to center of the outer barrel is 3′. Each barrel is charged separately from a magazine containing 50 rounds of ammunition. The charging, firing, and extraction of exploded shells are all accomplished by the turning of one crank, at each revolution of which the whole 10 barrels are discharged, emptied, and reloaded. A system of cog-wheels connects the firing crank with an automatic traverse.

It differs from the Gatling gun in the simultaneous loading and firing of 10 barrels, the latter loading each barrel through the same magazine aperture and firing but one shot at a time, though with almost incredible swiftness.

The *Requa* battery has 25 barrels lying horizontal and parallel on a carriage. It is a breech-loader, and the barrels are fired simultaneously.

The arrangement of the barrels is similar to that of the "infernal machine" of Fieschi, with which he fired upon Louis Philippe and his staff, killing several persons, but missing the king. In Fieschi's device the barrels were separately loaded, laid on a bench, clamped, and a train of powder laid over the touch-holes

In Requa's battery the paper cartridges are driven into all the barrels simultaneously by a sliding breech-block traversing at the rear of the whole platoon, and operated by a lever. Priming leads to each of the cartridges, and the charges are fired by a cap.

Two forms of the *Taylor* battery gun have the horizontal parallel (or converging) arrangement of barrels.

Lowell battery gun. "*Ordnance Report*," 1878, Appendix S, p. 375.

Hotchkiss, Revolving cannon, *Ibid.*, 1877, Appendix O, and p. 609 *et seq.*

Taylor, Battery gun, *Ibid.*, 1878, Appendix S, 1, p. 389, *et seq.*

Trial of *Hotchkiss'* revolving cannon, *Ibid.*, 1877, Appendix O.

Trial of *Hotchkiss'* revolving cannon, *Ibid.*, 1879, p. 143, with 17 plates.

Trial of *Gatling* gun, 5″ (English model), *Ibid.*, 1879, Appendix I[12], p. 190, with 15 plates. See

Gardner	"*Iron Age*," xx., Aug. 30, p. 11.
Hotchkiss	* "*Engineer*," xlii. 299.
Nordenfelt, Br. . . .	* "*Engineer*," xlvii. 416.

See also REVOLVING CANNON.

Ma-chine' Twist. A kind of silk thread, made three-cord, and twisted from right to left. Made specially for use in the sewing machine. Sewing silk is two-cord, and twisted from left to right.

See account in *J. L. Hayes'* "*Centennial Report*," v. 96, 97.

Mack'in-tosh Steel. (*Metallurgy.*) Steel made from malleable iron by a stream of carbureted hydrogen directed upon the bath of metal in a furnace. C. Mackintosh patent, 1825. Also known as the Baron process.

Mack'e-rel Latch. (*Fishing.*) A cord-clamp which holds the inboard end of a mackerel line.

Mack'e-rel Plow. (*Fishing.*) Also known as a *fatting-knife*, for creasing the sides of lean mackerel to make them resemble No. 1.

Mag'a-zine' Bat'te-ry. (*Electricity.*) One in which a magazine contains the crystals which are supplied to the liquid as exhausted, to keep the liquid saturated: —

As in the *Daniells'* battery, which has a magazine of sulphate of copper crystals; and the *Anderson*, which has a magazine filled with bichromate of potassium crystals.

Anderson's battery, U. S. Patent, "*Scientific American*," * xliii. 115.

Mag'a-zine' Gun. A gun containing a supply of cartridges, mechanically furnished to the chamber of the barrel, seriatim.

The subject is considered on pp. 1367-1369, "*Mech. Dict.*," where the following systems are described or referred to: —

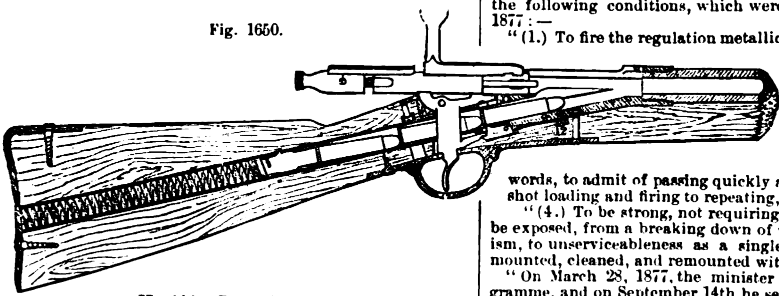
*Winchester.	*Callen.
*Ward-Burton.	Swiss.
Spencer.	Meigs.

Also on pp. 853, 854, *Ibid.*, and Plate XVIII.

The Hotchkiss repeater is a bolt and needle magazine gun. The magazine in the butt contains six cartridges which are forced forward by a spring. The gun is shown in Fig. 1650.

The cartridges are inserted one at a time, to the number of five, pressing each backward into the chamber until a click

Fig. 1650.



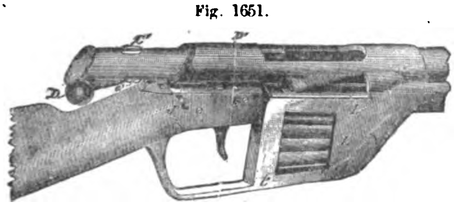
Hotchkiss Repeating Arm.

is heard, due to the head of the cartridge passing the cartridge stop. A sixth may be placed in the chamber. To load, turn the bolt and retract it. The bolt engages a cartridge, and the return motion forces the load into the chamber and cocks the piece. The piece has the usual 4 motions: Twist, draw, return, lock. The cocking being automatic, the piece is ready to fire.

Lieut. A. H. Russell's (U. S. Army) magazine gun is shown in Figs. 1651, 1652. The magazine is at the side and can be filled whether the piece be loaded or unloaded, the opening for insertion of the cartridge being accessible at all times.

The loading is on the bolt system, but no turning of the bolt is required. Fig. 1651 shows the bolt pushed forward

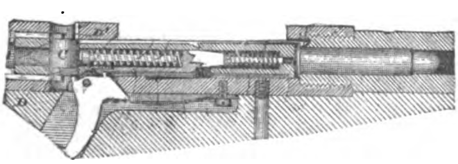
Fig. 1651.



Russell's Magazine Gun. (Elevation.)

slightly, forcing before it a cartridge just introduced into the receiver from the magazine *L*, which holds 5 or 6 cartridges, side by side. The magazine is at the side of the receiver and extends downward to the bottom of the trigger guard. The mouth of the magazine is at the side of the receiver, and the cartridges are forced upward by a spring so as to bring them in succession to the action of the bolt. A spring-gate pre-

Fig. 1652.



Russell's Magazine Gun. (Section through barrel and bolt.)

vents the escape of cartridges except to the receiver, while it allows them to be inserted sidewise into the magazine from without. They may be inserted singly, or the magazine may be filled quickly from a cartridge-box applied to the mouth of the magazine, the cartridges being forced in by the finger, the gate of the magazine yielding to the pressure from above and closing after the cartridges have entered.

The action of the bolt is rectilinear. It is drawn out by a handle which unlocks a pivoted catch-piece, *C*, to free the bolt, and relocks the piece *C* when the bolt is thrust home in loading. The forward motion of the bolt compresses the firing spring and the trigger catches in the hook of the firing pin. The breech mechanism is simple, and the operation requires merely a forward and back motion of the hand.

See also *Trabue's* magazine gun, patents Nos. 223,414; 223,660.

Report of trial of magazine arms for the French navy: —

"The French authorities have recently made a careful trial of repeating arms with a view to adoption should one be found which, while serviceable in other respects, fulfilled the following conditions, which were put forth in March, 1877: —

"(1.) To fire the regulation metallic cartridge of the army.

"(2.) To have the same trajectory and the same accuracy as the rifle model, 1874.

"(3.) So constructed as to be used as an ordinary single shot arm, or, in other words, to admit of passing quickly and simply from single shot loading and firing to repeating, and *vice versa*.

"(4.) To be strong, not requiring too tender care, not to be exposed, from a breaking down of the repeating mechanism, to unserviceableness as a single shooter; to be dismounted, cleaned, and remounted without difficulty.

"On March 28, 1877, the minister approved of this programme, and on September 14th he sent orders to Cherbourg to experiment with three types of repeaters, with detailed instructions as to the trials. These three arms were: —

"(1.) The *Hotchkiss*.

"(2.) The *Kropatschek*.

"(3.) The *Krag*.

"To these three the board confined themselves.

"The result of these trials showed that the magazine of the Hotchkiss was most quickly charged. The Hotchkiss also fires most rapidly; both in repeating and single shot fire the Kropatschek was not far behind it. The Krag does not seem to have been well understood and manipulated by the men.

The Kropatschek — modified — with eight cartridges in its magazine beat the Hotchkiss which had only six, while the Krag with nine cartridges was best of all. The time necessary to discharge this latter arm's magazine of nine rounds was 24.85 seconds, in which time the Kropatschek had on an average fired 8.9 cartridges per arm, and the Hotchkiss 7.9 starting with the magazine closed; with the magazine open 25 seconds were occupied, in which time the Krag fired 9, the Kropatschek 9.3, and the Hotchkiss 8.25 rounds on an average. Single shot fire proved better than recharging the magazine and repeating continually. The minimum times taken to fire off the magazines, at the conclusion of the experiments, when the men were expert, were as follows: Hotchkiss, 6 rounds, in 10 seconds; Kropatschek, modified, 8 rounds, in 14 seconds; Krag, 9 rounds, in 17 seconds; giving an average time per round of 1.66, 1.75, and 1.88 seconds respectively.

"Finally, it was concluded that the Hotchkiss rifle is the easiest and quickest in charging the magazines; then the Kropatschek: and last, Krag. As to rapidity of fire, the Hotchkiss and Kropatschek are about equal. Large magazines have a great advantage; the magazine once empty, it is best not to attempt to refill it till leisure gives the opportunity." — "*Engineer*."

The following United States patents may be consulted: —

184,285	*Hotchkiss*, adopted by Springfield Board, U. S. Army.
213,538	*Wetmore*, Attachments to above.
189,848 207,350	*Evans*, Gun.
201,855 202,613	*White*, Magazine for charging revolver.
210,091 210,181 213,866	*Burgess* Gun, As built by Martin.
221,079	*Livermore & Russell*, Impt. on Hotchkiss magazine.
221,328	*Lee* Gun, Recommended by Miles equipment board. Built at Sharp Works, Bridgeport, Conn.
230,823	*Russell's* magazine fire-arm (new bolt system.)

Appendix T to the "Report of the Chief of Ordnance," 1878, describes the official trials of magazine small arms for the United States service. It gives drawings and descriptions of the following magazine guns: —

No.	Name.	Plate.	Descriptive Page.
9.	Hotchkiss	I.	27
19.	Hotchkiss	II.	31 (adopted)
17.	Remington	III.	33
	Remington (modification)	IV.	
8.	Sharps	V	39
1.	Franklin	VI	40
2.	Ward-Burton	VII	42
11.	Burton	VIII	44
4.	Hunt	IX.	45
13	Winchester	X.	46
22.	Burgess	XI.	49

List of Magazine Guns at trial (*continued*).

No.	Name.	Plate.	Descriptive Page.
21.	Tiesing	XII.	52
26.	Chaffee	XIII.	53
7.	Buffington	XIV.	54
15.	Miller	XV.	56
24.	Clemmons	XVI.	59
6.	Lewis-Rice	XVII.	58
14.	Lewis-Rice	XVIII.	60
	Russell, magazine for Hotchkiss gun	XIX.	63
	Guer, modification of Hotchkiss bolt.	XX.	

The tests were as follows: —

Preliminary test, for safety; fired by the exhibitor.

1. Rapidity with accuracy.
2. Rapidity at will.
3. Endurance, by continuous firing 500 rounds without cleaning.
4. Firing defective cartridges.
5. Exposure to dust and firing without cleaning.
6. Exposure to rust by sal-ammoniac and two days subsequently in the open air.
7. Excessive charges.

Supplementary tests of various kinds.

The following classification give the peculiar points of each relatively to the method of feeding the cartridge.

CLASSIFICATION OF MAGAZINE ARMS.

FOUNDED ON THE METHOD BY WHICH CARTRIDGES ARE FED FROM THE MAGAZINE.

Magazine arms, supply chamber with cartridges from —

- 1st, butt-stock
  - 1st, by a spring
    - 1st, direct . . . . Hotchkiss. Lewis-Rice. Spencer.
    - 2d, indirect . .
      - 1st, by rotating barrel about axis parallel to it into line with magazine. . Scott and Triplet.
      - 2d, to position opposite receiver . . Clemmons.
  - 2d, by a rachet, which is —
    - 1st, automatic . . . . Chaffee.
    - 2d, operated by hand. . . . . Springfield-Miller.
  - 3d, by a spiral cam (screw motion) . . . . Evans.
- 2d, tip-stock by a spring — on a carrier which is—
  - 1st, sliding at right angles to axis of bore Winchester. Henry. Hunt. Vetterly.
  - 2d, rotating —
    - 1st, to position oblique to axis of bore . . . . Burton. Ward-Burton. Sharps. Remington.
    - 2d, to position parallel with axis . . . . . Tiesing. Burgess.
  - 3d, sliding and rotating — . . . . Buffington.
- 3d, magazine on top of barrel . . by a spring — to position parallel to axis of bore and above receiver — and by gravity into line with axis of bore. Franklin.
- 4th, magazine below bolt. by a spring (vertically) — to position opposite center of chamber. . . . . Lee.
- 5th, revolving chambers . . . . Hodges. Colt's repeating rifle. Revolving pistols.

FOUNDED ON THE MOTIONS OF THE PRINCIPAL PART BY WHICH THE BREECH IS OPENED AND CLOSED.

Breech-loading small-arms have — fixed chambers closed by — movable breech-blocks which are —

- 1st, sliding. in line of axis of barrel by —
  - 1st, direct action, *i. e.*, bolt-guns having —
    - 1st, concealed locks . . Hotchkiss. Remington. Burton. Ward-Burton. Franklin. Lee. Sharps Rifle Company.
    - 2d, center locks . . . Hunt.
  - 2d, indirect action, *i. e.*, moved by levers from — below . . . . Winchester. Burgess. Tiesing.
- 2d, sliding and rotating . . . . Buffington. Chaffee.
- 3d, rotating about an axis — at 90° to axis of barrel, and — horizontal lying —
  - 1st, above axis of barrel, and in — front. . . . . Springfield-Miller. Springfield-Clemmons.
  - 2d, below axis of barrel, and in — front, moved from — below (by a lever) Lewis-Rice.

The following detachable magazines, etc., are described in "*Ordnance Memoranda*," No. 15, Washington, 1873: those of—

Col. Benton's,	Springfield,
R. T. Hare,	Elliot.
Ira Merrill,	

C. B. Norton's "Appendix to American Inventions; Small Arms and Heavy Ordnance," Osgood, Boston: 1882.

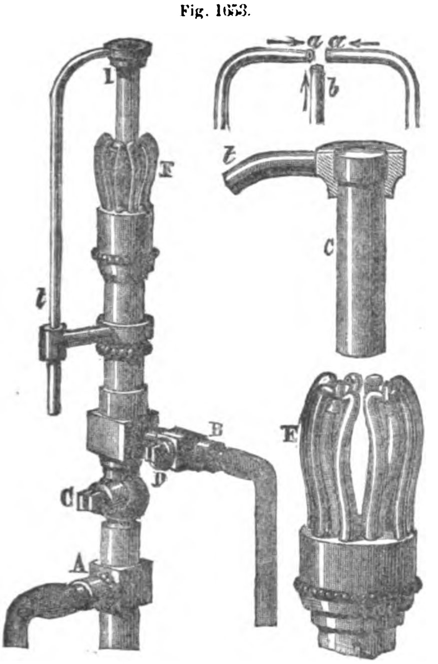
Mag-ne′si-a Light. A modification of the Drummond Light, in which a ball or crayon of carbonate of magnesia is substituted for chalk. See DRUMMOND LIGHT; LIME LIGHT, "*Mech. Dict.*"

The *magnesia* light is not to be confounded with the *magnesium* light, in which latter the metal is burned, either in strips or powder. See MAGNESIUM LAMP, p. 1370, "*Mech. Dict.*"

The substitution of magnesia for chalk is the invention of Sig. Carlevaris, an Italian physician.

In the apparatus of M. Tessié du Motay, as at first devised, a cylindrical crayon of compressed magnesia, prepared by

Fig. 1653.



Tessié du Motay's Magnesia Light.

the *système Caron*, was placed vertically above the burner, at which issues a melange of oxygen and ordinary illuminating gas. The design was afterwards modified, a change being made in the burner, so that the carbureted hydrogen arrived by two opposite pipes, *a a*, while the oxygen issued from the orifice of a vertical pipe, *b*, at a slightly lower level. Fig. 1653 shows the burner complete; on the right the respective oxygen and carbureted-hydrogen tubes, *A B*, with cock *C D* and the stem *t* of the holder *I*, from which the crayon *c* of magnesia is suspended, and by which it is vertically adjusted in the cluster of pipes *F*. On the right hand of the figure the *bec du Motay* is shown on an enlarged scale, and the arrangement of the pipes is also shown in a diagrammatic manner.

Mag-ne'si-um Light. A light made by burning the metal. See p. 1370, "*Mech. Dict.*," and Fig. 3684, p. 1689, *Ibid.*

Prof. Thurston's lamp is made by the American Magnesium Co. The strips of magnesium are rolled up on cylinders in the upper part of the apparatus. These strips are unrolled by clock-work in the lower part of the apparatus, and are carried between two small rollers, the uniform motion of which feeds them regularly into the lamp, where they are ignited. The ashes are cut off at intervals by means of eccentric cutters, and collect in the bottom of the apparatus. A small chimney is added, which is very important, as producing a draft of air directly through the flame. A portion of the products of combustion is thus carried away, and the flame becomes very intense, while it is less so without a draft. This lamp has been found very efficient, especially for marine signals. At trials made at sea, on two vessels stationed eight miles apart, the signals could be readily distinguished.

Larkin's lamp is based on a different principle. The magnesium is not employed as wire, or in strips, but as a powder. By this means the clock-work, or other mechanical device, has been dispensed with. The metallic powder is contained in a reservoir, which has a small opening in the bottom. The magnesium powder flows through this like the sand in a sand-clock. It is intimately mixed with a certain quantity of fine sand, in a manner diluted; first, in order to be able to make the opening sufficiently large; furthermore, to produce a continuous flow of the material. The mixture falls into a metallic tube, through which the illuminating gas is led from the upper end. The light is very brilliant, and the remaining sand falls into a vessel placed below, while the smoke passes away by a chimney.

Mag'net. See history and application, pages 1370–1374, "*Mech. Dict.*" See

Camacho	* "*Scientific American Sup.*," 19.
Prof. Henry's	* "*Scientific American*," xliii. 370.
Jamin, to make . . .	* "*Scientific Amer.*," xxxviii. 312.
Loan Collection, Br. . .	* "*Scientific American Sup.*," 520.
Spectrum	* "*Scientific American*," xxxiv. 244.
Needle in iron ore, Searching	"*Scientific American Sup.*," 753.

The chess board with magnetized pieces, for use in railway traveling, is a Prussian invention.

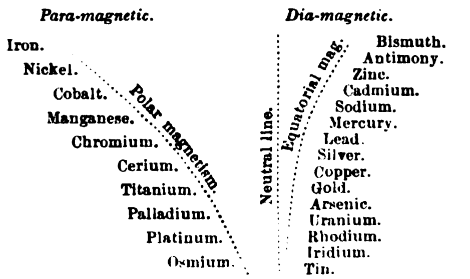
Mag-net'ic Bat'te-ry. (*Magnetism.*) A number of magnets joined together by their similar poles.

Mag-net'ic In-duc'tion. (*Electricity.*) The influence of a magnet through space, either to produce other magnets or to induce electric currents in metallic circuits.

Mag-net'ic Scale. A table or diagram exhibiting the para-magnetic and dia-magnetic metals in the order of their strengths respectively. The order given is from *Gordon's* "*Treatise on Electricity*," London, 1880. The diagrammatic illustration, in two hypothetical curves tangential to a neutral line, is by G. H. Knight. The dia-magnetic curve requires, it may be added, great exaggeration to make it visible. *Gordon*, ii. pp. 15–17.

In para-magnetic bodies the magnetism is strong and polar. In dia-magnetic bodies the magnetism is weak and equatorial. For example, the polar magnetism of the strongest known para-magnetic substance (iron) is estimated to be forty thousand times that of the equatorial magnetism of the strongest dia-magnetic substance.

MAGNETIC SCALE.



Mag-net'ic Sep'a-ra'tor. An instrument or apparatus for separating iron from other matters: as iron filings from those of brass; scraps of nails or wire from wheat, etc.; iron particles from ore in powder.

To remove wire from wheat	* "*American Miller*," vii. 106.
	* "*Scientific American Sup.*," 2781.
	"*Scientific American*," xlii. 194.
"Eureka,"	* "*American Miller*," viii. 368.
Vavin, Fr.	"*Van Nostrand's Mag.*," xix. 21.

See also ORE SEPARATOR.

Mag-ne'to Call'-bell. The sounder of a telephone circuit. See Fig. 508, p. 155, *supra*.

Mag'ne-to-e-lec-tric'i-ty (*Electricity.*) Electricity produced by magnetic induction.

Mag'ne-to-e-lec'tric Ma-chine'. The modern accepted definition of this is about as follows: —

That class of devices for translating motion into electricity in which the magnetic field is formed by permanent magnets or electro magnets energized by a current of electricity independent of the current generated by the machine itself.

Under DYNAMO-ELECTRIC MACHINE, pp. 283–286, Figs. 890-905, and Plates XI., XII., the subject is considered. The distinction between *Dynamo-electric* and *Electro-magnetic* represents a real difference in action; but this differentiation of terms is comparatively recent. See definition of the DYNAMO-ELECTRIC MACHINE, p. 283, *supra*.

The Gramme & Ivernois and Pacinotti electro-magnetic machines are shown in Plate XI., opp. p. 283, *supra*.

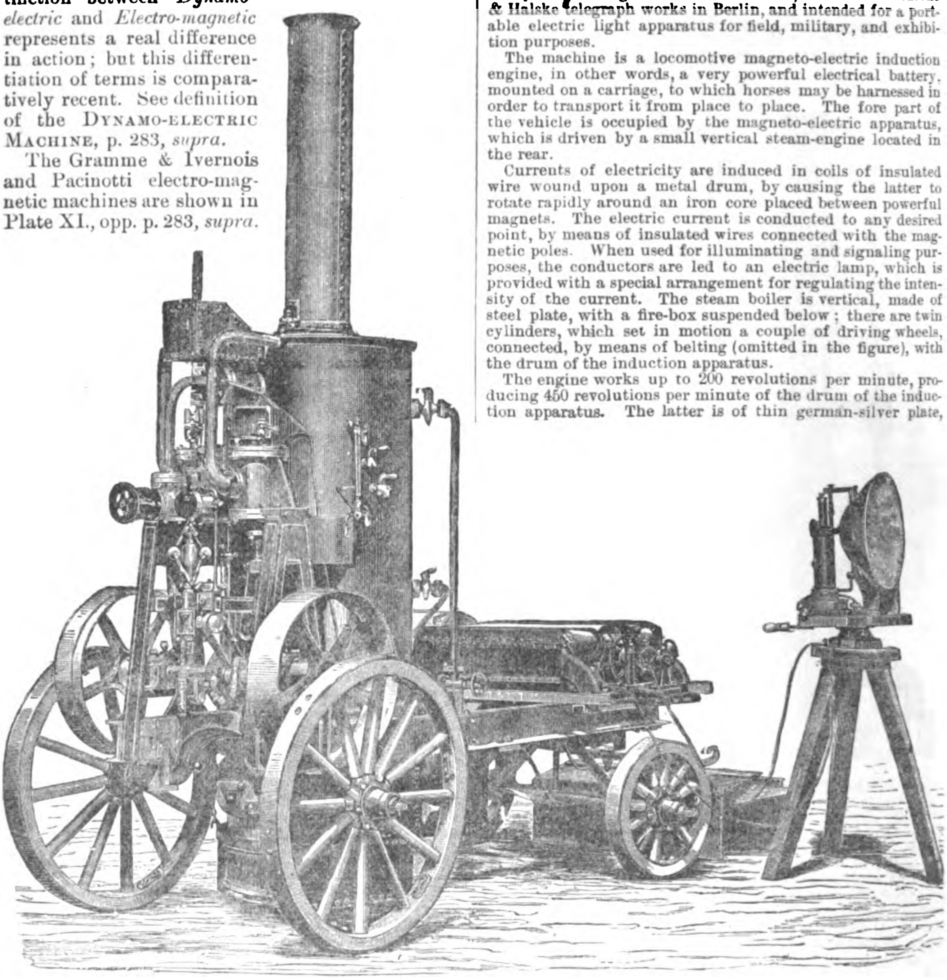
Fig. 1654 is an illustration from the "*Practical Magazine*" of a powerful magneto-electric machine, built at the Siemens & Halske telegraph works in Berlin, and intended for a portable electric light apparatus for field, military, and exhibition purposes.

The machine is a locomotive magneto-electric induction engine, in other words, a very powerful electrical battery, mounted on a carriage, to which horses may be harnessed in order to transport it from place to place. The fore part of the vehicle is occupied by the magneto-electric apparatus, which is driven by a small vertical steam-engine located in the rear.

Currents of electricity are induced in coils of insulated wire wound upon a metal drum, by causing the latter to rotate rapidly around an iron core placed between powerful magnets. The electric current is conducted to any desired point, by means of insulated wires connected with the magnetic poles. When used for illuminating and signaling purposes, the conductors are led to an electric lamp, which is provided with a special arrangement for regulating the intensity of the current. The steam boiler is vertical, made of steel plate, with a fire-box suspended below; there are twin cylinders, which set in motion a couple of driving wheels, connected, by means of belting (omitted in the figure), with the drum of the induction apparatus.

The engine works up to 200 revolutions per minute, producing 450 revolutions per minute of the drum of the induction apparatus. The latter is of thin german-silver plate,

Fig. 1654.



Portable Magneto-electric Machine.

covered with eight separate coils of copper wire of 0.28″ gage, and rotates between two very powerful horse-shoe magnets. At full speed, the current induced is sufficiently intense to heat a copper wire, 0.04″ in diameter and 38′ long, to redness, and, photometrically, is equal to 14,000 wax candles. The draft of the apparatus is about 2¼ tons.

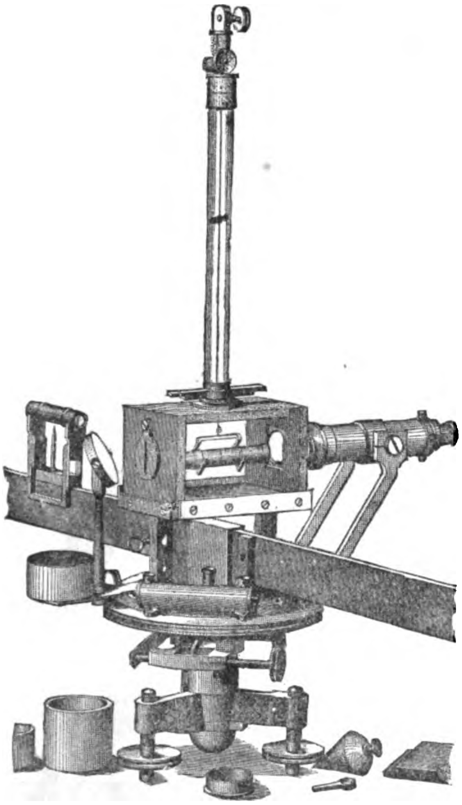
See *Barker* . . . . . * "*Scientific American*," xxxiv. 195.
Breguet, Fr. . . . . * "*Engineering*," xxii. 182.
* "*Scientific American Sup.*" 682.
Chutaux, Belgium . . "*Telegraphic Journal*," iv. 161.
de Méritens . . . . . * "*Telegraphic Journal*," vi. 393.
* "*Scientific American*," xxxix. 341.
Dubosq . . . . . . * "*Manufact. & Builder*," x. 85.
Fitzgerald, Br. . . . * "*Engineer*," l. 284.
Gramme . . . . . . * "*Engineering*," xxi. 147.
* "*Engineer*," xliv. 435, 461; xlvi. 329.
* "*Engineering*," xxvi. 65.
* "*Telegraphic Journal*," iv. 322.
Ladd . . . . * "*Engineer*," xliv. 401.
* "*Manufact. & Builder*," x. 109.
Lontin . . . . . . * "*Scientific Amer.*," xxxvii. 184.
Continuous current. * "*Telegraphic Journal*," iv. 100.
Niaudet . . . . . * "*Scientific American Sup.*," 129.
* "*Engineer*," xliv. 401.
* "*Manufact. & Builder*," x. 85.
Paris Exp. *Gramme* . . * "*Sc. Amer. Sup.*," 257, * 2237.
Portable, Engl. . . . * "*Scientific American*," xxxiv. 239.
Siemens . . . . . . * "*Manufact. & Builder*," x. 108.
Siemens . . . . . . * "*Engineer*," xliv. 401.
Soc. l'Alliance . . . . * "*Engineer*," xliv. 401.
Varley . . . . . . * "*Telegraphic Journal*," vi. 160.
* "*Scientific American Sup.*," 1995.
"*Scientific American Sup.*," 521.

Mag′net-om′e-ter. The furnishing of a magnetic station includes instruments for dip or inclination, variation or declination, and intensity.

The subject of the discovery of the variations of the compass by the Chinese, and subsequently by Columbus; the detection of the dip, and the invention of the dipping needle by Norman, of London; the determination of the *agonic* lines, eastern and western; various voyages of observation for the determination of magnetic phenomena; and the world-wide system of magnetic observatories, are referred to on pp. 1873, 1874, "*Mech. Dict.*"

"There are two forms of unifilar magnetometers in use: those with a complete astronomical theodolite, or alt-azimuth, mounted to the magnetic north or south of the box in which the collimator-magnet is suspended, and on the *same* stand with it; and those which have the box with suspended magnet mounted centrally over, and firmly connected with an azimuth-circle, the reading-telescope being mounted eccentrically on supports. The first form (devised by *Gauss*) is the preferable one in field use; it admits of greater expedition, allows of greater ease in observing, and is almost indispensable when the astronomical meridian has to be determined. With the magnet to the south of the theodolite, it

Fig. 1655.



United States Coast Survey Magnetometer.

readily admits of observations of the sun, for the determination of time and azimuth (also of latitude, if required) without interfering with the magnetic work proper. Deflections are read off on the scale of the collimator magnet, and must be converted into angular measures. The second form (see Fig. 1655), by *Dr. Lamont*, is capable, perhaps, of greater accuracy, and is better suited for a fixed observatory, especially when declination disturbances also are to be observed, or at stations where there is a large daily range in the declination. The angles of deflection are at once read off. In order to observe the azimuth-mark, the magnet and box have temporarily to be removed, which is unnecessary in the first form of the instrument. When observing deflections, the bar, and consequently the deflecting magnet, remain fixed in the magnetic prime vertical, in the magnetometer, with attached theodolite: but in the second form of the instrument the deflecting and deflected magnets always remain at right angles to each other. Improvements have been made at the Coast Survey Office in the construction of magnetometers, with a special view of making them more portable than the older instruments, which were found unnecessarily large and heavy. A 3'' Casella theodolite was utilized for this purpose. The magnet (3'' long and ¼'' in diameter) and light box, with glass tube, were first attached to the upper frame of the theodolite; afterward to its stand, by which greater steadiness was secured. The relative horizontal intensity only could be measured by means of oscillations. Subsequently, a similar instrument was fitted up with 2 magnets, inertia ring, and deflecting bar for absolute measure, the magnets being only about 1¼'' and 1½'' in length. Several instruments were constructed with 4'' theodolites and magnets, 1.50 and 1.84'' in length, respectively; diameter, 0.3''. One of these instruments is presented in Fig. 1655. The upper part of the theodolite can be removed, and the magnet-box placed on its azimuth-circle." — *Prof. Hilgard.*

See: *Hopkins* . . . . * "*Scientific American*," xli. 99.
"*Manufact. & Builder*," xi. 222.
Mag. inclin. apparatus. * "*Scientific American Sup.*," 2551.

Mag'ne-to-print'ing Tel'e-graph. A printing telegraph actuated by magneto-electric machine. In that of *Anders*, the machine is driven by a treadle. See Fig. 3960, p. 1802, "*Mech. Dict.*"

Mag'ne-to-tel'e-phone Call. A small magneto-electric machine with bell attached, acting as a call signal for a telephone. Fig. 508, p. 155, *supra.*

Numerous examples, *Hopkins*, * "*Sc. Am. Sup.*," 2570, 2571.

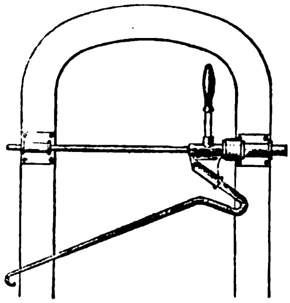
Mag'no-phone. A name applied by W. L. Scott, an English investigator, to what is now generally known as the *microphone.*

"*Manufacturer and Builder*" . . . . x. 151.
"*Engineer*" . . . . xiv. 374, 408.

Maid'en Nut. The inner one of two nuts on the same screw: the outer is the *jam*-nut.

Mail Car. (*Railway.*) A postal-car. One for carrying mail bags; frequently fitted up for sorting letters *in transitu*, and for receiving and delivering bags *en route*. When thus fitted, such a car is specifically known as a *post-office car.*

Fig. 1656.



Mail Catcher.

Mail Catch'er. (*Railway.*) A device on a postal car to catch mail bags at a station without stopping the train.

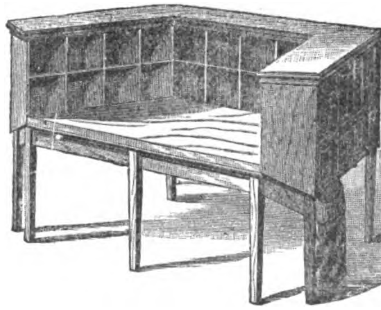
It usually consists of a bent iron bar on the car to catch into the loop handle of a mail bag, exposed on a platform post for that purpose.

French . . . . "*Sc. Amer. Sup.*," 835.
Bag fastening, *Mertz & Worman* * "*Sc. American*," xli. 310.

Mail'ing Ta'ble. A table at which mail matter is distributed to the mail bags for the various routes or stations.

On three sides of the table are tiers of boxes, each having a swinging door at the rear, and conveniences for fastening a bag at the rear of the box when the door is opened. Mail may be thrown into the box at any time, and the door opened when the bag is ready.

Fig. 1657.



Mailing Table.

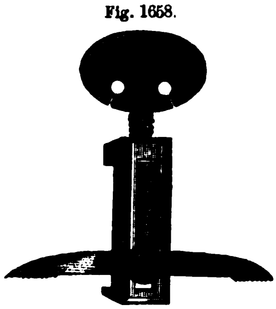
See also Distributing Table, Fig. 835, p. 262, *supra.*

Main Keel. (*Nautical.*) As distinguished from the false keel, keelson, etc., which are adjuncts or appendages.

Main Spring Vise. A compressing tool for condensing the main spring of a gun-lock in order to put it in the lock. Fig. 1658.

Main-tain'ing Wheel. (*Horology.*) A wheel actuated by a spring, to keep a watch going while being wound. A *going wheel*.

Fig. 1658.



Main Spring Vise.

Maize Cut'ter. A large form of chaff cutter. More especially one for cutting green corn for ensilaging.

See ENSILAGE CUTTER, Fig. 971, p. 315, *supra*.

Ma-jol'i-ca. (*Ceramics.*) A species of fine pottery with opaque enamel and brilliant colors. The name is derived from Majorca. See p. 1376, "*Mech. Dict.*"

See also MEZZA MAJOLICA, a ware with a leaden glaze in which the colors run so as to give a softened or mezzo effect.

Mal'le-a-ble Bronze. A simple method of rendering bronze as malleable as copper or iron, has been announced by Dronier.

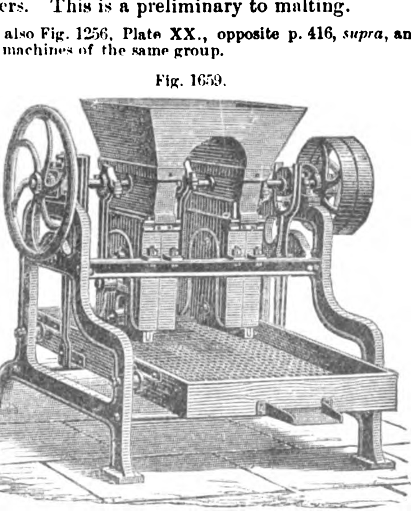
It consists in the addition of ½ to 2 per cent. of mercury. The mercury seems to act mechanically rather than chemically, and may be combined with one of the metals of which bronze is made, before they are combined, by pouring it into the melted metal and stirring well, or it may be put into the melted copper along with tin, or just after the latter has been added, or an amalgam of tin is stirred into the melted copper.

Mal'le-a-ble I'ron Pro'cess. (*Metallurgy.*) A process of decarburizing cast or pig iron by heating in an ordinary oxidizing atmosphere below the fusing temperature. It proceeds gradually from the surface to the center. Articles are packed in oxide of iron in boxes and exposed in ovens to a red heat for 5 or 6 days. See pp. 1376–1377, "*Mech. Dict.*"

Malt Clean'ing Ma-chine'. A machine of the nature of a grain cleaner, in which barley is freed from all extraneous matters, such as seeds of other grain, grass and weed seeds, dust and foul matters. This is a preliminary to malting.

See also Fig. 1256, Plate XX., opposite p. 416, *supra*, and other machines of the same group.

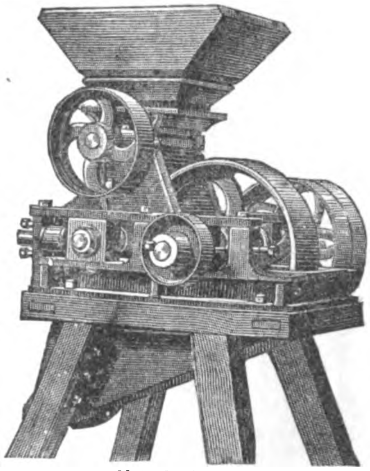
Fig. 1659.



Malt Cleaning Machine.

Malt Crush'ing Mill. A machine for grinding malt preliminary to mashing. Fig. 1660 is a French machine, by Duprez, of Rheims, which has an ingenious mechanical arrangement to throw out stones and nails. By the rapid motion of the machine the fecula of the malt is completely divested

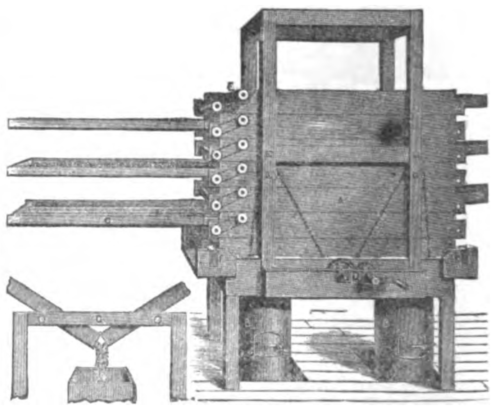
Fig. 1660.



Malt Crushing Mill.

of its natural envelope, which secures complete maceration and perfect infiltration in the vat during the mashing process.

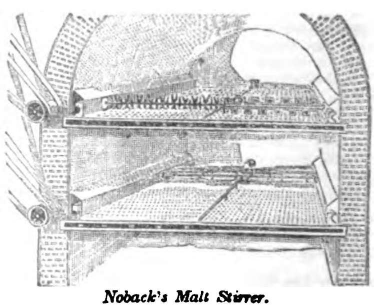
Fig. 1661.



Reynolds' Malt Dryer.

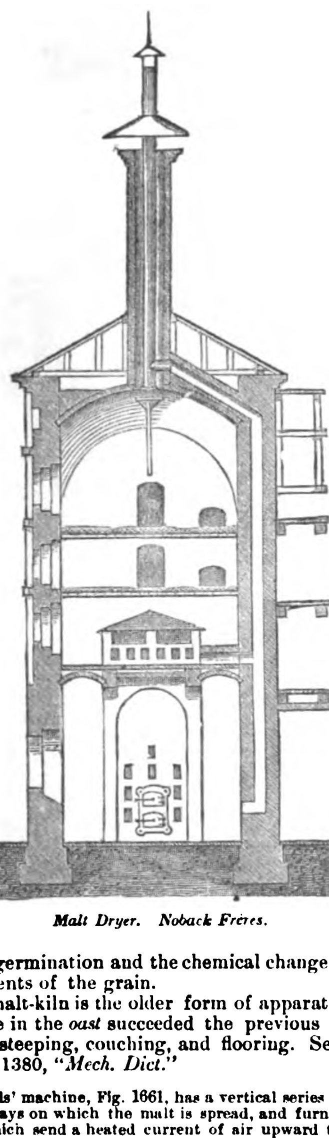
Malt Dry'er. A machine or apparatus in which malt is artificially dried in order to arrest the pro-

Fig. 1662.



Noback's Malt Stirrer.

Fig. 1663.



Malt Dryer. Noback Frères.

cess of germination and the chemical change in the constituents of the grain.

The malt-kiln is the older form of apparatus and exposure in the *oast* succeeded the previous operations of steeping, couching, and flooring. See Fig. 3036, p. 1380, "*Mech. Dict.*"

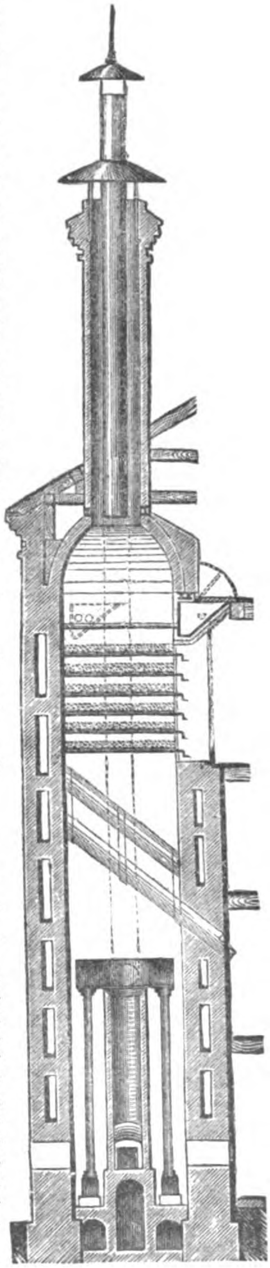
Reynolds' machine, Fig. 1661, has a vertical series of wire-bottom trays on which the malt is spread, and furnaces beneath, which send a heated current of air upward through the chamber in which the trays are placed.

A is a sectional chamber, with three compartments; each section contains rollers on which the trays *C* move backwards and forwards through the hot and cold air alternately as desired, the center being only partially heated by the two heaters *B B*; *C* are folding trays, twice the length of the chambers; *D* crank and gear wheels attached to movable frame *F* by chains, which serve to raise the entire sectional chamber and trays 10″, to admit a fresh tray when desired. Below is shown a table with rollers, showing the manner of discharging the malt from the trays when finished.

The malt kiln of Brüder Noback and Fritz, Prague, Bohemia, is shown in Figs. 1662, 1663, 1664. Fig. 1662 shows two floors in the upper section of the tower, Fig. 1664.

The malt is spread evenly on the floor, the latter being made of slats, of wires or wire cloth, so as to allow of the passage upward of the heated air from the stove shown at the lower apartment of the tower. Some differences of arrangement of the heating apparatus in the towers will be noticed in the Figs. 1663 and 1664 respectively. Each has a stove in the lower story, a flue which has a rectangular deviation to a flue built in the wall and a return to the chimney which crowns the whole. The heat generated by the stove suffuses the chamber and passes upwardly through the perforated floors, and the layers of malt, and escapes by the annular space around the central smoke flue in the chimney. In one of the figures, two malt floors are shown, and in the other as many as six. Each has the traveling stirrer, shown more in detail in Fig. 1662. This is a shaft which is armed with paddles and extends across the width of the malt chamber and has at the same time a movement of translation lengthwise of the chamber; so that it moves *along* the floor, stirring up the malt the whole *width* of the floor. The two movements are by gearing and rack in the covered side chambers which run lengthwise of the floor. When the stirrer has reached the end of its course, the belt is automatically shifted and the return course commences. See MALT TURNER, Fig. 1666, *infra*.

Fig. 1664.



Malt Tower. (*Noback, Prague.*)

Malt Ma-chine′.

See cleaner, Aust., Fig. 1.
* "*Sc. Amer. Sup.*," 4076.

Duprez, Fig. 1, Fr.
* "*Engineer*," l. 266.
* "*Sc. Amer. Sup.*," 1795.

Crusher, Austrian, Fig. 2.
* "*Sc. Amer. Sup.*," 4076.

Neubecker, Fig. 2, Ger.
* "*Engineer*," l. 266.

Damper, Austrian, Fig. 3.
* "*Sc. Amer. Sup.*," 4076.

Neubecker, Fig. 3, Ger.
* "*Engineer*," l. 266.

Kiln, Fig. 44, Austria.
* "*Engineer*," l 458.

Screen, *Nalder*, Br.
* "*Engineer'g*," xxvi. 479.
* "*Engineer*," xlvi. 443.

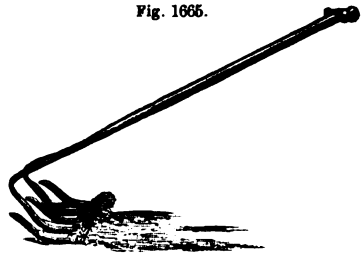
Malt Rake. A hand tool used in stirring malt on the kiln floor. The hoe portion scrapes the floor and allows no grains to escape being raised, and the fingers at the rear allow the grains to escape as the object is simply to stir and not to give a movement of translation. (Fig. 1665.)

Malt Screen. A device for cleaning extraneous matters from barley or from malt. See Fig. 1248, Plate XX., opp. page 416, *supra*.

Malt Turn′er. A mechanical arrangement for turning the malt while being heated in the kiln. (Fig. 1666.)

The floor of the kiln is made of wire, and the turning apparatus consists of a shaft having four arms projecting radially from it, on the ends of which are wire brushes clamped between two scrapers. This shaft has two motions, one rotating and the other longitudinal. When it arrives at

Fig. 1665.

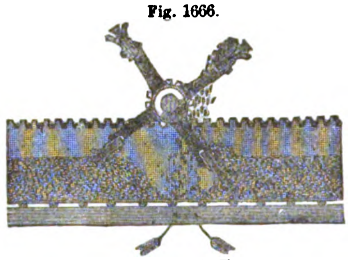


Malt Rake.

the end of the floor it shifts the driving belt, and returns over the same course.

Malt'wood's Find'er. (*Microscopy.*) A means for registering the position of an object on a slide.

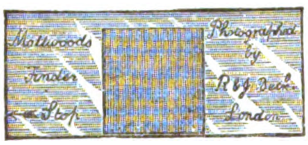
Fig. 1666.



Bergner's Malt Turner.

It is a slide with numbered rulings, 100 × 100. A slide containing an object of considerable area, and a point of special interest in the field being observed, the slide is removed and the finder substituted; the exact square is noted, and this being marked upon the slide of the object, the particular point of interest in the field of the slide can be at once brought into view, by placing the finder on the stand and bringing the number square into the field, and then substituting the slide with the object.

Fig. 1667.



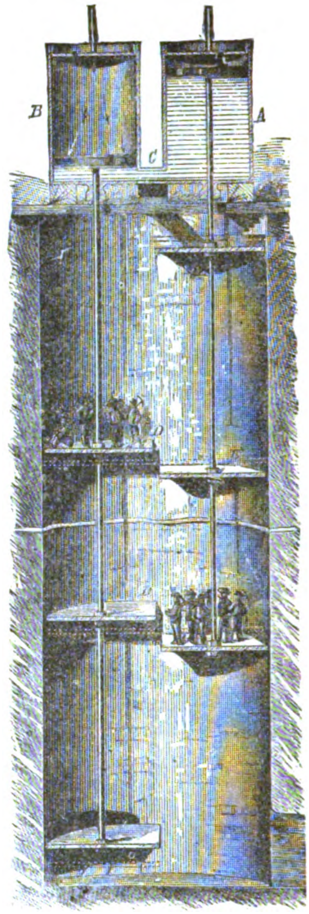
Maltwood's Finder.

Man En'gine. An apparatus for raising and lowering men in mines. Two forms are shown in Fig. 3042, p. 1382, "*Mech. Dict.*"

A more elaborate and capacious apparatus is used in the collieries of the *Sociétés des Charbonnages de Mariemont et Bascoup*. These large corporations own an area of some 500 square miles of coal fields, and employ 9,000 men, producing, from 14 mines, 7,000 tons per day. The apparatus for lowering and elevating the miners to and from their work is shown in Fig. 1668. *A* and *B* are two steam cylinders, connected by the pipe *C*, and containing water in the spaces below the pistons. The latter are attached to platforms *D* and *E*. A miner about to descend will step upon upper platform, *E*, when it is at the top. Steam admitted above the piston in cylinder *A* will drive the piston down the length of one stroke, and bring it even with a platform, *D*. Steam is then admitted above the piston in cylinder *B*, forcing said piston down, and hence driving the water into the other cylinder. This of course lowers *D* and raises platform *E*, and, as is evident, again brings two platforms on a level, when the piston in *A* is at its highest, and that in *B* at its lowest point. The miner now steps from platform *D* to a lower platform, *E*. Steam is again admitted, this time above the piston in *A*; platform *E* sinks, and eventually comes on a level with a third platform, *D*, and so on. This operation is continued, the workmen entering at the top and stepping from one platform to another until the bottom is reached. The ascent is by the inverse method.

Ma-neu'ver-ing Wheel. One of the wheels on the top carriage of a gun, on which it runs in and out of battery on the chassis.

Fig. 1668.



Man Engine.

Man'ga-nese' Bat'te-ry. A galvanic battery using the peroxide of manganese. See LECLANCHÉ BATTERY.

Man'ga-nese' Bronze. An alloy made by P. M. Parsons, England, in 1877, by adding from 1 to 2 per cent. of manganese to the proper proportions of copper and zinc, as used in making brass.

The average tensile strength of the metal when forged or rolled is 30 tons per square inch, with an elastic limit of from 11 to 18 tons, and an elongation of from 20 to 45 per cent. when in the annealed state. When cold-worked, the breaking strength in bars or plates rises to 40 tons per square inch, with an elastic limit of over 30 tons, and an elongation of about 12 per cent. When drawn into wire, the strength goes up to 70 tons per square inch.

The effects of forging are remarkable, raising the strength to such high limits, and practically giving a new and most valuable metal to the world. In some respects, indeed, it resembles aluminium bronze, but is superior in resistance to this alloy, which does not exceed 22.6 tons, and is also inferior in elongation and elasticity. Manganese bronze will find an application wherever gun-metal is used, while the facility and benefit of forging will render it still more useful in construction.

It is already much used in armor and sheathing for vessels, the making of torpedo boats and launches, bearings, pins, brasses and piston rings of steam engines.

It is said to be 60 per cent. stronger than gun-metal, and wears 3 or 4 times as long.

Parsons' manganese bronze: trials at the government gun factories, Woolwich, Eng., in comparison with Muntz-metal and gun-metal, gave the following. "*Engineering.*"

Material.	Strain per sq. inch. Elastic Limit.	Strain per sq. inch. Breaking Strength.	Ultimate elongation 2''.
	tons.	*tons.*	*per cent.*
Mang. bronze, cold rolled	34.4	39.6	11.6
Forged and annealed	16.6	30.7	20.7
Hot rolled and annealed	15.2	27.4	12.8 *
Cold rolled and annealed	14.5	29.1	18.3
Hot rolled (mild quality)	11.0	29.0	45.6
Muntz metal, rolled and annealed	7.8	24.0	54.6
Gun-metal. Cast.	7.0	16.0	16.6

* Broken, owing to a fault in turning.

In carrying out the invention, the copper should be first melted in a crucible or other vessel in the ordinary manner, and the spiegeleisen or ferro-manganese, either with or without the addition of wrought-iron scrap as sometimes practiced, should at the same time be melted in a separate smaller furnace capable of generating a high temperature in a graphite crucible under powdered charcoal, and when it is completely fused, and the copper is also fused, and at a boiling heat, the ferro-manganese should be poured into the copper and the two well mixed together by stirring with an iron rod previously made red-hot; the tin, or zinc, or both, should then be added in the usual way and in the requisite proportions, according to the kind of alloy it is desired to produce. After the tin and zinc are added the metal should be again well stirred with a red-hot rod and skimmed; it may then be either poured into ingot molds for future use, or it can at once be cast in molds to produce any articles required.

Four kinds of manganese bronze are at present manufactured, varying somewhat in their qualities: —

1. For forging and rolling into plates, sheets, and drawing into wires and tubes.
2. For casting into bars and plates subjected to strain.
3. For casting into bearings and brasses.
4. For casting into valves, faces, piston rings, slide blocks, top and end connecting rod brasses, etc.

The following U. S. Patents may be consulted: —

203,266 *Hale*, May 7, 1878.
206,604 *Parsons*, July 30, 1878.
178,490 *Ward*, June 6, 1876.

Prof. Genti publishes an analysis or a specimen of manganese bronze from a Transylvania factory. It is nearly of the color of brass, is tenacious and ductile under the hammer, and contains sulphur, manganese, copper, zinc, iron, with traces of silica, tin, and carbon. The essential ingredients are 15 parts of copper, 4 of manganese, and 1 of zinc. — "*Revue Indust.*"

See also MANGANESE COPPER, which is also known as CUPRO-MANGANESE.

The subject may be pursued by reference to the following: —

"*Scientific American*"	xxxiv. 356; xxxv. 259; * xxxvii. 345; xli. 21.
"*Scientific American Sup.*,"	489, 807, 226, 1635, 2440, 2971, 3345.
"*Iron Age*"	xvii., March 30, p. 8; May 4, p. 1; March 16, p. 3; May 6, p. 17. xviii. Nov. 2, p. 7; xxi., June 13, p. 15; xxiv., July 10, p. 11; Sept. 18, p. 1; xxv., May 20, p. 24.
Manufacturer & Builder "	viii. 104; x. 24; xii. 111.
"*Van Nostrand's Mag.*"	xiv. 541; xviii. 287.
'*Eng. & Mining Journal*	xxi. 277, 306; (U. S. Patent, 206,-604, July 30, 1878); xxiv. 441; xxviii. 55, 360; xxix. 221; xxx. 54.
Engineering "	xxi. 152; xxvii. 523; xxii. 280; xxiv. 330.
Min. & Scientific Press "	xxxii. 195; xxxvii. 3; xxxviii. 347.
Am. Man. & Iron World "	xxv., July 25, p. 8; xxvi., Jan. 16, p. 7; xxvi., Feb. 13, p. 8.
Engineer "	xl. 123; xlii. 274; xliv. 301.
Telegraphic Journal " Copper, 15. Manganese, 4 Zinc, 1	vi. 86.
English Mechanic "	xxvii. 475.
Technologiste "	xxxvii. 168; xli. 489.

Man'ga-nese' Cop'per. An alloy made at Isabellenhuette, near Dillenburg, Germany.

Copper	70
Manganese	30
	100

It is used as an addition to brass, bronze, etc., for increasing the density, tensile strength, and ductility of the metal, as the formation of oxides of tin or copper, which impair the physical properties of the material, is prevented by the great ease with which manganese is oxidized.

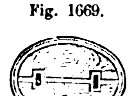
For bearings the following is recommended: —

Copper	80
Manganese copper	9
Tin	6
Zinc	5
	100

Larger amounts of manganese — for instance, 2.3 to 6 per cent. — make the metal particularly hard, and it is stated that bronze can be made in this manner to assume a hardness approximating that of steel.

Man Hole. An opening by which a city subway or sewer is reached from the street.

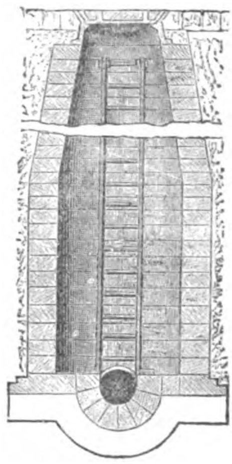
Fig. 1669.



The sub-ways of London and Paris are spacious and far-extending. See Fig. 6040, p. 2462, "*Mech. Dict.*"

The man-hole and manhole cover in Figs. 1669, 1670 are those used in London, carefully built in masonry, with standing iron ladders and with elm blocks in the cover rim, or an iron plate, in the respective figures.

Batten, Br., *"*Engineer*," l. 343.



London Man Hole.

Man'i-fold. 1. (*Heating.*) The chambers with nozzles into and from which the pipes of a radiator lead. Fig. 1671 shows two manifolds, a set of bent tubes with couplings, and a pair of coil plates to hold up the system.

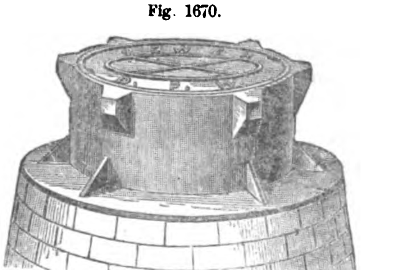
Manifolds are: back outlet, side outlet, double, etc.

2. A method of multiplying copies of a writing.

Man'i-fold Writer.

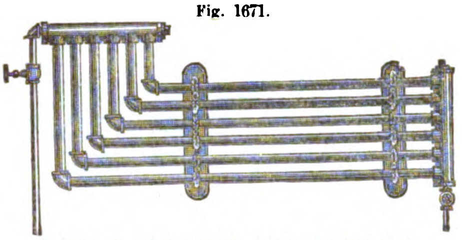
One French manifold writer consists of a metallic *slate* covered with tallow, mixed with one of the purple or red coal-tar colors. A sheet of tissue paper is laid thereon and written on with a hard pen without ink. On taking up the tissue paper the writing reversed is found upon the other side. The tissue paper is now laid (inky side up) on several folds of wetted blotting paper; the writing paper intended for the reception of the impression is moistened (sponged over) with an aqueous solution of gum tragacanth, laid upon the

Fig. 1670.



Stone's Man-hole Cover. (*London.*)

Fig. 1671.



Radiator for Wall, with Manifolds and Coil Plates.

matrix, and placed for a few seconds in a copying press. By these means 20 or 30 good copies can be obtained.

Another method has sheets of varnished paper to write on, with an ink by which the varnish is destroyed and the paper rendered porous. This is then placed on an ink pad, and the writing paper to be employed upon the top. On squeezing, ink is forced through that portion of the paper from which the varnish has been dissolved, and an impression is produced. An indefinite number may be so obtained.

E. De Zuccato's facsimile process for multiplying MSS. by chemical means is as follows: —

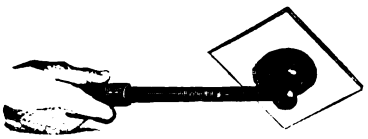
A sheet of thin paper is first prepared with a resinous varnish and dried. Upon one side of this the writing is executed with an ink consisting of a colored solution of potash or soda. The soluble compound formed by the alkali and resin is next removed by water, leaving the paper pervious to fluids where the ink lay upon it. This sheet is now placed face down upon a pad damped with a solution of persulphate of iron, and upon its back or upper side is laid the sheet to be printed upon, stamped with a dilute solution of ferrocyanide of potassium. After the pressure of a copying press has been applied, the facsimile writing will be found in blue (Prussian blue) upon the blank sheet. By substituting other sheets similarly prepared a large number of copies may be obtained from the same matrix.

Man'i-graph. A name for a method of multiplying copies of writing.

See Copying Process; Gelatine Copying Process; Hectograph, etc.

Ma-nip'u-la'tor. 1. An intermediate contrivance for handling plates without exposing the hands to injury. Useful in working with photographic plates and negatives. At the end of the handle is a suction disk of caoutchouc.

Fig. 1672.



Negative Manipulator.

2. A machine for shampooing or pummeling the body; rubbing the arm, legs, back, kneading the abdomen, etc. A substitute for exercise with the bed-ridden; and a useful adjunct in gymnastic training. See Exercising Machine.

Ma-nom'e-ter. An instrument for measuring the elastic force of a gas or of steam. See Fig. 4039, and references to Boyle and Ramsden, page 1684, "*Mech. Dict.,*"

Koenig's flame manometer . . . . Figs. 1046, 1047, page 344, *supra*.
Hopkins, flame manometer . . . . . . * "*Scientific American*," xxxix. 135.
Electric . . . . "*Scientific American*," xxxix. 74.

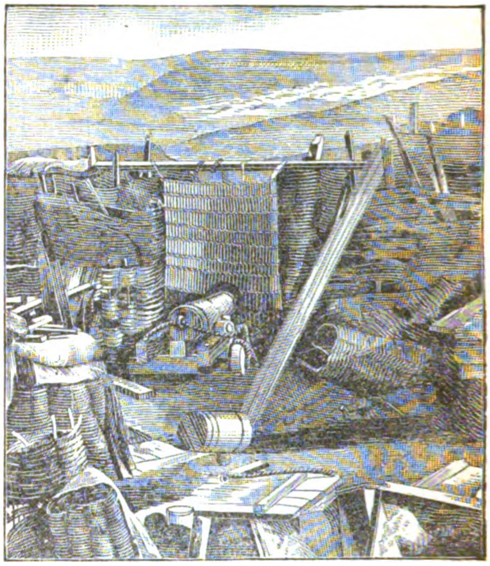
* *Breguet's*, *Vidi's*, *Galy-Cazalat's*, Article "*Manomètre*," *Laboulaye's* "*Dict. des Arts et Manufactures*," iv., ed. 1877.
* *Bourdon's*, *Ibid.*, "*Manomètre*," ii., Figs. 4, 5.
* *Journeux's*, *Ibid.*, "*Manomètre*," ii., Figs. 1, 2, 3.
* *Richard's*, *Ibid.*, "*Manomètre*," ii., Figs. 6, 7.
See also, *Ibid.*, "*Éclairage au Gaz*," ii., Fig 96 *et seq.*

Mariotte's tube, *Deschanel's* "*Natural Philosophy*," Am. ed., Part I., p. 171; *Depret's* apparatus for proving Boyle's law; *Regnault's*, for the same, and *Pouillet's*, for showing unequal expansion of different gases, are also shown on pp 172–174 of same work.

Man-te'an. (*Fabric.*) A fine French worsted stuff made of carded wool, both warp and weft; taffetas armure, which see.

Man'te-let. A bullet-proof screen to protect gunners serving a piece from the fire of the enemy. It is usually woven of rope. Fig. 1673 shows a mantelet in an embrasure of the Malakoff tower, before Sebastopol, in the Crimea.

Fig. 1673.



Mantelet, in the Malakoff Battery.

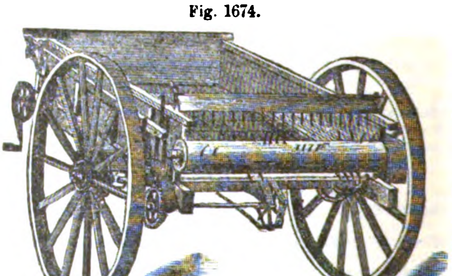
Mantelets are also used in front of rifle-pits; also to protect pioneers and sappers, and those working or passing in the trenches and approaches of an invested work.

Ma-nure' Drag. (*Add.*) 2. A fork with bent tines to unload manure by dragging it off the wagon.

Ma-nure' Spread'er. A cart having a bed of traveling slats, and a spiked roller at the tail gate, to distribute the load while the vehicle is moving over the surface of the ground.

It can be attached to the fore-wheels of any ordinary farm wagon. The floor of the cart is a revolving apron, which is carried backward by the gearing, bringing its contents against a rapidly revolving beater, which breaks up and distributes the manure. It is thrown into gear by a single lever at the left hand of the driver's seat, and throws itself out of gear when the load is spent. In running to and from the field none of its machinery is in motion, and it may be used through the season the same as an ordinary cart.

Fig. 1674.



Kemp Manure Spreader.

Man'y-light Reg'u-la'tor. (*Electricity.*) An order of regulator for voltaic-arc lights which allows a number of lights on one circuit. See POLYPHOTE REGULATOR.

Mar'ble, Im'i-ta'tion. See recipes, p. 1390, "*Mech. Dict.*"

Statuary: Coat a plaster-of-Paris or papier maché figure with white dammar varnish and dust with pulverized glass; it then resembles *alabaster*. It may be varnished a second time and dusted with coarsely pulverized glass or mica and it will resemble *Carrara marble*. May be veined with a delicate blue pigment between the coats.

To give to sandstone the appearance of marble: Impregnate the well dried stone with soluble silica and alumina. For colors, add mineral pigments to the liquid.

Marbleizing limestone: Work the stone to form and then put it in a boiler, submerged in water and bring a steam pressure of 75 to 100 lbs., according to the size of the object. Allow the object to cool; remove the object and submerge it in an alum bath, colored or otherwise. — *Hosmer.*

Artificial, "*Building News*"	"*Van Nost. Mag.*," xix. 324.
Imitation	"*Manuf. and Builder*," x. 12.
	"*Scientific Amer.*," xxxv. 130.
Cement	"*Scientific Amer. Sup.*," 1457.
Sawing machine, Carrara, It.	"*Min. & Sc. Press*," xxxvi. 211.
Working machine	"*Scientific American*," xlii. 50.

Report on marbles, foreign and native, by *J. S. Newberry*, "*Centennial Reports*," vol. iii., Group I., p. 187, *et seq.*

Mar'ble-ized Glass. (*Glass.*) Made by immersing hot glass in water, reheating and expanding by blowing. The incipient fractures become joined but show in the article like veins in marble.

Mar'ble-iz-ing I'ron. First coat with a thin layer of plaster-of-paris and alum, made to adhere by previously roughening and oxidizing the iron. This coat being well leveled and ground smooth, the paint used will readily adhere.

Mar'bling Pa'per. Described on p. 1391, "*Mech. Dict.*"

Elaborate description and directions from "*Paper World*," reproduced in "*Manufacturer and Industrial Gazette*," iv. 2, pp. 6, 7.

Woolnough . . . "*Scientific American Sup.*," 1889.

Marc. The residuum of grapes after pressure therefrom of the *must*. Corresponds with the *pomace* of apples, the *grains* of malt.

Ma'rie-Da'vy Bat'te-ry. (*Electricity.*) One in which the zinc stands in pure water and the carbon in a paste of moistened proto-sulphate of mercury in a porous cup. See MERCURY BATTERY.

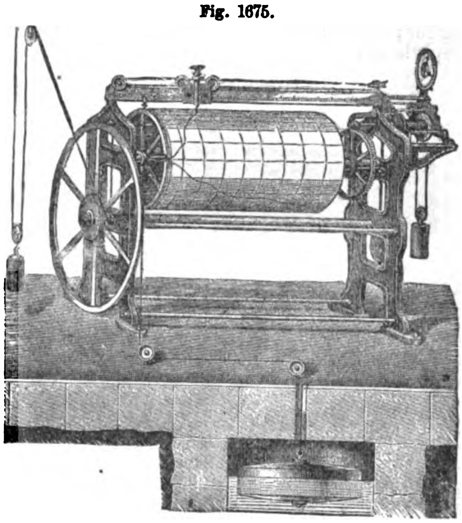
Sabine, London, 1867	229
Niaudet, American translation	* 140

Ma'ri-graph. A registering tide gage; by an extension of the meaning it may be held to mean an instrument for registering the fluctuations of height in sea, harbor, river, or canal. Other terms are used for some of these: such as *fluviograph*, etc. See also, TIDE GAGE, Fig. 6426, p. 2566, "*Mech. Dict.*"

The French Marigraph shown in Fig. 1675 is operated by an endless cord which connects with a float located in a suitable reservoir, into which the sea water enters. The changes of level of the water are registered on a large horizontal cylinder which is rotated by clock mechanism once in 24 hours. The cylinder is covered with a sheet of paper, changed fortnightly or monthly, and which is divided into longitudinal divisions, giving, on a reduced scale, the heights of the tides in meters and centimeters. A carriage, mounted on rollers upon a steel rule above the cylinder, carries a pencil which is pressed against the paper by a spring. The carriage communicates by an endless cord with a small grooved wheel mounted on the shaft of the larger wheel which receives the motion of the float previously referred to.

On a third wheel, of medium diameter, is wound a cord, which is drawn by a weight in an opposite direction to that of the cord of the float. When, therefore, the float rises, the effect of the weight is to remove the shaft so as to take up the slack of the cord so that the latter is always kept taut. The pencil carriage is similarly actuated, and traces on the cylinder a mark of which the extremity is the maximum height of the water. If the level is constant, the carriage remains motionless, and the pencil traces on the cylinder a line parallel to the transverse divisions.

Fig. 1675.



Marigraph.

A dial placed above the mechanism shows the hour, and at the same time serves to regulate the changing of the paper, and to indicate the moment at which the apparatus should be started on its daily motion. An electric indicator serves to give warning of any desired level being reached by the water. The indicator is movable, and is set on a special rod on the rule at the point corresponding to the height of water to be noted. When the carriage, on reaching that point, comes in contact with the indicator, the effect is to sound a bell.

Ma-rim'ba. A musical instrument of percussion, consisting of bars which yield various tones when struck. A *sticcado* (from the Italian).

The instruments are frequently called by names which indicate the material of which the bars consist.

Marimba is Portuguese, and the instruments of Angola have been introduced into European museums under that name. The instrument is common over a large part of the African Continent, and also in Malaysia. It is found in Guatemala but is probably of negro introduction. One from Central America is in the National Museum, Washington, D. C.

See author's article on "*Crude and Curious Inventions at the Centennial*," 1876, '*Atlantic Monthly*," * vol. xxxix., pp. 523–525, where may be found the marimbas of Angola, Central Africa, of Malaysia (*gambang*) and Siam (*Ra-naht-ake*).

The subject may be pursued by reference to DULCIMER; HARMONICA; LAPIDEON; * WOOD-HARMONICON; XYLOPHONE; "*Mech. Dict.*" Also, STEEL-BAR PIANO, * Fig. 3689, p. 1695, *Ibid.* Also, * LYRE; METALLOPHONE, *supra et infra*.

All the above have bars in series arranged according to a musical scale. The scales vary; diatonic, pentatonic, and those of the African and Asiatic, not quite in harmony with either.

See also, MARAMBA, p. 1889, "*Mech. Dict.*"

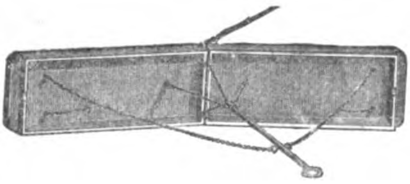
Ma-rine' Bat'te-ry. (*Electricity.*) One in which the plates are immersed in the sea, to be acted upon by the salt water.

Ma-rine' Boil'er. See under the following references: —

SS. "Arizona," Br. . .	* "*Engineering*," xxx. 192.
High pressure, *Boyer*, Br.	* "*Engineering*," xxvii. 410.
Water tube, British Navy	* "*Engineering*," xxi. 318, 349.
Furnaces, tug "Grinder," Br.	* "*Engineer*," xlv. 23.
Herreshoff	* "*Engineer*," xlvii. 259.
And engines. "Hohenzollern," Ger. Navy .	* "*Engineering*," xxiii. 308, 314.
Passman, Br.	* "*Engineer*," xlvi. 358.
High pressure, light weight, *Scott* . . .	* "*Scientific American Sup.*," 1886.
High pressure, *Scott* . .	* "*Engineering*," xxiv. 412.
Shaw	* "*Scientific American Sup.*," 1410.
"Thunderer," British Navy	* "*Engineer*," xlii. 133.

Ma-rine′ Drag. A drag-anchor. A floating anchor; thrown overboard in a storm to keep the ship's head to the wind when disabled or lying to.

Fig. 1676.



Capt. Beals' Marine Drag.

See DRAG-ANCHOR, Fig. 1738, p. 737, "*Mech. Dict.*"

Ma-rine′ En′gine. The engines of the steamships of the American line, "Pennsylvania," "Ohio," "Indiana," and "Illinois," were built by the William Cramp & Sons Ship and Engine Co., of Philadelphia. The vessels are of 3,030 tons, have a length of 355′ over all, and a beam of 43′. The engines are shown by longitudinal and transverse vertical sections in Plate XXVIII., and by plan in Fig. 1677.

"The engines are independent, compound, and surface condensing, with the crank set at right angles. The cylinders are 57¼″ and 90⅛″ in diameter, respectively, and the stroke of pistons is 4′. The main slide valves are on the outside of the high and low-pressure cylinders, which are both inclosed in a jacket connecting them together, and forming a receiver. The high-pressure cylinder is also steam-jacketed, but the low-pressure cylinder is not. The pistons are 16¾″ deep; the rod for the high-pressure cylinder is 8″, and that of the low-pressure 8½″ in diameter, and both are carried upwards through the cylinder heads. The cross-heads are of wrought iron, with cast-iron slides bolted to their ends. The main slide valves have double ports, each is fitted with an independent cut-off valve on the back, no provision being made for counterbalancing the pressure on the valve faces. The weight of the main valves is counterbalanced by the steam pressure in a cylinder on the top of the steam chest. Both main valves are driven by motion of the double bar-link type.

"The engines are reversed by direct-acting steam gear, the reversing cylinder being 20″ in diameter, with a slide valve on top, which is thrown open by hand, and closed by the motion of the piston-rod in any position. A screw is also provided which can be clamped to the piston-rod of the cylinder so as to move the links by hand if there is a want of steam.

"Relief valves are fitted at the end of each cylinder with gear to use them as starting valves. The connecting rods are forked by the cross-heads and are fitted with strap ends. The cross-head journals are 10½″ in diameter and 10½″ long, and the crank-pins are of steel 15½″ in diameter and 20″ length of journal. The crank-shafts are built up in two lengths, and are made interchangeable; the main journals are 15½″ in diameter and 30″ long, except the forward journal, which is 24″ long. The cranks are counterbalanced.

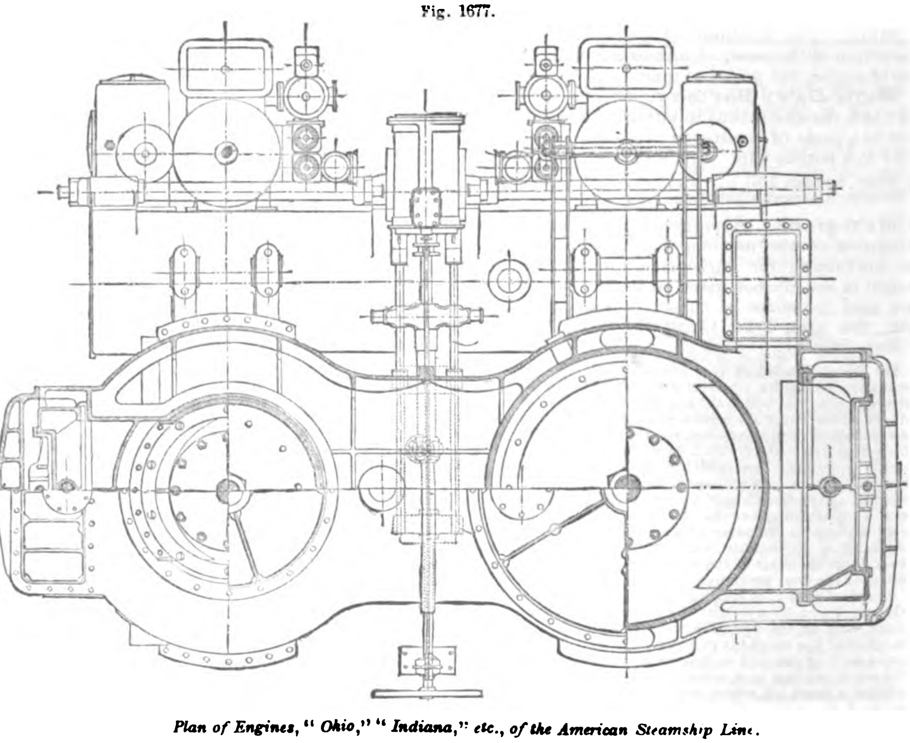
"The bed-plate is made in two parts and is bolted up to the condenser. This latter is in two pieces and contains 1,492 tubes, ⅞″ in diameter and 14′ long, the surface exposed being thus 4,786 square feet. The water from one circulating pump passes through them three times and from the other twice. The pumps are worked from the main cross-heads through wrought-iron levers as shown. Each air and circulating pump is cast separately and bolted to the condenser. A feed and a bilge pump are bolted to each air pump. The latter are 26″ in diameter, the circulating pumps are 18″ in diameter, and the feed and bilge pumps are each 6″. The stroke of all is 26″.

"A vertical turning engine is bolted to the side of the condenser and gears into a worm-wheel fastened to the intermediate shaft coupling between the two cylinders. The propeller shaft is 15½″ diameter, and is sheathed in the stern pipe. The propeller is four-bladed, with the blades cast separately and bolted to the bars; the diameter is 17′ and the pitch 24′.

"The boilers are double-ended, three in number, and fired fore and aft. The diameter of each is 12′ 3″ and the length 17′. There are three furnaces in each end 2′ 10″ in diameter, with grate bars 5′ 4″ long. There are 316 tubes 3″ in diameter and 7′ long in each boiler."

The compound has become the most popular, as it is the most economical, of marine engines. Reference has been made to 52 examples in COMPOUND STEAM ENGINE, p. 215, *supra*.

Fig. 1677.



Plan of Engines, "Ohio," "Indiana," etc., of the American Steamship Line.

ENGINES OF THE STEAMSHIPS "PENNSYLVANIA" "OHIO," "INDIANA," AND "ILLINOIS,"

CONSTRUCTED BY THE WILLIAM CRAMP AND SONS' SHIP AND ENGINE BUILDING COMPANY, PHILADELPHIA.

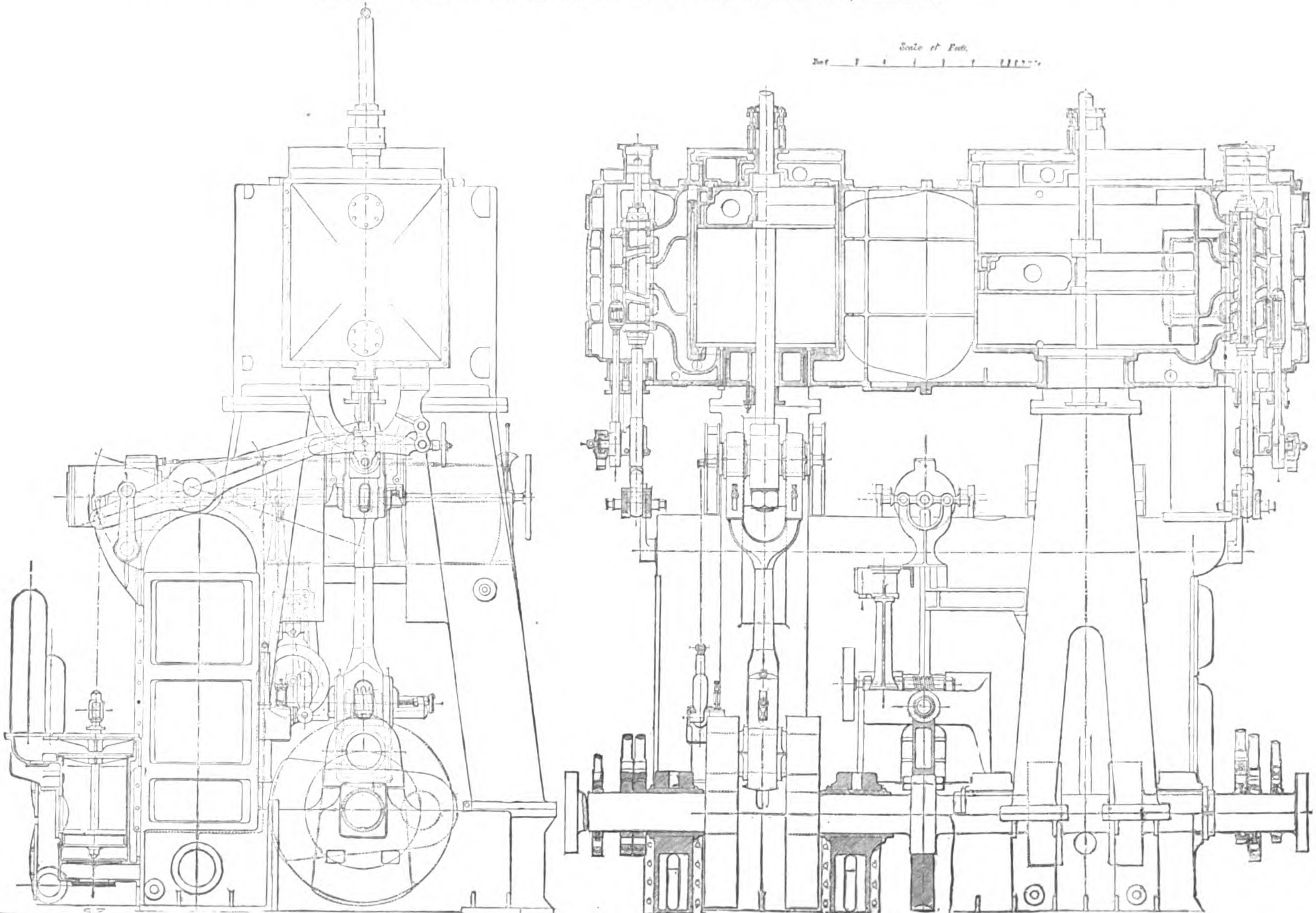


PLATE XXVIII. MARINE ENGINE. (*American Transatlantic Line.*) See page 582.

"The running of the Ohio during the voyage from Queenstown to Delaware Breakwater on her second voyage, was as follows: —

Date.	Knots Run by Screw.	Knots Run by Observation.	Running Time.		
Oct, 1873.			*hours.*	*min.*	
17	246.8	226.0	18	59	
18	323.8	280.7	24	23	
19	333.5	322.0	24	15	
20	335.7	294.0	24	23	
21	331.0	No obser.	24	0	15 minutes detention.
22	341.5	No obser.	24	24	
23	336.7	946 in 3 days	23	43	18 minutes detention.
24	339.5	333.7	24	22	
25	343.2	321.0	24	21	
26	142.0	140.0	10	30	
	3,075.7	2,863.4	9 days, 7 hours, 20 min.		

"The slip of the screw amounted to 212.3 knots, or 6 8 per cent., while the average speed was 12 8 knots. The weather was calm. Average indicated horse power, 1,977.54.

"That the performance of the engines we have described has been most satisfactory is proved by the great regularity of the passages made by the vessels to which they are fitted, while their workmanship and general finish well deserve praise." — "*Engineering.*"

The change from *paddle* to *screw* has revolutionized the forms of marine engines. The necessity for placing the propeller shaft near the keel has placed the engine above it, and the proximity of the keel and consequent short radius of the crank has reduced the stroke of the piston.

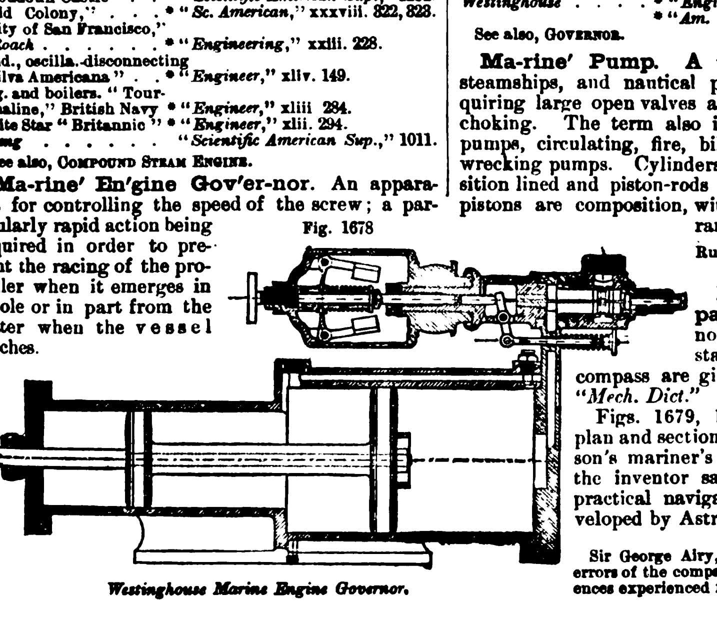
See the following: —

Torpedo launch "Acheron," N. S Wales . . * "*Engineering*," xxviii. 99.
"Calais-Douvres" . . * "*Engineer*," xlv. 400.
Ericsson's "Destroyer" * "*Engineer*," xlvi. 457.
Compound, "Gallia."
Thomson, Br. . . . * "*Engineering*," xxviii. 220.
German Iron clads . . * "*Engineering*," xxiii. 10.
"Hudson," Cromwell line . . . . * "*Engineer*," xlii. 242, 320, 390; xliii. 236, 388, 431, 462.
* "*Scientific American Sup.*," 959.
Irish Channel Steamers * "*Scientific American Sup*," 1394.
Surface cond. oscillating "Lord of the Isles," Br. . . . . * "*Engineering*," xliv. 66, 115, 132.
"Loudoun Castle" . . "*Scientific American Sup.*," 1252.
"Old Colony," . . . * "*Sc. American*," xxxviii. 322, 323.
"City of San Francisco," *Roach* . . . . . . * "*Engineering*," xxiii. 228.
Cond., oscilla.-disconnecting "Silva Americana" . . * "*Engineer*," xliv. 149.
Eng. and boilers. "Tourmaline," British Navy * "*Engineer*," xliii 284.
White Star "Britannic" * "*Engineer*," xlii. 294.
Young . . . . . "*Scientific American Sup.*," 1011.

See also, COMPOUND STEAM ENGINE.

Ma-rine' En'gine Gov'er-nor. An apparatus for controlling the speed of the screw; a particularly rapid action being required in order to prevent the racing of the propeller when it emerges in whole or in part from the water when the vessel pitches.

Fig. 1678



Westinghouse Marine Engine Governor.

The subject has been considered in the "*Mech. Dict.*," and the following referred to at the pages noted: —

Huntoon, * *q q'* Plate XXI., opposite p 998.
Huntoon, * Fig. 4750, p. 2073.
Silver, * Fig 3066, p. 1394.
Cathcart, * Fig. 3067, p. 1394.
Duff, * Fig. 3068, p. 1395.
Wolcott (electro-mag.), p. 1395.
Mosman (chronometric), p. 1395.
Osborne, p. 1394.

The principle embodied in the Westinghouse marine engine governor is the employment of steam pistons as the medium for operating the throttle-valve or link, and the only duty of the governor is to actuate a small piston valve which controls the pressure of steam on opposite sides of these pistons, thus varying their position, and also that of the throttle-valve or link to which they are attached.

The apparatus consists of two parts, a differential cylinder and a regulator; the former contains a piston-rod, one end of which is connected to the starting valve of the engine, and the other passes through a long tube or sleeve, carrying at either end a piston fitting the differential cylinder just mentioned

The apparatus is shown in Fig. 1678; its operation is as follows: —

Steam is admitted into the large and small parts of the cylinder so that the pressure on each side of the larger piston is equalized, while the pressure on the smaller piston keeps it at the end of its stroke, that is, to the left in the cut, the opening in the end of the smaller cylinder leading to the air or condenser. This position keeps the engine valve open and this is the normal running condition. The portion of the regulator containing the weights is driven by a strap from the engine, and, as soon as racing commences, the increased speed given to the revolving weights causes them to fly outward and depress the regulator spindle which acts upon a piston valve and allows the steam to escape from the right hand side of the larger piston, to the atmosphere, reducing the pressure on that side of the piston. The pressure of steam on the larger piston then instantly overbalances that on the smaller one and the pistons fly to the right and thereby close or partially close the valve admitting steam to the engine. The speed is by this means instantly reduced, the piston valve returns to cover the port in the regulator chamber, and the pressure is restored to equality on each side of the large piston.

Durham's screw engine governor acts also on the principle of the combination of a governor with a steam cylinder and piston.

Refer to: Governor, pneumatic, *Dunlop*, Br. . . * "*Engineer*," xlviii 103.
Jenkins & Lee . . . . * "*Engineering*," xxx. 370.
Durham, Br. . . . . * "*Scientific American Sup*," 2897.
Westinghouse . . . . * "*Engineering*," xxvi. 177.
* "*Am. Man.*," p. 9, May 2, 1879.

See also, GOVERNOR.

Ma-rine' Pump. A pump for steamboats, steamships, and nautical purposes generally, requiring large open valves and passages to prevent choking. The term also includes boiler feeding pumps, circulating, fire, bilge-water, and perhaps wrecking pumps. Cylinders are preferably composition lined and piston-rods solid composition; the pistons are composition, with spring rings, or arranged for leather.

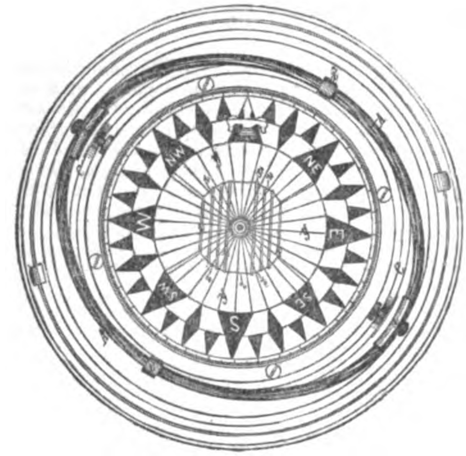
Russian navy. * "*Engineering*," xxi. 326.

Mar'in-er's Com'-pass. The history, early notices, and modern instances of the mariner's compass are given on pp. 1395–1398, "*Mech. Dict.*"

Figs. 1679, 1680 are respectively plan and section of Sir William Thomson's mariner's compass, designed, as the inventor says, "to carry out in practical navigation the principles developed by Astronomer-royal Airy.

Sir George Airy, in 1840, showed how the errors of the compass, depending on the influences experienced from the iron of the ship, may be perfectly corrected by magnets and soft-iron placed in the neighborhood of the binnacle. The system has become universal. The principal difficulty in practice "has been the size of the needles in the ordinary compass which

Fig. 1679.



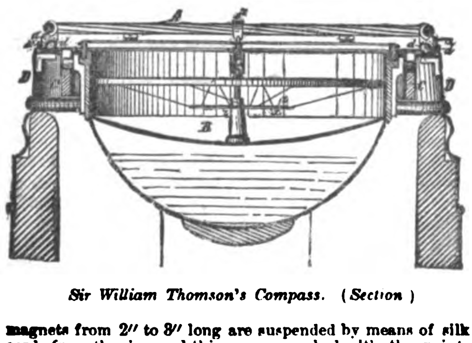
Sir William Thomson's Mariner's Compass. (Card.)

renders one important part of the correction, the correction of the quadrantal error for all latitudes by masses of soft iron placed on the two sides of the binnacle, practically unattainable; and which limits, and sometimes partially vitiates the other chief part of the correction, or that which is performed by means of magnets placed in the neighborhood of the compass.

See paper by Sir William Thomson, United Science Institution, * Feb. 4, 1878. See United States Patent No. 232,781.

In size and outward appearance this compass (with binnacle, etc.), does not differ from those hitherto in use; but the patent card is constructed on an entirely new principle. It consists of a central aluminium boss and an outer aluminium rim connected together by fine silk cords. Small

Fig 1680



Sir William Thomson's Compass. (Section)

magnets from 2″ to 3″ long are suspended by means of silk cords from the rim, and thin paper marked with the points of the compass and degrees is attached to the rim and partially supported by the silk cords between the rim and the boss. By this arrangement the principal part of the weight is in the aluminium rim, and is consequently as far as possible from the center on which the card moves. This gives a very long period of free oscillation, and, consequently, great steadiness.

The card with the needles is extremely light, the 10″ compass weighing 178 grains, which is about one twentieth of the weight of an ordinary compass of such dimensions. The *frictional error* is thus reduced to a very small amount.

The *quadrantal error* in this compass is corrected by a pair of soft iron globes fixed one on each side of the binnacle. When the quadrantal error has been thus once accurately corrected, the correction is perfect, to whatever part of the world the ship may go, and requires adjustment at no subsequent time, except in the case of some change in the ship's iron, or of iron cargo or ballast sufficiently near the compass to introduce a sensible change in the quadrantal error.

The *semi-circular error* is corrected by applying two adjustable magnetic correctors, one for neutralizing the thwart-ship component, the other for the fore-and-aft component of the ship's magnetic force.

The *heeling error*, chiefly experienced in iron sailing ships, is corrected by the application of an adjustable magnet below the compass in a line through its center perpendicular to the deck.

Cf. Japanese	. . .	"*Telegraphic Journal*," iv. 212.
Sir W. Thompson	. . *	"*Engineering*," xxiii. 191.
		"*Scientific American Sup.*," 1064
Nickel needle	. . . .	"*Scientific American Sup.*," 2686.

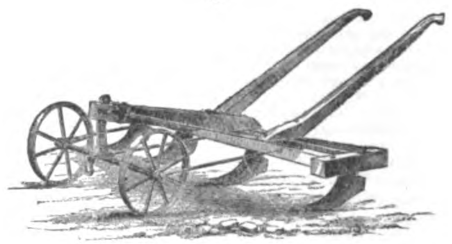
Ma-rine' Sig'nal. The term includes many kinds of apparatus, such as whistling, ringing, and electric buoys, fog horns, guns, and trumpets, sirens, etc. See under various heads.

Prof. Meyer's topophone for locating sound, Patent No. 224,199.

Safety signal, *Barker*	. . . . . *	"*Engineer*," xlix. 411.
Signal buoy, *Mann*	. . . . . .	Patent No. 226,238.

Mark'er. (*Agriculture.*) An implement for marking off rows on the ground as a guide for planting or dropping.

Fig. 1681.

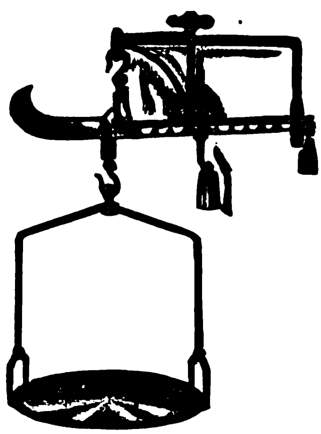


French Row-marker.

The one shown is a French implement — *rayonneur* — used in marking rows for planting beets and other drill crops.

Mar'ket Beam. A form of steelyard of special adaptation to market purposes in its range of weight, means of suspension, and large pan.

Fig. 1682.



Market Beam.

See scales, Plate LXXIII., p. 2754, "*Mech. Dict.*"

Mark'-off. (*Printing.*) In proof-reading, the slip of copy upon the margin of which the termination of a page of proof is marked. This in order to assure the proper sequence in the commencement of the next page.

Mar'lin-spike Hitch. (*Nautical.*) A form of bend. See *g*, Fig. 2513, p. 1105, "*Mech. Dict.*"

Mar'tin Bit. (*Manége.*) A stiff-bar bit, having a spoon-shaped port, from 4¾″ to 6″ long and ½″ wide; the top is convexed and polished; when in use, this long piece rests against the roof of the horse's mouth, and when necessary it becomes unusually severe, yet it does not injure the mouth as much as other port bits.

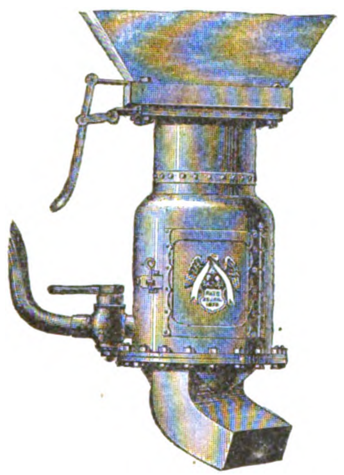
Mar'tin Steel. (*Metallurgy.*) Steel made by adding malleable iron to a bath of pig-metal in a reverberatory. P. and É. Martin, Patents, 1865–1867. A Siemens-Martin ingot, weighing 120 metrical tons, was cast by the Terre Noire Company, in 1878.

Ma-ryn'go-tome. (*Surgical.*) A fine hastate pointed instrument of incision; used in operations on the ear. — *Buck.*

Mash Ma-chine'. A machine for pulping mash before discharging it into the tun where it is steeped.

Siebel's device, shown in Figs. 1683, 1684, is a sparger used to soften and pulp the mash on its way from the hopper to the

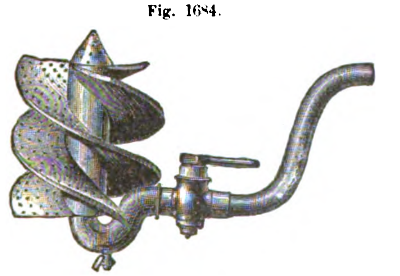
Fig. 1683.



Siebel's Malt Pulper.

tun. Fig. 1683 is an exterior view of the apparatus, and Fig. 1684 a view of the interior sparger. It consists of a hopper, sparger chamber, and spout, and a pipe and worm with perforations to eject water to suffuse the passing malt. The gate valve at the bottom of the hopper being withdrawn, the ground malt in the hopper commences to descend; hot water is admitted to the sparger by turning the spigot. The

Fig. 1684.

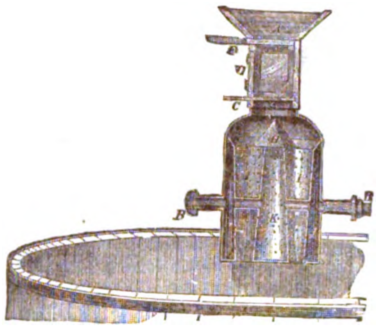


Sparger.

vertical portion and the spiral of the latter are hollow and perforated, to discharge jets of hot water arriving by the pipe. The descending malt is spread by the cone, and, passing down the face of the spiral is reduced to a soft pulp before being discharged by the chute into the tun beneath.

In *Trageser's* self-acting mashing machine the malt enters from the hopper *A*, strikes the cone *H*, and passes down

Fig. 1685.



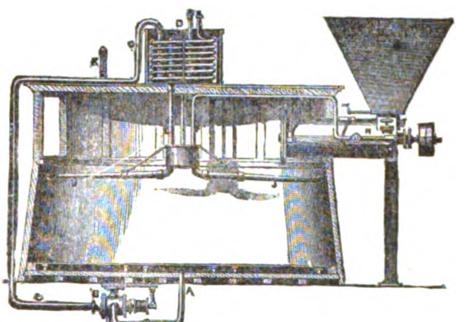
Trageser's Sparger.

an annular space *I* between two cones *J K*. Water from pipe *B* surrounds the outer cone and fills the inner one, and is sparged through perforations upon both sides of the malt passing downwards into the tun.

Mash Tun. A vat in which ground malt is steeped and stirred to make wort. See Figs. 3077–3080, pp. 1402, 1403, "*Mech. Dict.*"

Fig. 1686 is *Boby's* mash-tun (Br.), which is adapted for mashing at a low temperature, and subsequently increasing the heat, avoiding the use of successive amounts of hot water; called in England *piece liquors.*

Fig. 1686.



Boby's Mash Tun.

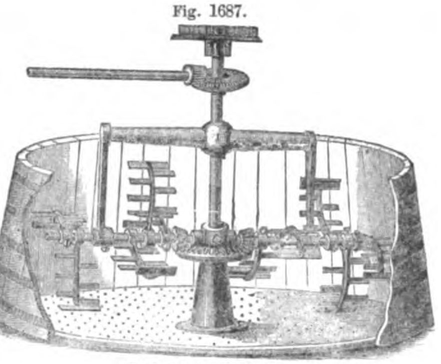
In the figure —

A. Pipe provided with stop-cock, to convey wort from bottom of tun to pump.
B. Pump with rigger, to be driven by means of a strap.
C. Pipe which conveys wort from pump into copper cistern with coil
D. Copper cistern containing coil for heating wort.
E. Tube from coil cistern to sparge.
G. Tube with cock for the purpose of emptying pump and pipes after the operation.
J. Sparge arms.
K. Thermometer, indicating temperature of wort in tun.

The peculiarity of *Feiderlein's* mash tun (Fig. 1687) is in the mechanism. It has a strong perpendicular driving shaft, by which the whole system of rakes is revolved in a horizontal plane The rakes revolve in vertical planes, and are journaled upon a horizontal shaft which itself has a rotary sweep in addition to its axial rotation. The double-armed rake lifts the malt on both sides of the tun at once.

Fig. 1688 shows *Schimper & Immen's* mash machine, a portion of the side of the tun being broken away to exhibit the apparatus and interior The stirrer consists of a spiral which rotates with its horizontal shaft, and partakes with the latter of a sweeping movement in a horizontal plane around the vertical axis to which it is attached. The movement of rotation of the screw is given by the meshing of a pinion on the horizontal shaft with a bevel wheel on the floor of the tun. The mash is heated by a steam coil above

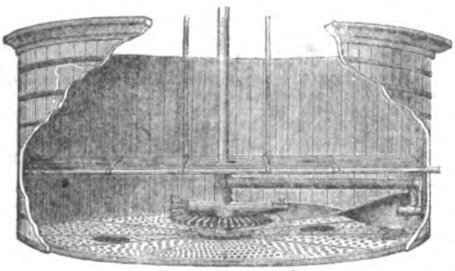
Fig. 1687.



Feiderlein's Mash Tun.

the agitator. The arrangement prevents the accumulation of the solid contents at the bottom of the tun: the currents created by the compound motion of the screw — of translation about the vertical axis and of rotation about its own horizontal axis — maintains a constant circulation between the center and the perimeter of the bottom of the tun; a vertical circulation taking place at the outer walls of the tun and also in the center.

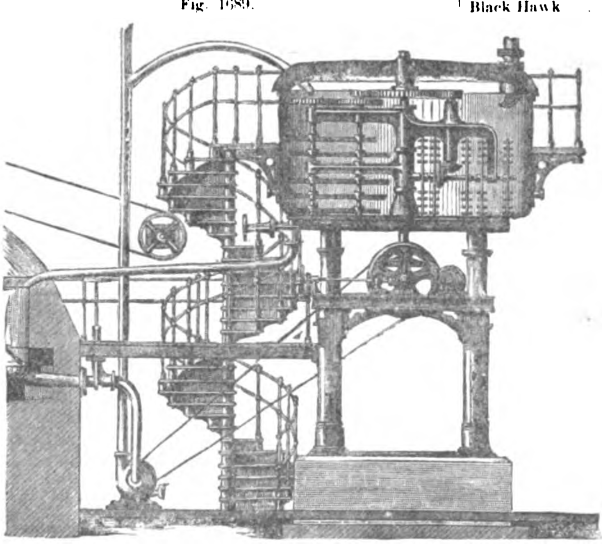
Fig. 1688.



Mash Machine.

The mash tun of *Noback, frères*, of Prague, is shown in Fig. 1689. The figure shows the boiler, pump, tun, and mechanism for stirring; also the pipe and band connections. The stirrer has a revolution of translation in a horizontal plane around the vertical axis. The arms on the sides of the axis have respectively rakes revolving in horizontal and vertical planes so as to leave no corner or surface of the mash tun unvisited.

Fig. 1689.



Mash Tun. (Noback, Prague.)

Ma'son-ry. The various kinds may be found under —

Ashlar	Range.
Dimension stone.	Rubble.
Random.	Squared stone.

For list of masonry, varieties, tools, etc., see list under STONE-WORKING, *infra.* Also, list MASONS AND BRICKLAYERS' TOOLS AND WORK, p. 1405, "*Mech. Dict.*"

The column of Trajan is of Parian marble, constructed of circular blocks placed one above another, like so many immense mill-stones, so large and high that each makes the circumference of the pillar, there being but 17 in the shaft of the column; in all, 24, including the base and the capital, reaching 24 toises of elevation, — 152 feet.

The windows and the steps of the spiral staircase are carved out of each block.

"The most valuable pillars about Rome, for the marble of which they are made, are the —

"Four columns of oriental jasper in Ste. Paulina's chapel in Ste. Maria Maggiore.

"Two of oriental granite in Ste. Pudenziana.

"One of transparent oriental jasper in the Vatican library.

"Four of Nero-Bianco in Ste. Cecilia in Transtevere.

"Two of Brocatello and two of oriental agate in Don Livio's palace.

"Two of Gallo-Antico in St. John Lateran.

"Two of Verdi Antique in the Villa Pamphilia.

"These are all entire and solid pillars, and made of such kinds of marble as are nowhere to be found but among antiquities, whether it be that the veins of them are undiscovered, or that they were quite exhausted upon the ancient buildings." — *Addison.*

See also paper on "*Ancient Roman Works*," by Nash, read before the "Architectural Association" of England. Published in "*The Builder*" and republished in "*Van Nostrand's Eng. Mag.*," xvii. 464-472.

Cf. Gillmore's "Building Stones."

Ma'son's Ham'mer. A steel hammer weighing from 3 to 8 pounds, having a square face, and an edge peen, the line of the latter in the plane of the sweep of the handle.

Mast. The following list gives the full height of the masts of a number of vessels, excluding those under 130′: —

HEIGHT OF SPARS FROM KEELSON TO TRUCK.

Ships.	′	″
Alexander Marshall	156	9
Great Western	162	8
Young America	205	0
Black Hawk	172	0
C. H. Marshall	154	8
Three Brothers	203	0
Invincible	190	4
Australia	170	0
John Bright	169	0
Cultivator	176	8
Baltic	174	6
James Foster, Jr.	159	9
Guy Mannering	173	11
Harvest Queen	167	8
Neptune	164	9
Ocean Monarch	179	0
Thornton	166	10
Universe	158	6
Vanguard	161	10
Isaac Webb	165	8
Manhattan	165	8
Steamships.		
China	144	0
Great Republic	141	0
America	141	0
Japan	143	0
Colon	140	0
Granada	140	0
Acapulco	140	0
City of Peking	204	0
City of Tokio	204	0
Schooners		
Alcott	136	0
Mohawk	146	3
Wm. Mason	138	6
Dauntless	141	6
Robert Dillon	165	0

Cf. *Fincham's "Masting Ships and Mastmaking."*
Kipping's "Treatise on Masting and Rigging."
"Treatise on Sails and Sailmaking."

Mast Head. (*Nautical.*) The upper part of a mast above the rigging.

Mast-head' Lamp. (*Nautical.*) A signal and sailing lamp swung aloft as a caution to other craft.

Fig. 1690.

Mast-head Lamp.

Mast-head' Pen'dant. (*Nautical.*) A short piece of rope fixed upon the head of a mast under the shrouds, having at its end an iron thimble spliced into an eye, to receive a hook of a tackle.

Mast Hinge. (*Nautical.*) A socket for setting up a boat's mast, and allowing it to be struck by unstepping it at the keel.

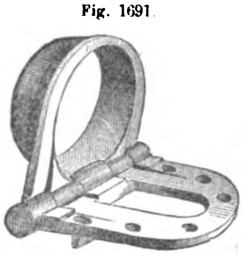
Mast Lin'ing. A thickness of cloth on a sail to prevent chafing against the mast.

Mat. 1. (*Nautical.*) A plaited rope fabric used to bind on shrouds or spars to prevent chafing. It is made of strands of old rope, spun yarn, foxes, sennit, etc.

See: Paunch mat. Sword mat.
Sennit. Thrum.
See list under SEIZING.

2. (*Hydraulic Engineering.*) 1. A woven structure of willows, weeds, or brush, secured by ropes or wires into a continuous mat, and used as a revetment for river banks. See MATTRESS.

Fig. 1691.



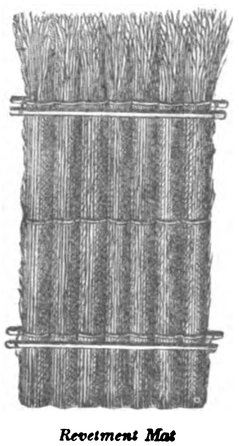
Mast Hinge.

One laid by the U. S. Engineer near Covington, Nebraska, was 2,000′ long and 69′ broad, and from 6″ to 12″ thick. It was built on a mattress boat, which gradually receded as the mat was constructed, letting the mat slip into place in the water. See "*Report of U. S. Engineers,*" * 1880, p. 1455.

Fig. 1692 shows a mat made of 6 or 7 fascines laid side by side, and lightly bound between 4 poles tied together in pairs at the ends and middle with lath yarn. Such a mat is about 12′ × 5′ 8″.

Full description of making may be found in "*Report of Chief of Engineers, U. S. Army,*" 1876, * vol. ii., Part II., p. 404. Mats are used to anchor with stones in making dams or jetties: as a revetment to banks, to prevent scour of river bottoms, etc.

Fig. 1692.



Revetment Mat

3. A species of rug, for the feet.

Felt mats are made by the following process: A piece of felt of suitable thickness is cut into strips ⅜″ to ¾″ in width, and as long as the mat is to be wide. These are laid side by side on edge, and holes are made through them, and through these holes cords of fine wire are passed, and the strips are then drawn tightly together and fastened in place at each end of the wires. This gives a fabric as thick as the strips are wide, and of a light, flexible, and elastic character. The strips may be in various colors and may be disposed in any desirable pattern. When finished, the mats have a good face on either side.

4. A floor covering, or substitute for carpet.

The ordinary Japanese mats are made of the materials mentioned below and lined with rice straw, are more than 1″ thick, and throughout Japan are all of the same size, viz., 6′ by 3′.

The surface of the mats in rooms, and mattings of better quality in general are made of the *Juncus effusus*, — the pith of which is used for candle- and lamp-wicks, — in the province of Oomi; of the *Isolepis*, in Bingo, and of the *Cyperus rotundus*, in Satsuma and Bungo. For the commoner mattings rice straw and also different kinds of rushes are used; for instance, *Scirpus lacustris*, *Hydropirium latifolium*, and typha, which plants grow almost everywhere. Rain cloaks are also made of certain kinds of grass or of palm-leaves.

Fluted portable matting . . . * "*Man. & Builder,*" xi. 43.
Malakoff mantelet . . . . Fig. 1673, p. 580, *supra.*

Mat Boat. (*Hydraulic Engineering.*) A frame of ways supported on scows, on which mat for revetment is woven, and from which it is launched into place to act as a preventive of scour on a river bank or elsewhere.

Match. Considered on pp. 1408, 1409, "*Mech. Dict.*"

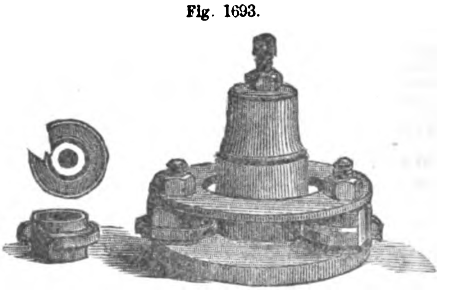
Process of match-making in France described under article "*Allumettes,*" *Laboulaye's "Dictionnaire des Arts et Manufactures,*" vol. iv., ed. 1877.

American process . . . "*Harper's Weekly,*" June 22, 1878.
"*Scientific American Sup.,*" 1832.

Match'er Head. (*Wood-working.*) The head in a planing machine which carries the cutting tool.

Fig. 1693 shows a form in which the cutting tool — either the grooving or the tongueing cutter — is a solid circular disk secured between the plates of the head by a bolt running through its center, and projecting from the periphery of the plates a sufficient distance to cut the groove and clear the edge of the board. The cutters are 2¼″ diameter and afford about 7″ cutting surface, being filed back as they wear.

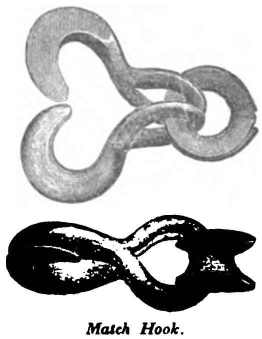
Fig. 1693.



Matcher Head.

Match Hook. A tackle hook, consisting of two portions which shut together, each forming a mousing for the other. A *sister* hook.

Fig. 1694.



Match Hook.

Ma-te-lasse'. (*Fabric.*) A silk-and-wool French dress goods.

Mat Hook. A long pole with an iron hook, used to hook on to the binding pole of a mat. Used also in handling the mats in floating into place and holding while being anchored with stones. See under JETTY, p. 512, *supra*. c

See Figs. 10, 12, "*Report of Chief of Engineers, U. S. Army*," 1876, vol. ii., Part II. Appendix X. 4, pp. 408, 409.

Mat Pole. (*Hydraulic Engineering.*) A pole 20′ long, 3″ in diameter, smoothly shaved and iron pointed, used in placing mats of brush for shore protection, jetties, etc. See MAT HOOK.

Fig. 1695.

a. Mat Hook.
b. Mat Pole.

Ma'trix. 1. (*Mining.*) The rock or earthy matter containing a mineral or metallic ore.

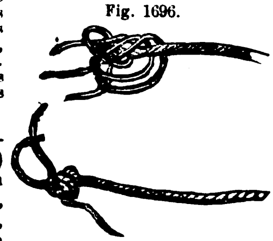
2. (*Dentistry.*) A mold used in filling proximal cavities in teeth. The matrix is a slip driven between the teeth, its wedging side against the abutting tooth and its concave side against and agreeing with the cavity to be filled. — *Dr. Louis Jack.*

Ma'trix Rol'ling Ma-chine. A machine which in large establishments takes the place of the beating table and brush. Fig. 5800, p. 2380, "*Mech. Dict.*" The work of the machine is to force down the prepared matrix paper into the type in taking a cast thereof by the paper process; described on p. 2380 above cited.

Mat'thew Walk'er. A form of knot something like a double wall knot.

To make it: Unlay the rope for 10″ or 12″; pass the first strand around the rope and bring the end up through the bight thus formed; pass the second strand around the rope and bring the end up through both bights; pass the third strand around the rope, and bring the end up through the three bights; haul the ends gently until the knot is in shape, then haul tight, and finish with a crown. The cut shows the strands laid through the bights and also hauled tight.

Fig. 1696.



Matthew Walker Knot.

Mat'tress. (*Hydraulic Engineering.*) A mass of woven withes, poles, brush, willows, or what not, used to place on a bank or shore to preserve it against the impact of water and prevent erosion by the current.

There are many modes of building, and among the most remarkable instances to be found are the maritime and interior dyke works of Holland and the Eads' improvements of the southwest pass of the Mississippi. Good illustrations of methods are to be found in Plates I. to XIV. opposite p. 1380, vol. ii., "*Report of Chief of Engineers, U. S. Army*," 1880.

See also mattresses of Galveston jetty, same work and volume, * p. 1228.

A good account of all the tools and methods used at Nebraska City is given in the "*Report of the Chief of Engineers U. S. Army*," 1879, * ii. 1074.

It includes the following: —

Harpoon shuttle.	Shuttle fastening.
Brush jack.	Hook needle fastening.
Brush jack needle.	Mattress fastening.
Hook needle.	Curved needle fastening.
Curved needle.	Various kinds of sewing.
Jack fastening.	

Drawings and descriptions of elaborate mattress work on the Mississippi River may be found in the "*U. S. Engineers' Report*," 1879, * ii. 1111, 1118.

Charleston harbor . .	* *Ibid.*, i. 736.
Savannah river . . .	* *Ibid.*, i. 742.
Arkansas river. . . .	* *Ibid.*, 1878, ii. 658.
Mississippi jetties . .	* "*Scientific American Sup.*," 332.

Among the various tools used in making revetment mattresses are the following, which are described under their various headings, *supra*: —

Brush jack.	Harpoon shuttle.
Brush jack needle.	Hook needle.
Curved mattress needle.	

To these may be added the following names of types of revetment work, which see: —

Apron.	Mat.
Curtain.	Revetment.
Floating brush dike.	Sand fence.
Floating wire dike.	Willow curtain.
Hurdle.	

Mat'tress Boat. (*Hydraulic Engineering.*) A boat on which a mattress is built and from which it is launched. Such mattresses are used in revetments of banks or the prevention of scour of bottoms, also in making dikes to act as dams, chutes, or breakwaters.

Views and details of mattress boats as used on the Mississippi are to be found in "*Annual Report of Chief of Engineers, U. S. Army*," 1880, * ii., pp. 1418, 1439.

A mattress boat consists essentially of a set of 8 trussed ways supported by two scows. The ways upon which the mattresses are made form the upper chords of the trusses. See also Plate I., and p. 1074, vol. ii., "*United States Engineer's Report*," 1879.

May'nooth Bat'te-ry. (*Electricity.*) In a cast-iron pot containing nitro-sulphuric acid is placed a porous jar which contains the amalgamated zinc and dilute sulphuric acid.

Niaudet, American translation	175.
"*Scientific American*"	xl. 123.

Meal Cool'er. A process in which the meal from the millstones is conducted along a passage in which is a current of air induced by a fan, in order to remove the heat generated by attrition between the stones.

Seen in *Vallod's* French patent, 1836.
Deuchfield's United States patent, 1858.
Robinson's English patent, 1858.

Cartier, French . . .	"*Laboulaye's Dictionnaire*," 1854.
Webster.	* "*American Miller*," viii. 146.
	* "*American Miller*," vol vi.

Meas'ur-ing, Cal'cu-la-ting, Test'ing, and Re-cord'ing In'stru-ments. Subjects in these classes are considered under the following heads: —

Abacus.	Azimuth instrument.
Absorptimeter.	Bag weigher.
Actinometer.	Balance.
Adding machine.	Balance dynamometer.
Adding pencil.	Bar iron tester.
Aërometer.	Barometer.
Aërophone.	Barometer flowers.
Aërothermic balance.	Barometric balance.
Æsthesiometer.	Barometrograph.
Air testing.	Barrel gage.
Air thermometer.	Base line instrument.
Alcoholmeter.	Bathometer.
Aleurometer.	Batoreometer.
Alidade.	Beam.
Altimeter.	Belt tension apparatus.
Altitude measurer.	Besidometer.
Ammonia meter.	Bias measure.
Anemograph.	Bioscope.
Anemometer.	Blast recorder.
Anemometrograph.	Boiler indicator.
Aneroid.	Boiler prover.
Angle measurer.	Bottom.
Arithmometer.	Bridge testing car.
Arithmoplanimeter.	Cable testing apparatus.
Assaying apparatus.	Calcimeter.
Astatic galvanometer.	Calculating machine.
Astigmatism apparatus.	Calendar.
Astrolabe.	Caliper.
Astronomical time-marker.	Caliper gage.
Atmolyzer.	Caliper machine.
Audiometer.	Caliper rule.
Audiphone.	Caliper square.
Auscultator.	Calorimeter.
Autokinetic telegraph.	Campylometer.
Automatic clock.	Carburometer.
Auto-ophthalmoscope	Cardiagraph.
Autophone.	Cardiometer.
Axilla thermometer.	Cartridge scales.
Axle set and gage.	Cash-recording machine.
Axometer.	Cathetometer.

Cement tester.
Centesimal alcoholmeter.
Centesimal scale.
Chain-testing machine.
Chair balance.
Cheiloangioscope.
Chlorometer.
Chromatrope.
Chromograph.
Chromometer.
Chromostroboscope.
Chronograph.
Chronometer.
Chronothermometer.
Circle.
Circular balance.
Circular compass.
Circular spring balance.
Clepsydra.
Climatometer.
Clinical thermometer.
Clock.
Clock dial, luminous.
Clock register thermometer.
Cloth tester.
Clouds, apparatus for measuring height of.
Coal-testing apparatus.
Coinage.
Colorimeter.
Color comparator
Combination scale-beam.
Comparator.
Compass.
Compass alarm.
Conductometer.
Conformator.
Conograph.
Control watch.
Corrective gage.
Cosmograph.
Counter.
Counter scale.
Coupon numbering machine.
Crane steelyard.
Creamery scale.
Cremometer.
Crown telephone.
Crusher gage.
Current apparatus.
Current meter.
Curve.
Cutter.
Cyclometer.
Cycloscope.
Cyrtometer.
Decimal balance.
Decimal scale.
Deep-sea thermometer.
Deep-water bottle.
Deflectometer.
Densimeter.
Dentiphone.
Diagometer.
Diagraph.
Dial.
Dianemoscope.
Diapason clock.
Diatheroscope.
Differential governor.
Differential pressure regulator.
Differential stethoscope.
Diffusiometer.
Dipleioscope.
Diplograph.
Distance measurer.
Dividing engine.
Dormant scales.
Dosimeter.
Double-beam balance.
Double coil galvanometer.
Dual telephone.
Dynagraph.
Dynagraph car.
Dynamograph.
Dynamometer.
Ebullioscope.
Echoscope.
Electrical clock.
Electrometer.
Electromotograph.
Endoscope.
Engine counter.
Éprouvette
Equation apparatus.
Equilibrium balance.
Equilibrium scale.
Escapement regulator.
Esthesiometer.
Eudiometer.
Evaporimeter.
Even scales.
Expansion of metals apparat.
External gage
Fare indicator.
Fare punch.
Fare register.
Fiber tester.
Fire-damp alarm.
Fire-damp detector.
Fire-damp indicator.
Fire-damp meter.
Fire-damp photometer.
Fire-damp test.
Flame manometer.
Flying sounder.
Freshet signal.
Fulgurator.
Gage glass.
Gage standard.
Galvanometer.
Gas detector.
Gas indicator.
Gas meter.
Gas tester.
Gas verifier
Girder tester.
Glaucometer.
Globe
Gluten tester
Goniometer.
Gradientor.
Grain measurer.
Grain register.
Grain scale.
Grain weigher.
Gravity indicator
Grisoumeter.
Grist toller.
Harmonic analyzer.
Harmonograph.
Hay scales.
Heat meter.
Heat regulator.
Heliometer.
Helioscope.
Heliotrope.
Hemarheumoscope.
Holophote.
Horograph.
Horological instruments.
Horse-power computing scale.
Hydra.
Hydraulic gage.
Hydro-dynamometer.
Hydrometer.
Hydro-pyrometer.
Hydro-rheostat.
Hydrostatic weighing mach.
Hygrometer.
Hygroscope.
Ice balance.
Inclination compass.
Index plate.
Induction balance.
Inductometer
Inductophone.
Integrator.
Interference apparatus.
Internal gage.
Internal pressure gage.
Iron scales.
Kaleidoscope.
Kerosene tester.
Lactodensimeter.
Lactometer.
Lactoscope.
Lap scale.
Laryngostroboscopic apparat.
Letter balance.
Level.
Leveling instrument.
Lifting machine.
Light registering apparatus.
Log.
Logograph.
Log scale.
Lubricant tester.
Luminous dial.
Lysimeter.
Magnetometer.
Magnophone
Manometer.
Mariner's compass.
Mariotte's tube.
Market beam.
Market scale.
Maximum thermometer.
Measure.
Measuring faucet.
Measuring instrument.
Measuring machine.
Measuring tap.
Meatoscope.
Megalographe.
Megaphone.
Megascope.
Megohm.
Melodiograph.
Meteorograph.
Metric system.
Microhm.
Micrometer.
Micrometer caliper.
Micrometer screw.
Microphone
Microphone relay.
Microtasimeter.
Microtelephone
Mile-stone.
Milk glass.
Milk scale.
Milk test.
Minimum thermometer.
Mirror barometer.
Mirror galvanometer.
Molarimeter.
Motion indicator.
Motion timer.
Motograph.
Motophone.
Movement.
Multiplicator.
Myograph.
Napier's bones.
Nap meter.
Natrometer.
Navigational sounding mach
Navisphere.
Numbering stamp.
Octoplex telegraph.
Odontograph.
Office watchman.
Ohm.
Oil gage.
Oil tester.
Oleometer.
Opeidoscope.
Ophthalmoscope.
Optometer.
Orograph.
Oroheliograph
Oscillometer.
Otheoscope.
Otoscope.
Ozonoscope.
Pachymeter.
Package balance.
Pantograph.
Pantometer.
Paper tester.
Papyrograph.
Pedometer.
Pendulum.
Perambulator.
Petroleum tester.
Phanero-grisoumeter.
Phoneidoscope.
Phonic wheel.
Phonograph.
Phonomotor.
Phonoscope.
Phosphorescent dial.
Photographometer.
Photohelioscope.
Photometer.
Photophone.
Picnohydrometer.
Picnometer.
Piezometer.
Pig-metal scales.
Pinch cock.
Pipe prover.
Pipe testing machine.
Plane table.
Planigraph.
Planimeter.
Platen gage.
Platform scale.
Plethysmograph
Pluviameter.
Pluviometrograph.
Pluvioscope.
Pneumatic clock.
Pneumograph.
Pocket level.
Polar clock.
Polariscope.
Polaristrobometer.
Polygonoscope.
Polygraph.
Polyscope.
Polymeter.
Portable scales.
Potassimeter.
Potent.
Powder testing.
Praxinoscope.
Praying wheel.
Pressure gage.
Pressure indicator.
Pressure register.
Printer's rule.
Profilograph.
Proof staff.
Psychometer.
Pulsometer.
Pupillometer.
Pyrheliometer.
Pyrometer.
Quadrant.
Quadrant electrometer.
Radiation thermometer.
Radiometer.
Rails, instru. for measuring wear of.
Railway scale.
Railway speed recorder.
Rain gage.
Range finder.
Ranging rod.
Receiver.
Recoil dynamometer.
Rectal speculum.
Reflecting galvanometer.
Register.
Registering instrument.
Registering scale.
Registering thermometer.
Remontoir.
Reservoir recorder.
Resistance tube.
Resonator.
Respirometer.
Rhinoscope.
Rule.
Rule gage.
Ruling machine.
Saccharometer.
Sacker and weigher.
Salinometer.
Scales.
Scoop, weighing.
Screw and wire gage.
Screw-pitch gage.
Screw thread gage.
Sematrope.
Seismograph.
Seismometer.
Ship's log.
Silk-testing machine.
Siphon recorder.
Siren.
Solar radiation register.
Sondograph.
Sound.
Sounder.
Sounding.
Sounding lead.
Soundings thermometer.
Soundings water cup.
Specific gravity balance.
Specific gravity bottle.
Specific gravity scales.
Specific gravity instruments.
Specific heat apparatus.
Spectrometer.
Spectroscope.
Speculum.

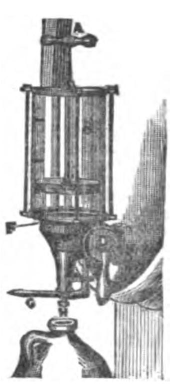
Speed indicator.
Speed measurer.
Speed recorder.
Speed regulator.
Sphereometer.
Sphygmograph.
Sphygmometer.
Sphygmophone.
Sphygmoscope.
Spirophone.
Spring tester.
Spring valve.
Square.
Stadiometer.
Stadium.
Stathmograph.
Station indicator.
Steam engine indicator.
Steam gage.
Steam gage tester.
Step gage.
Stereometer.
Stereoscope.
Stethoscope.
Stethoscopic microphone.
Stock scale.
Stop watch.
Storm glass.
Strain indicator.
Strain measurer.
Straight spring balance.
Sugar tester.
Surface plate.
Sympalmograph.
Tachometer.
Tally.
Tally register.
Tannin testing apparatus.
Target, leveling.
Taseometer.
Tasimeter.
Telectroscope.
Telegastograph.
Telegraph.
Telelectroscope.
Telemeter.
Telemicrophone.
Telephone.
Telephone call.
Telephonograph.
Tell-tale compass.
Temperature regulator.
Tension apparatus.
Test gage.
Testing fibers.
Testing machine.
Test plate.
Test spoon.
Thermal alarm.
Thermograph.
Thermometer.
Thermometrograph.
Thermophone.
Thermoscope.
Thermoscopic indicator.
Thermostat.
Thermotelegraph.
Ticket counter.
Ticket punch.
Tidal register.
Tide-calculating machine.
Tide gage.
Time ball.
Time globe.
Time lock.
Toller.
Tonometer.
Topophone.
Torsion balance.
Torsion machine.
Tourbillon.
Tower clock.
Track indicator.
Track scale.
Train-speed indicator.
Transmitter.
Trial jar.
Trial number.
Trigonometer.
Triple telephone.
Tripod head.
Try-square.
Turnstile
Universal galvanometer.
Universal square.
Ureometer.
Urethrameter.
Urethrometric sound.
Urinometer.
Uroscope.
Uterometric sound.
Velocimeter.
Viameter.
Vino colorimeter.
Viscosimeter.
Visiometer.
Voltameter.
Volumeter
Wall clock.
Watch.
Watch clock.
Watchman's time detector.
Watch telephone.
Water gage.
Water-level gage.
Water-level indicator.
Water meter.
Weighing machine.
Weighing scale.
Weighing scoop.
Wire gage.
Wire measur'g and cutting m.
Wire measuring machine.
Wire tester.
Yarn assorter.
Yarn meter.
Yarn scale.
Yarn tester.
Zoögyroscope.

Meas'ur-ing. See also : —

The art of, *Siemens* . .	"*Engineering*," xxi. 493.
Extension measuring apparatus, *Willis*, Br. .	* Fig. 991, page 322, *supra*.
Height of clouds, *Matlock*	* "*Scientific American Sup.*," 1482.
Ringwood . . .	* "*Scientific American Sup.*," 1574.
Instruments	* "*Scientific Am. Sup.*," 505, 1638.
Insts., coast survey . .	* "*Scientific American Sup.*," 447.
Jacket, *Lingen* . . .	* "*Scientific Amer.*," xxxix. 295.
Machine	"*Scientific American Sup.*," 389.
Cornell University .	* "*Engineering*," xxi. 396.
	* "*Polytechnic Rev.*," Aug. 5, 1876.
Machine and Gage . .	* "*Min. & Sc. Press*," xxxviii. 305.
Base, triangulation.	
Com. Whiting . . .	* "*Scientific American Sup.*," 2364.
Minute	* "*Man. & Builder*," xii. 134.
Minute of Modern Science, *Mayer*	"*Sc. Am. Sup.*," * 879, 911, * 944, * 975, * 1007, * 1065, * 1135, 1221, * 1274, * 1455, * 1518, * 1595, * 1637, * 1694, 1773, * 2549, * 2625, * 2664, * 2782, * 2810.
In physics, *Spottiswoode*	"*Scientific American Sup.*," 2340.
Stopper, *Keller* . . .	* "*Scientific American*," xxxix. 265.
Standard of	"*Scientific American Sup.*," 2846.
	"*Sc. American*," xxxvii. 372.
Metric system	"*Scientific American*," xl. 393.

Meas'ur-ing Fau'cet. One which shows by means of a graduated vessel of marked quantities, the amount of liquid passing from a tank to a vessel, for instance, or a meter arrangement by which a given quantity is forced through an opening.

Fig. 1697.



Measuring Faucet.

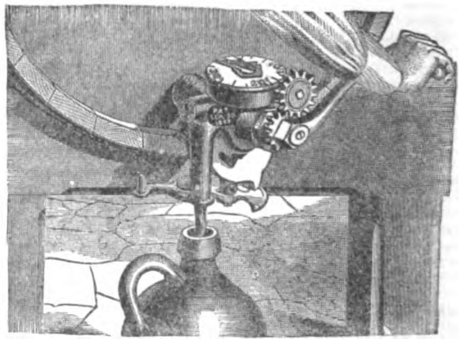
Fig. 1697 is an illustration of the first-mentioned kind; the liquid, being allowed to flow from the barrel into the graduated glass vessel *B*, is forced from the latter by pressure on piston handle *A* at opening *H*, the subsidence of the level in *B* being noticed. *G* is the gate.

Fig. 1698 is a force feed measuring faucet for heavy oils, molasses, etc. The chamber, of known capacity, is emptied at each revolution of the crank, and the pointer on the dial registers the revolutions.

Meat Cut'ter. A meat slicer, for dried beef especially. See BEEF SHAVER, Fig. 256, p. 86, *supra*.

Hittenger's round knife meat cutter has a rotary meat pan and two sets of circular knives that, as the pan rotates, cut the meat. A scraper is attached to the frame by which the sides of the pan are cleared of meat.

Fig. 1698.



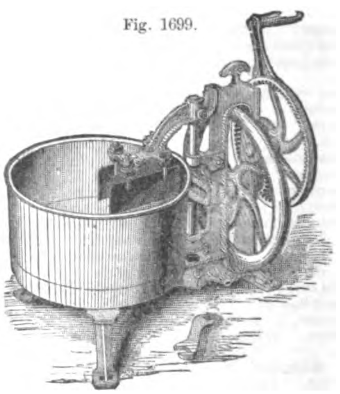
"Enterprise" Measuring Faucet.

See also forms of machines, Figs. 3106–3110, pp. 1415, 1416, "*Mech. Dict.*" See also SAUSAGE MACHINE, *Ibid.*

Meat Chop'per. A mincing machine for reducing meat to fragments for sausage, hash, or croquettes, salad, pates, etc.

Fig. 1699 is a small-sized machine for the above purposes; also useful chopping fruit and vegetables. The knives are reciprocated vertically with rapidity and the pan turned on its base.

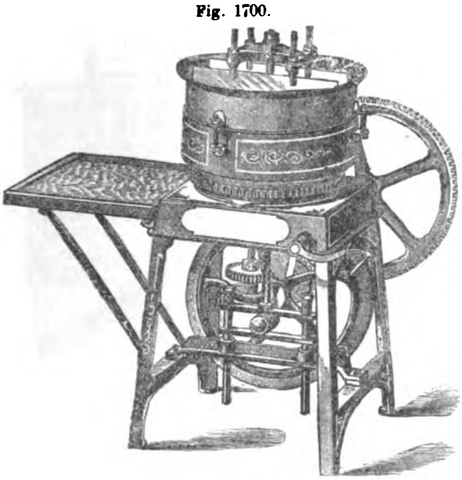
Fig. 1699.



Domestic Meat Chopper.

The *Nittinger* meat chopper is on a larger scale, being driven by power, and having automatic turning motion for

Fig. 1700.



Butcher's Meat Chopper.

the pan. The knives are moved vertically by means of an axial rod passing down through the center of the chopping block and attached to a crank-pin beneath. The block has an intermittent motion in the interval between the cuts.

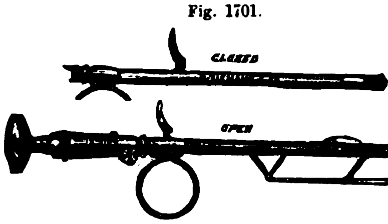
Me-a'to-scope. (*Surgical.*) A speculum for observing a natural passage. Specifically a urethral speculum. The term *endoscope*, from ἔνδον, within, is applied to instruments having a similar purpose.

See Part III., *Tiemann's "Armamentarium."*

Meatoscope, *Weir's*	Fig. 8.
Glass	Fig. 18.
Endoscope, *Désormeaux's*	Fig. 9.
Otis	Fig. 10.
Laveur's	Fig. 11 *b*.
Urethral speculum, *Skene's*	Fig. 11.
Folsom's	Fig. 8 *b*.

Me-a'to-tome. (*Surgical.*) An instrument to cut open the urethra. Fig. 1701 shows that of Dr. Mitchell, with concealed knife.

Fig. 1701.



Dr. Mitchell's Meatotome.

Gouley's, Fig. 19, Part III., *Tiemann's "Armamentarium."*

Meat Rock'er. A mincing knife having a handle at each end, and worked by a rocking motion.

Fig. 1702.

Meat Rocker.

Me-a'tus In'stru-ments. (*Surgical.*) 1. Instruments for the examination of, or operation on the external meatus auditorius.

Bistoury.	Forceps (see list).
Caustic holder.	Furuncule knife.
Cotton holder.	Marygotome.
Curette.	Otoscope.
Ear hook.	Polypus forceps.
Ear mirror.	Polypus snare.
Ear scoop.	Powder blower.
Ear speculum.	Probe
Ear syringe.	

2. Instruments for the meatus urinarius. See Urethral Instruments.

Me-chan'i-cal Bat'te-ry. (*Electricity.*) One in which the plates are moved or shaken to prevent polarization, and to bring them in contact with fresh liquid.

Me-chan'i-cal Ex'er-ci-ser. See Exercising Machine.

Me-chan'i-cal Fin'ger. (*Microscopy.*) A device used in segregating from a mass of minute material on a slide a minute object, such as a diatom, for instance, and placing it solus upon a slide.

It consists of a wire, bristle, or hair on a stage forceps, the end projecting to the center of the field. The stage is then manipulated by the mechanical movements until the object is beneath the hair. The slide may then be raised by the parabola fixed in the sub-stage so that the minute object becomes attached to the hair. Remove the slide and substitute a clean glass slide, and raise it so as to detach the object from the hair.

Me-chan'i-cal Fir'ing. A mechanical arrangement for the supply of fuel to a furnace.

See * Furnace Feeder, Figs. 1116, 1117, p. 363, *supra*.
* Puddling Furnace, *infra*.
* Smoke-consuming Furnace, "*Mech. Dict.*"
* "*Scientific American Supplement*," 1218.

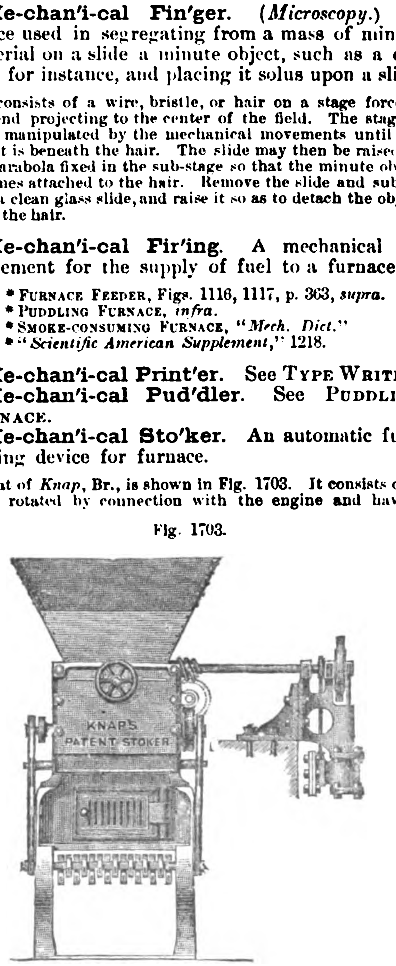
Me-chan'i-cal Print'er. See Type Writer.

Me-chan'i-cal Pud'dler. See Puddling Furnace.

Me-chan'i-cal Sto'ker. An automatic fuel-feeding device for furnace.

That of *Knap*, Br., is shown in Fig. 1703. It consists of a shaft rotated by connection with the engine and having

Fig. 1703.



Mechanical Stoker.

wings in the bottom of the fuel hopper so as to allow an amount of fuel to drop into the furnace, proportioned to the rate of revolution of the shaft and the size of the opening.

Belt connection to a lower shaft gives a periodical lifting to the grate bars so as to disturb clinkers and drop the ashes.

See also Figs. 1116, 1117, p. 363, *supra*; Fig. 5229, p. 2226, "*Mech. Dict.*," "*Sc. Amer. Sup.*," 1423.

Meer'schaum, Ar'ti-fi'cial. The chips and waste of meerschaum pipe making, hardened by pressure.

Gypsum, boiled with stearic acid or paraffine, much resembles meerschaum. The resemblance may be increased by coloring the mixture with solution of gamboge and dragon's blood.

"*Scientific American*" . . . . xxxiv. 383.

Meg-al'o-graphe. A French name for a form of camera-lucida, made by Secretan, of Paris.

It is used for microscopic drawing and pattern drawing for industrial purposes.

It differs from the ordinary camera-lucida, inasmuch as it admits of drawing directly from objects under the microscope, or from designs produced by the turning of the kaleidoscope. It is provided with three tubes: one microscopic, one kaleidoscopic, and the third simple. A prism on a detached tube of its own is adjustable to either of these, and by means of mechanical contrivances the point of view may be changed as occasion demands.

"*Scientific American*" . . . . xxxv. 345.

Meg'a-phone. An instrument for assisting hearing, invented by T. A. Edison.

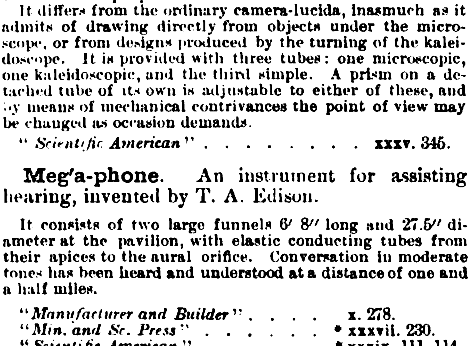
It consists of two large funnels 6′ 8″ long and 27.5″ diameter at the pavilion, with elastic conducting tubes from their apices to the aural orifice. Conversation in moderate tones has been heard and understood at a distance of one and a half miles.

"*Manufacturer and Builder*" . . . . x. 278.
"*Min. and Sc. Press*" . . . . * xxxvii. 230.
"*Scientific American*" . . . . * xxxix. 111, 114.
"*Telegraphic Journal*" . . . . * vi. 297, 383.

Meg'a-scope. A species of camera-obscura for throwing a reflected magnified image upon a screen. In one invented by Dr. Curran, the image is projected by a large compound objective lens 7″ in diameter. The light from the lantern is thrown upon the object itself and is thence reflected to the screen.

In a French form of the instrument, represented in Fig.

Fig. 1704.



Megascope

1704, especially designed for making enlarged copies of designs, medals, statuettes, and engravings, the instrument consists of a screen, a magnifying lens, a shelf to hold the object, and a mirror to project the light upon the surface presented towards the lens.

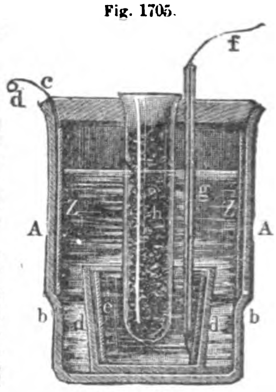
The object is placed on the shelf at such distance from the mirror that the reversed image on the screen shall have the desired size. The image being magnified will have less brilliancy than the object, since the rays reflected from it are spread over a larger surface. To avoid this, the mirror reflecting solar light, or a pair of calcium lights, as used by Dr. Cresson, are employed to illuminate it. The screen is of glass, and the draftsman places himself behind it, and follows with a pencil the lines of the image.

* "*Scientific American*," xxxv. 57.
"*Manufacturer and Builder*," x. 72.
Cresson . . . . . "*Scientific American*," xli. 63.
Morton . . . . . "*Scientific American*," * xxxv. 57.
Knight . . . . . "*English Mechanic*," * xxv. 250.
"*Journal Franklin Institute.*"

Me-gass' Dry'er. See Bagasse Dryer.

Mei'din-ger Bat'te-ry. (*Electricity.*) A modification of the Daniell battery, having no porous cell.

Fig. 1705.



Meidinger Battery.

The glass vessel, *A*, has a shoulder, *b*, on which rests the zinc element, Z. In *A* is placed a small glass cup, *d*, lined with copper, *e*, on the lower end of which an insulated copper wire, *g*, is riveted. A glass cylinder, *h*, having a hole at the lower end, is suspended from the wooden lid, and contains the sulphate of copper crystals, which keeps the liquid in the cup *d* saturated with that salt. The remainder of the space in vessel *A* is filled with a solution of sulphate of magnesium.

Prescott's "*Electricity*" . . . . * p. 53.
Sabine . . . . * 225.
Niaudet, Amer. transl. . . . . * 124.

The Meidinger *balloon* battery has a flask magazine for supply of crystals.

Niaudet . . . . * 127.

Meg-ohm'. (*Electricity.*) A measure of electrical force or resistance equal to 1,000,000 ohms.

Mé-lange'. (*Fabric.*) A French dress goods of cotton chain and woolen weft.

Me-lan'o-scope. Invented by Lommel. It consists of a pair of spectacles, made of two kinds of glass, one on top of the other; the first glass is dark red, the second light violet. This combination admits only red rays, so that all green plants appear black. It may thus be used to recognize the flames of substances which show red lines in the spectroscope, such as potash, strontium, etc.; its use is limited to substances which give red lines.

Me-lan'o-type. A photograph on a background of japanned metallic plate. Invented by Smith & Neff. The name was originated by Peter Neff.

Me-lo'di-o-graph. A contrivance to record the notes of tunes played upon an instrument.

In the melodiograph of Zigliani, a double flat spring placed under each key is connected with a battery and with a recording apparatus, which consists of a comb provided with insulated teeth gently resting on a copper cylinder. A strip of ruled and chemically prepared paper is drawn over this roller by clock-work, and receives the impressions or marks of the teeth of the comb. This clock-work can be regulated so as to cause the paper to move in conformity with the time kept by a person playing the instrument. Every time a key is depressed the circuit is closed, and the electricity, passing through one of the teeth of the comb, makes a mark corresponding to the key that has been depressed.

That of M. Carpentier is described in * "*La Nature*," and the account is reproduced in "*Scientific Canadian*," * x. 106, 107. It was exhibited at the International Exposition of Electricity, Paris, 1881.

The subject has been considered in the "*Mech. Dict.*," Music Writer, p. 1502, where the following instruments are referred to: —

Creed, Br., 1747.	Hennersdorf, Ger., 1748.
Freke, Br.	Unger, Ger.
Hohlfield, Br.	

See also Music-recording Instrument, *Ibid.*, same page.

Besides the use of the melodiograph for composers and transcribers of music, the purpose of Carpentier's apparatus is the perforating of sheets for *melophones* and other apparatus for the automatic playing of music. See also "*Scientific American*," xli. 166.

In the apparatus of M. Carpentier the harmonium is one part and the melodiograph another. 50 wires concealed beneath the floor put the two instruments in communication. 50 keys of the harmonium are provided with devices, so that the depression of each makes contact with the corresponding wire. The currents operate a series of perforators, which act upon a band of paper, each one being operated by the movement of its appropriate key. The band of paper is carried along in the melodiograph by clock-work.

In the use of the perforated paper band for playing, 50 small brushes of silver wire placed in the instrument make contact through the holes with a cross-piece against which they press the paper. When a contact is made by the contact of a brush, through a hole, with the cross-piece, a current circulates in it, operates the opening machine of the corresponding key and causing the reed to speak, sustaining the sound so long as the brush makes its contact through the hole, which may be long or short.

Mel'o-graph. See MELODIOGRAPH.

Melt'ing Fur'nace. (*Glass.*) A furnace in which the *frit* for glass is melted, being then transferred to a *blowing* furnace from which it is worked. This is the better practice. In America it is most frequently worked from the *melting* furnace direct.

Melt'ing Point of Al-loys'. See ALLOYS, "*Mech. Dict.*," p. 66, *et supra.*

Melting points of gold and silver alloys: —

Silver 100 (pure)	954° C.
Silver 80, Gold 20	975
Silver 60, Gold 40	995
Silver 40, Gold 60	1020
Silver 20, Gold 80	1075
Gold 100	1095
Platinum 5, Gold 95	1100
Platinum 25, Gold 75	1225
Platinum 40, Gold 60	1320
Platinum 60, Gold 40	1460
Platinum 80, Gold 20	1600
Platinum 100	1775

"*Annalen der Physik.*"

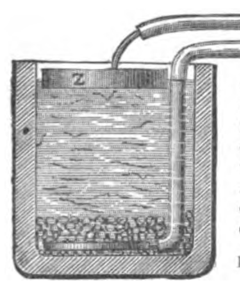
Mem'bra-na Tym-pa'ni In'stru-ments. (*Surgical.*) Instruments for operating on the membrana tympani include: —

Simrock's scissors.	Tympanum perforator.
Eustachian catheter.	Artificial tympanum.
Catheter holder.	Polypus knife.
Meatus knife.	Tensor-tympani instrument.
Otoscope.	

See also EAR INSTRUMENTS, p. 289, *supra.*

Me-not'to Bat'ter-y. (*Electricity.*) A form

Fig. 1706.



Menotto's Battery.

of gravity battery having its copper-plate imbedded in the sulphate of copper crystal at the bottom of the jar, above which is a layer of wet sawdust on which rests the zinc element.

Prescott's "*Electricity,*" * p. 61.
"*Sc. Am. Sup.,*" . . * 2513.
Niaudet, "*Am. Transl.,*" 111.
"*English Mechanic*" . . . . xxvii. 506.

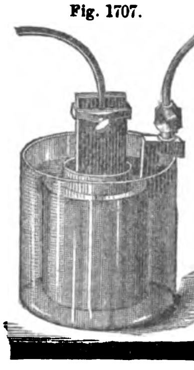
Mer'cu-ry. See following references: —

Commutator, *Lartigue*, Fr.	* "*Engineering,*" xxvii. 273.
Condenser, *Castle & Long*	* "*Min. & Sc. Press,*" xxxv. 209.
Condensers, Cal.	* "*Engineering,*" xxviii. 482.
Almaden	* *Laboulaye's* "*Dict.,*" ii., ed. 1877, article, "*Mercure,*" Figs. 1749-1752.
Furnace, *Berrens*	"*Iron Age,*" xxii., Oct. 17, p. 11.
Idria	* *Laboulaye's* "*Dict.,*" "*Mercure,*" ii., Figs. 1753-1756.
Sarrebrück	* *Laboulaye's* "*Dict.,*" "*Mercure,*" ii., Figs. 1757-1759.
Obermoschel	* *Laboulaye's* "*Dict.,*" "*Mercure,*" ii., Figs. 1760-1762.
Purification	* "*Sc. Am. Sup.,*" 2897.
Reduction works, Cal.	* "*Engineering,*" xxviii. 408.
Safety valve	* "*Sc. Am. Sup.,*" 2193.
Apparatus for testing pressure of; *Teubner*, Ger.	* "*Sc. Am. Sup.,*" 3833.

Its occurrence, mining, smelting, etc Report of *D. de Cortazar*, "*Centennial Exhibition Reports,*" Group I., vol. iii., p. 196.

Mer'cu-ry Bat'te-ry. (*Electricity.*) 1. One having a shallow trough of vulcanite with a partition. On the bottom of each cell is a carbon plate; the zinc is supported a short distance above it, and both submerged in proto-sulphate of mercury. The MARIE-DAVY BATTERY.

Fig. 1707.



Marie-Davy Battery.

2. Another form has the zinc in brine, and the carbon in sulphate of mercury in a porous cup.

"*Ganot's* "*Physics*" (1877), * p. 689.
Sabine's "*Electric Telegraph,*" London, 1867, 229.
Beaufils' sulphate of mercury battery has a solid depolarizer.
"*Telegraphic Journal*" . . . . * vi. 397.
Mercury chromate battery, *Fuller* * "*Sc. Amer. Sup.,*" 1127.

Mer'cu-ry Fur'nace. The mercury furnace of M. Hippolyte Berrens, at Barcelona, Spain, is thus described in the "*Correspondance Scientifique:*"

"It consists of a horizontal or vertical furnace, charged periodically, as its action is not continuous. It connects with a transmission chamber, from which the gases pass into condensers, 17 to 25 in number, the shape of which resembles that of two cones united at their base. The lower cone is buried in the ground, the upper, made of sheet iron, is cooled by a continuous stream of water. Each condenser has a capacity of about 30' cubic. They communicate with one another at their lower parts. The last one of the system is connected with a chamber containing charcoal, destined to remove the last traces of mercury from the gases. There is no chimney, but an aspirator instead, which permits accurate regulation of the furnace. The walls of the apparatus are coated with a layer of a mixture of equal parts of charcoal powder and cement. The furnace at Barcelona was charged with 15,717 pounds of 2.76% ore. Theoretically, therefore, the yield should have been 455.89 pounds of quicksilver, but in fact it was 450.96, which proves a loss of 0.79%, although the carbon of the last receiver was not examined. Gold leaf placed at the end of the apparatus did not show the least trace of amalgam. In a second trial, — made in summer, at a time when work at Almaden is entirely suspended on account of the too heavy loss of quicksilver, — the exhauster was run at so high a speed that the ore in the furnace was glazed; the time of the operation was decreased by 25 hours, and yet the yield from a charge of 15,790 pounds of 2.82% ore was 434.51 pounds, the loss amounting to 3.67%. A horizontal furnace is now building at Anfondeguilla capable of working 20 to 30 tons of 1% ore per day."

See also references to Mercury furnaces under MERCURY, *supra.*

Mer'cu-ry Hold'er. (*Dentistry.*) A vulcanite cup with cover, for the convenient preparation of amalgam.

Me-rid'i-an Cir'cle. Refer to: —

Fauth & Co.	* "*Scientific American,*" xli. 111.
Paris Observatory	* "*Scientific Amer.,*" xxxviii. 1, 4.

Laboulaye's "*Dictionnaire des Arts et Manufactures,*" iv., ed. 1877, article "*Instruments d'Optique,*" * Fig. 86.
Meridian instrument, *Ibid.*, Fig. 29.

Me-ri'no. (*Fabric.*) A fine wool French dress goods woven with a twill on both sides. It is made from 8 to 50 picks to the inch, and is piece-dyed.

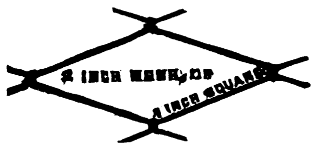
Cashmere resembles it, except in the respect of being twilled on one side only.

Me-ri'no Tulle. (*Fabric.*) An all-wool French goods.

Mesh. The loop in the texture of a net.

The measure is stated by the width of the mesh stick on which it is made; or by the length of one side of the quadrilateral loop. Fig. 1708.

Fig. 1708.



Mesh.

Mesh'ing Net. (*Fishing.*) One which entangles the fish by their gills in the meshes. Seines, and many other nets with specific names, are included with the term *meshing*. See NET.

Mes'sage Cop'y-ing Press. (*Telegraphy.*) A press for taking a copy of a message received before remitting to the sendee.

A duplicate is taken, for filing, by laying a sheet of dampened unsized paper upon the message, and passing the two through a copying press. The latter consists of a pair of rollers, which are turned by steam power, an electro-motor, or by hand, according to circumstances. In large offices, usually by a Phelps electro-motor.

Manifolds are used for press news, of which a large number of copies are required.

Met'al. *Cf.*: —

Alloys, facts about	"*Sc. American*," xxxvii. 217.
Coating with oxides	"*Scientific American Sup.*," 1672.
Coloring	p. 210, *supra*.
Flow of	* "*Scientific American Sup.*," 1885.
Mining leases, etc., Engl.	"*Scientific American Sup.*," 857.
Packing, *Jackson*, Br.	* "*Engineering*," xxv. 34.
Preserving compound	"*Scientific American*," xxxvi. 388.
Protecting	"*Scientific American Sup.*," 1763.

Met'al-ine. A material for the making or the lining of journal boxes. See METALINE, p. 1423, "*Mech. Dict.*," and JOURNAL BOX, p. 1220, *Ibid.*

One analysis gives: —

Paraffine	4.98
Carbon	18.89
Silica	6.44
Lime	8.96
Magnesia	1.90
Ferric-oxide	8.94
Alumina	2.53
Lead	82.40
Zinc	20.07
Tin	1.55
Copper	2.75
Moisture	0.51
	10.01

"*Engineering*"	xxix. 53.
"*Scientific American*"	xxxiv. 390.

Met'al-ized Glass. An ornamental glass having flakes of gold, platinum, mica, etc., distributed through the glass. It is made by the "Aurora Glass Co.," of London, but much resembles the *Aventurine* (which see), of which it is perhaps but an imitation.

The metals used are principally white and yellow. It is presumed these metals are reduced to powder or thin leaves, and when the article is in process of manufacture the glass is rolled in this metallic dust, which then adheres to the glass, and, by re-heating, the article is finished in the usual way. A piece of broken glass of this variety showed the metals to be near the outer surface and slightly sunk into the glass.

Another mode of working imprisons a metalized surface between two layers of glass.

An object is first blown in glass of the desired color; metallic flakes are then rolled on to it, and a new layer or envelope put on this. The flakes are thus inclosed between two layers of glass. Vases shown in Paris, in 1878, had black interior covered with white mica, others with golden flakes.

Me-tal'lic Chain. The chain of square iron links with clasps. Invented by *Vaucanson*.

Me-tal'lic Pack'ing. Tubes of lead, or some soft metallic alloy, filled with hemp, cotton, or some other suitable vegetable material. These tubes can be prepared of great length and cut to fit any given requirement. The ends may be either soldered together or forced into close contact. The convenience, durability, and cheapness of this packing are especial recommendations. — *Strieder*, "*Dingler's Pol. Jour.*"

Me-tal'lic Shin'gle. A plate of metal with ridges on the face for ornament, and beneath the overlap for joint; a substitute for shingles, tiles, or slate.

Me-tal'li-kon. An English architectural surface decoration for consoles, brackets, casings of pillars, etc.

It consists of ornamental glass, or ceramic slabs, or forms mounted by cement on glass plates which are secured in place. "*Building News*," 1876. "*Scientific American Supplement*," 745.

Me-tal'lo-phone. A keyed instrument with outside resemblance to a piano, but having metallic bars instead of strings. See Fig. 3689, p. 1695, "*Mech. Dict.*"

The subject of musical instruments of percussion possessing bars tuned to a scale is considered under MARIMBA. See also references *passim*.

Met'al-lur'gy. Subjects in Metallurgy are considered under the following heads: —

Aëro-hydric blow-pipe.
Air furnace.
Alloys: —
  Aluminium alloys.
  Aluminium bronze.
  Anti-incrustation alloy.
  Anti-fracture alloy.
  Appliqué.
  Bell-metal.
  Bismuth bronze.
  Brass.
  Bronze.
  Bronze iron.
  Bronze steel.
  Carbon bronze.
  Champ levé.
  Chasing.
  Chromeisen.
  Cloisonné.
  Cock alloy.
  Cupro-manganese.
  Damasceening.
  Damasking.
  Dysiot.
  Electro-silicon.
  Ferro-manganese.
  Ferro-phosphide.
  Ferro-silicium.
  Fusible metals.
  Gold alloy.
  Lubricant alloy.
  Manganese-bronze.
  Manganese copper.
  Metallikon.
  Melting point of alloys.
  Nickel-bronze.
  Phosphor-bronze.
  Phosphide of copper.
  Silver alloy.
  Solder.
  Spence's metal.
  Tungsten-bronze.
  White bronze.
Aluminium.
Aluminium alloys.
Aluminium bronze
Aluminium gun-metal.
Aluminium gold.
Aluminium silver.
Aluminium solder.
Amalgamator.
Amalgam retort.
Amber bronze.
Ammonia-ore process.
Angle-iron
Annealing.
Annealing machine.
Annular furnace.
Anti-friction metal.
Anti-incrustation alloy.
Antique bronzing.
Appliqué.
Atwood steel.
Axe tempering.
Axle-box metal.
Baron steel.
Basic lining.
Bell.
Bell and hopper.
Bell-metal.
Belly-pipe.
Bérard steel.
Bessemer steel.
Bidiri work.
Billet.
Bismuth alloys.
Bismuth bronze.
Black flux.
Blast furnace.
Blast furnace charger.
Blister steel.
Bloom.
Bloomary.
Blowing engine.
Blow-pipe.
Blow-pipe furnace.
Blue bronze.
Bluing.
Brass.
Brass alloys.
Brass black-finish.
Brass blacking.
Brass finishing.
Brass coloring.
Brassing
Brickbat core.
Bronze.
Bronze blacking.
Bronze casting.
Bronze coloring.
Bronze iron.
Bronze paint.
Bronze steel.
Bronzing.
Browning.
Burning.
Calcining furnace.
Carbon-bronze.
Carbonizing furnace.
Case hardening.
Cast steel.
Catalan forge.
Cementation furnace
Cement steel.
Champ-levé.
Chaplet.
Charcoal core.
Charcoal iron.
Chasing.
Chénot steel.

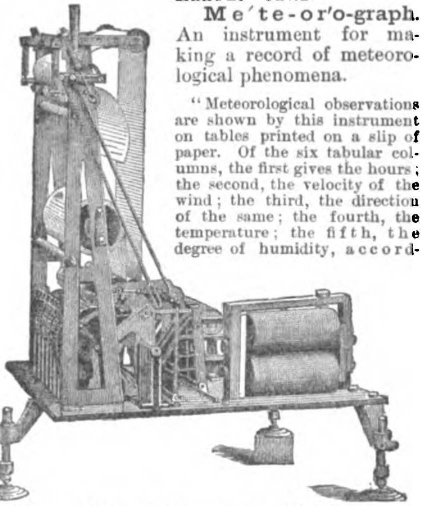
Tulas silver.
Tungsten bronze.
Tungsten steel.
Turf furnace.
Turning furnace.
Tuyere.
Uchatius steel.
Vermeil.
Vickers steel.
Washing furnace.
Water box.
Welding tubes.
White bronze.
Whitworth steel
Wind furnace.
Wire plating.
Woots.
Zinc.
Zinc coating.
Zinc coloring.
Zinc furnace.
Zinc plating.
Zinc powder.

Met'al Saw. The band saw — *scierie à ruban* — has been adapted in France and England for cutting thin plates of metal into curved forms, for ornamental or constructive purposes. Such plates form escutcheons, hinges, overlays, and inlays.

Met'al Seal. See LEADEN SEAL.

Me'te-or'o-graph. An instrument for making a record of meteorological phenomena.

Fig. 1709.



Theorell's Printing Meteorograph. (*Swedish.*)

"Meteorological observations are shown by this instrument on tables printed on a slip of paper. Of the six tabular columns, the first gives the hours; the second, the velocity of the wind; the third, the direction of the same; the fourth, the temperature; the fifth, the degree of humidity, according to August's method; and the sixth, the atmospheric pressure, which is given in millimeters. The degrees of the thermometer employed are those of the Centigrade scale, and negative degrees are expressed by their complements of 100. The direction of the wind is indicated by figures from 1 to 32. The numbers expressing the velocity of the wind signify meters in a second.

"The registration takes place by means of electrical currents, which are closed in the barometer and both the thermometers by contact between the quicksilver and steel wires that descend into their tubes, and at the weather-cock and anemometer by contact between a metal knob, which is put into motion by the current, and a wheel which is in a direct mechanical combination with each of these instruments.

"The steel wires in the barometer and in both the thermometers are connected, each by its respective system of brass wheels, with numerical types engraved on the edges, in such a manner that the rotation of the wheels causes an upward or downward motion of the steel wires, so that the point of the scale on which the lower extremity of the wire is situated is necessarily that indicated by the number appearing at the same moment uppermost on the corresponding wheels. The two other brass wheels with engraved figures are likewise combined, by means of electric currents, with the above-named metal knobs in the weather-cock and the anemometer, in such a manner that the figure which is uppermost on the periphery of the wheels at the moment it is about to be registered indicates the direction of the wind at the same moment, and its mean force during the preceding quarter of an hour.

"The wheels containing the figures are governed by an electro-magnetic motor, which for each observation sets the five systems successively in motion until the corresponding wires have reached the quicksilver in the barometer and the two thermometers, and caused a contact between the above-named metal knob in the weather-cock and the anemometer, and the wheels, which are in a mechanical combination with each of these instruments.

"The numbers, therefore, that are uppermost on the numbered wheels are just those which indicate the height of the barometer and of the two thermometers, as well as the direction and velocity of the wind. And now the same electro-magnetic motor operates upon a printing apparatus, which, after having deposited color on the types, presses the above-mentioned slip of paper against them.

"This being done, the steel wires are drawn up again by the motor, which stops as soon as a certain distance from the quicksilver is attained, and all is ready for the next observation. The interval between the observations is a quarter of an hour.

"As the clock which determines the time of the observations does not require winding up, the instrument itself restoring the tension of the mainspring every quarter of an hour, it continues going as long as the impellent force, *i. e.*, the electric current, is maintained; and as the slip of paper applied lasts for fully three months, that is the period for which the instrument may be left to itself." — *M. Sörenson.*

In the meteorological recording instrument of Von Baumhauer, of Utrecht, Holland, shown at the Centennial, the instrument was run by weight and clock-work, the stylus making its marks or dots upon a revolving vertical cylinder with blackened surface.

See also —

	"*Sc. Amer. Sup.*," 591.
Printing, *Theorell*, Sweden . .	* "*Engineering*," xxvii. 6.

See also ANEMOMETER, *supra*.

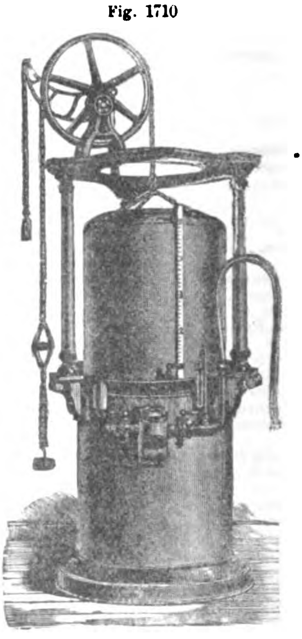
Me'ter. (*Fishing.*) The strengthening line of a seine or gill net, to the upper one of which the floats, and to the lower the weights, are attached. The *seaming* is the marginal line of the net, to which it is seized by meshes, and the *meter* is an outside line seized at intervals of a yard.

Me'ter and Am-mo'ni-a Sat'u-ra'tor. (*Gas.*) An experimental instrument, used in the proving of the quality of gas. — *Goodwin.*

Me'ter Prov'er. (*Gas.*) A holder of known capacity used in testing the accuracy of the indications of a gas meter.

The prover is accurately counterpoised and adjusted so as to give a uniform pressure from top to bottom. The water must be uniform in temperature with the air of the room in which the experiment is conducted. The meter is connected to the holder, and a small quantity admitted to bring the pointer on the index to any figure desired. Next adjust the pointer on the holder to 0°. Turn on the gas and make one or more complete revolutions of the pointer on the dial. The quantity registered by the meter should

Fig. 1710



Meter Prover.

correspond with the indications on the vertical scale of the holder. Per centage of error is readily calculated.

Met'ric Sys'tem. In addition to the remarks on page 1428, "*Mech. Dict.*," METRIC SYSTEM, in regard to the constitution of the French commission of 1798 to report upon the selection of a natural standard of measurement; and on p. 1554, ODOMETER; p. 173, ASTRONOMICAL INSTRUMENTS, in reference to early measurements in Egypt and Mesopotamia of an arc of the meridian, and by Fernel, physician to Catharine de Medici, 1550: —

Cassini (*b.* 1625; *d.* 1712), the discoverer of the diurnal periods of Jupiter, Mars, Venus, and the Sun; of four satellites of Saturn, of which Huyghens had previously discovered one, and the first observer of zodiacal light, gave great attention to the measurement of an arc of the meridian. Cassini was invited to Paris by Colbert, and he and his descendants of three generations presided over the Observatory of Paris.

President de Brosses, "*En Italie*" (1739), tome i., p. 237, *et seq.* (Didier, Paris, 1858), mentions the church of San Petronio in Bologna and its curiosities: —

"Mais ce qu'il y a de principal est la fameuse ligne méridienne tracée sur le pavé par Cassini, laquelle, tant qu'elle existera, servira de règle aux astronomes à vener pour measurer l'obliquité de l'écliptique Elle est ménagée fort adroitment dans la plus grande longeur de l'église, passant avec obliquité entre deux piliers. *La longueur de cette ligne fait la six-cent-millieme partie de la circonference de la terre.*

"Elle est de marbre, devisée dans sa longueur en deux partis égales, par un filet de cuivre qui marque précisement le méridien; et sur le marbre sont gravées toutes les chose qui peuvent avoir rapport à l'ouvrage pour le rendre parfait. L'endroit de la voûte où est le petit trou par où l'image du soleil va se porter à midi précisément sur la ligne de cuivre s'étant un peu affaissé, on fut obligé, sur la fin du siècle dernier, de restaurer l'ouvrage. Il passe maintenant pour le plus parfait de tous ceux qui sont en ce genre, et ses bonnes qualités sont inscrites sur une pierre incrustée dans le mur. J'ai été choqué de voir qu'on la foulait aux pieds sans respect, ce qu'en efface beaucoup les caractères."

New standard . . . . . "*Sc. Am. Supplement*," 764.
To approx. yards and meters . "*Scientific Am.*," xxxviii. 41.

Me-tror'ga-non. (*Surgical.*) A uterine knife with a guard blade. — *Newman.*

Mex'i-can Bit. (*Manège.*) A stiff cheek bit, having a high port, to which is attached a large ring, which, when the bit is in the horse's mouth, encircles the jaw. The cheeks are long, and have rein rings at the lower ends; they are also wide and quite ornamental; chains and small drops are attached to various parts for the purpose of ornamentation; it is the most severe bit in use.

Mex'i-can Cloth. (*Fabrics.*) A silk and wool French goods.

Mez'za Ma-jol'i-ca. (*Ceramics.*) Pottery with a lead glaze and decorated with colors, in which the running together of the glaze and color gives a mingled or softened appearance to the outline of the ornamentation.

The Italian *mezza majolica* of the 15th and 16th centuries was made in great quantity, and some pieces were of great beauty.

It may be said that it preceded the stanniferous glaze (used by the Saracens in Spain and Majorca) and that the secret of the tin glaze was rediscovered by Luca della Robbia, who thus initiated the majolica ware.

Mi'ca. Some of the mechanical and ornamental uses of mica are enumerated on p. 1430, "*Mech. Dict.*"

Spectacle glasses of mica, used in Germany, are concaved in the shape of watch glasses, and are about 1·25″ in thickness. They are mounted in simple brass wire frames, and are made sufficiently large to fit closely around the eye sockets. The advantages gained by this utilization are very great.

Murray's ornamental process for treating mica: —

The mineral is first cut to the desired thickness, then coated with a thin layer of fresh isinglass diluted in water, and the gold or other surface applied, after which it is allowed to dry. A copper pattern of the desired design is next placed on the reverse side of the sheet, and any superfluous parts of the gilding are removed by means of a small brush, the design remaining on the parts not brushed. Colors are then laid on as desired, and the whole is coated with a solution of liquid glue, diluted in alcohol. The sheet is then fastened with glue permanently in position.

Puscher's process, Nuremberg: Treat thin plates with strong sulphuric acid and then silver as with glass. Cut into shapes for inlaying.

Heat to redness to give a dulled look; for inlaying, —

Scatter powdered mica on sheets of gelatine and varnish.

Mix powdered mica with dissolved gum arabic for a silver paint.

Powdered mica, boiled in hydrochloric acid, washed, and sorted for fineness: used in dusting over artificial flowers, fancy papers, passementerie; articles of wood, metal, glass, paper, papier-maché, gypsum, etc. The articles are painted in bronze colors; then receive a binding coat of gelatine, and the mica is dusted on.

See for colors, etc., BRONZING, p. 138, *supra*.

Dusted over articles coated with asphalt varnish imitates granite.

See also MARBLE, ARTIFICIAL, *supra*.

Mi'co-lon Steel. (*Metallurgy.*) Steel made by the process suggested by Réaumur, 1722, by adding wrought iron to cast iron to reduce the mixture to the proportion of carbon to form steel.

Martin's process is a successful application of the same suggestion.

It may be applied either in the crucible or the cupola. In the former, the proportions of iron and steel are placed in the crucible with such an amount of spiegeleisen as may consist with the character of steel required.

The cupola process, in which coke alone is used as fuel, proceeds in the same way, but the proportions chosen by the inventor have been preferably such as to give a good casting steel for bells, but one which will not weld.

M. Debette thinks "that we have heard the last of this."

Mi'cro-bat'ter-y. A very small galvanic battery, used in testing the delicacy of instruments; as, for instance, a cell of thimble size, with a fraction of a teaspoonful of exciting liquid.

Mr. Collet wrote from Heart's Content, Newfoundland: —

"I have just sent my compliments to Dr. Gould, of Cambridge, who is in Valentia, Ireland, with a battery composed of a gun cap with a strip of zinc, excited by a drop of water the size of a tear."

See also Micro-battery for telephone, "*English Mechanic*," * xxvii. 602.

Mi'cro-far'ad. (*Electricity.*) The millionth part of a farad. The practical unit of capacity; being the trillionth part of the absolute electromagnetic unit = $\frac{1 \text{ volt.}}{10.000}$. — *Gordon.*

Mi-crom'e-ter. (*Microscopy.*) A piece of glass ruled into 100ths and 1000ths of an inch, and used to measure objects in the field.

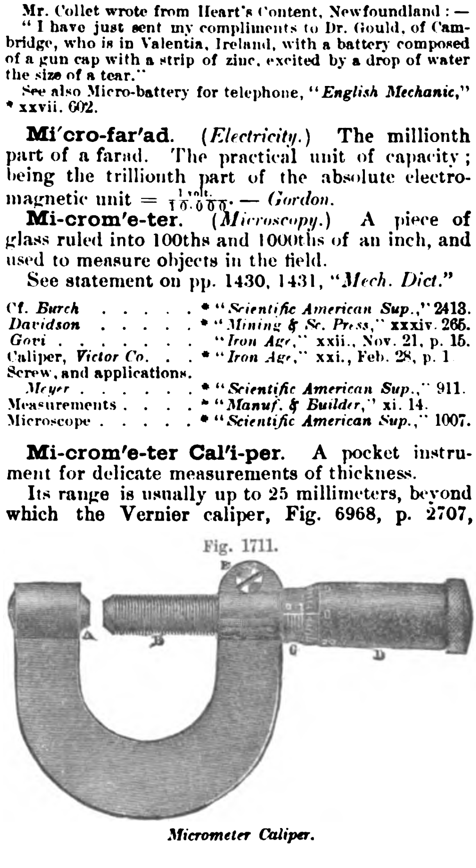
See statement on pp. 1430, 1431, "*Mech. Dict.*"

Cf. *Burch* . . . . . * "*Scientific American Sup.*," 2413.
Davidson . . . . . * "*Mining & Sc. Press*," xxxiv. 265.
Gori . . . . "*Iron Age*," xxii., Nov. 21, p. 15.
Caliper, *Victor Co.* . . * "*Iron Age*," xxi., Feb. 28, p. 1
Screw, and applications.
Meyer . . . . . . * "*Scientific American Sup.*," 911.
Measurements . . . . * "*Manuf. & Builder*," xi. 14.
Microscope . . . . . * "*Scientific American Sup.*," 1007.

Mi-crom'e-ter Cal'i-per. A pocket instrument for delicate measurements of thickness.

Its range is usually up to 25 millimeters, beyond which the Vernier caliper, Fig. 6968, p. 2707,

Fig. 1711.



Micrometer Caliper.

"*Mech. Dict.*," is regarded as the preferable instrument.

The micrometer caliper is graduated to read to 40ths of millimeters, but 80ths are readily obtained. Binding and adjusting screws furnish ready means for compensating for any wear resulting from use.

The instrument is also made to read in fractions of inches. The one shown has a capacity of 1″, and can be set to ½ and ¼ thousandths.

Mi-crom'e-ter Screw Con'tact Cal'i-per. Mr. A. S. Kimball describes a method used by him to detect the contact of micrometer screws.

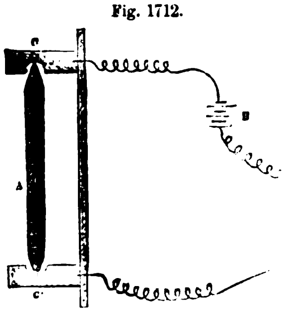
In the case in question the micrometer screw had 60 threads to an inch, and its head was graduated to 300 parts, so that the unit of measurement was the 1-18,000th″. The iron bar, micrometer screw, and a telephone, were put in the circuit of a weak Leclanché cell. When the screw was turned up to loose contact with the bar, the familiar boiling sound of a too sensitive microphone was heard, which ceased the instant firm contact was made, the change to silence being abrupt and sharply defined.

Mi'cro-phone. An instrument which is simply a telephonic transmitter of peculiar form, but which owes its name to the fact that it plays the same part in acoustics in regard to feeble sounds that the microscope does in optics in regard to small objects. It is an amplificator of mechanical vibrations of weak intensity, which it changes into undulatory currents.

Its action depends upon the property possessed by some substances of varying their electrical resistance under varying physical conditions; stress, temperature, division, etc.

The name was given by Mr. Hughes, whose instrument is shown in Fig. 1712, and a view of Ducretet's model is given in Fig. 1713.

Fig. 1712.

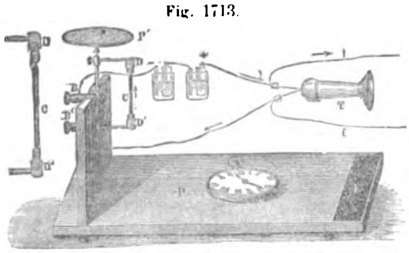


Hughes' Microphone.

"It is formed of a small charcoal crayon, *A*, pointed at both ends. It is lightly held in a vertical position between two cups hollowed out of two small carbon blocks, *C C*, which are fixed to a thin sounding-board. This last is laid on a firm plate. The blocks *C C* are connected by wires with the pile, and the line wire that leads to the telephone.

"Not only words and musical notes, but the faintest vibrations, and even imperceptible sounds, are converted by it into sonorous repetitions. The slightest stroke on or touch against the plate will produce a loud, grating sound in the telephone." — "*Electrician*."

Fig. 1713.



Ducretet's Model of Hughes' Microphone.

Referring to the question, Hughes *vs.* Edison, *in re* microphone, the "*Electrician*" remarks: —

"It is now easy to understand the slight differences that exist between Edison's carbon transmitter, and the microphone in the simple form given to it by Mr. Hughes.

The telephonic or microphonic action is produced in both instruments by the *variations of electric resistance*, which result from the vibrations that are communicated to the transmitter

"In Edison's carbon telephone these vibrations act on a plate, that produces variable pressures on a disk. In Hughes' microphone, the vibrations change the points and surface of contact; one is arranged for transmitting words only, while the other is more specially adapted for sending feeble sounds.

"There has been every reason, therefore, from the beginning to consider the inventions of Edison and Hughes as perfectly distinct, both as regards the methods employed, and the effects produced. A whole series of instruments have since bridged over the dividing line between the two original inventions. It is not easy to draw distinctions between the two systems, with the new transmitters of Blake, Boudet, Paris, Ader, etc., before us, but all the microphones and microphonic speakers can be designated under the generic name of *carbon transmitters*."

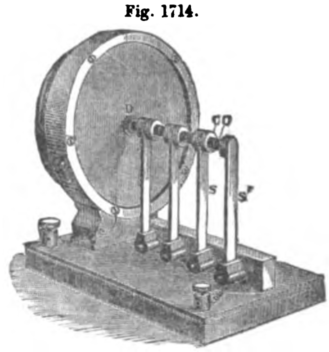
"The small model of a microphone by Ducretet, Fig. 1713, reproduces most of the experiments. A small graphite or coke crayon is pointed at both ends, and kept in a vertical position between two coke carbons, *D D'*. The bearer of the upper cup, *D*, is so arranged that the equilibrium, and the play of the crayon between the cups, can be readily regulated, and consequently the sensitiveness of the microphone The two cups are in direct communication with the two boundaries, *B B'*. The whole is fixed to a small board and a wooden upright, *P*. Two india rubber tubes, underneath, serve as feet to the board, and isolate any foreign vibrations. A slip of emery paper provides a rough surface, *E*, for producing frictions to be transmitted by the instrument.

"A pile of two or three Daniell or Leclanché elements, and a telephone, *T*, *placed at a distance*, form a complete circuit, in which is comprised the crayon *C*, with imperfect contacts." — "*Electrician*."

Edison discovered that carbon varied its electrical resistance with variation of pressure, and upon this is based his articulating telephone. Subsequently, this property was found to be inherent in other instances, even the atmospheric medium itself.

Edison's plan was to use several pieces of semi-conductor

Fig. 1714.



Edison's Microphone.

instead of one. One of his earliest may be seen in Fig. 1714 Some pieces of charcoal are supported each by an upright spring Fig 1715 has two carbons separated by a plate of metal. Another form has 10 plates of silk prepared by saturation in dextrine and lamp-black. Edison's *pile telephone* has alternate plates of zinc and copper with a bibulous medium between pairs.

Prescott's "*Speaking telephone, Electric light*," etc., gives many forms, including the above, and also —

The *condenser*, in which the plates are arranged, as in the ordinary form of condenser.

The *microphone* with graphite rods.

Microphone with pendants.

Microphone without carbon.

The name microtelephone was given by Julian Ockoswicz.

See also STETHOSCOPIC PENDULUM, *infra*.

Coke microphone: Blyth. Articulate sounds can be received, as well as transmitted, by an instrument made of an ordinary earthenware jar, about 3½″ in diameter and 4″ deep, half filled with

Fig. 1715.

Microphone with Carbon disks.

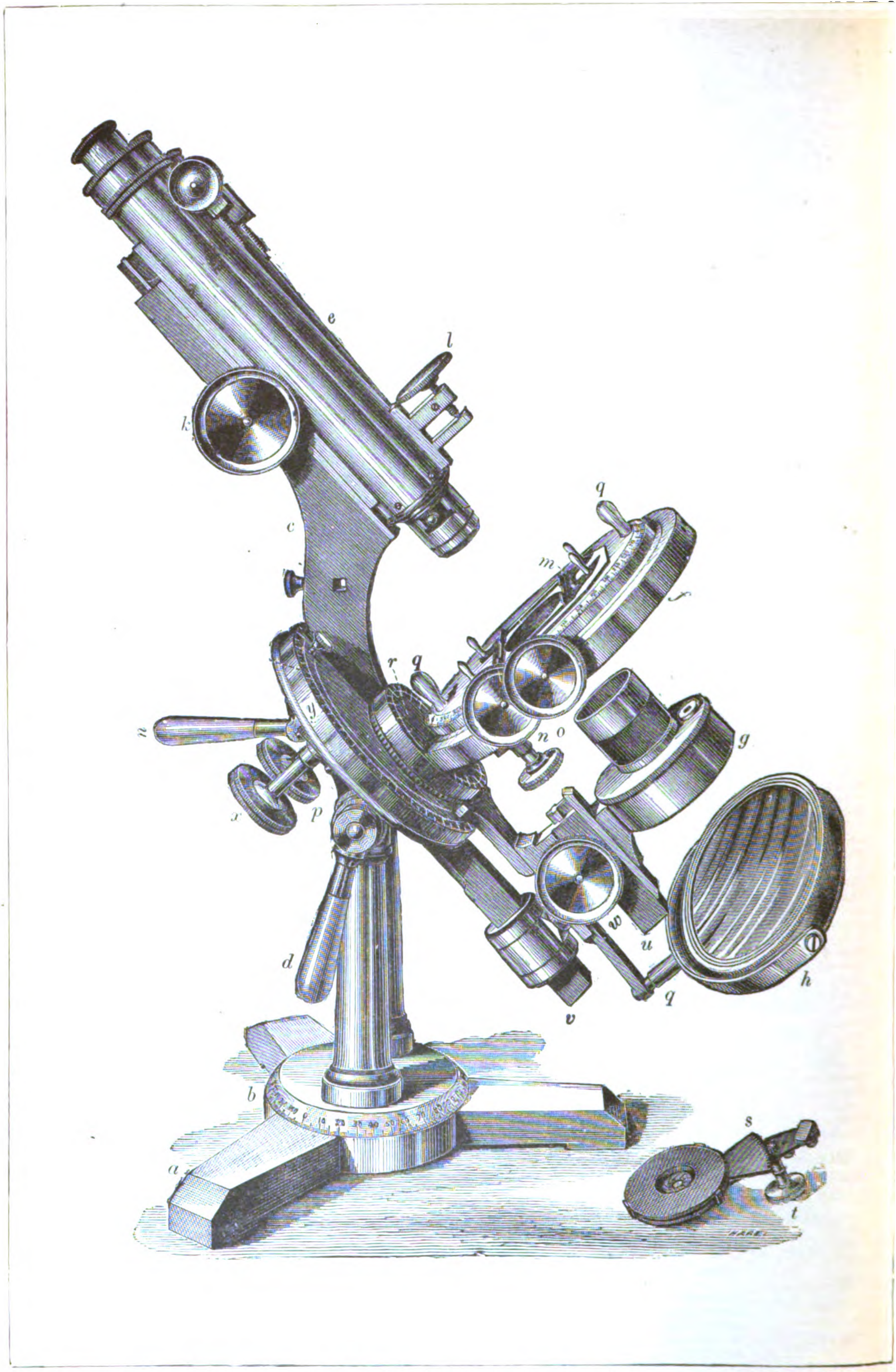


PLATE XXIX. BECK'S "INTERNATIONAL" MICROSCOPE. *See page 599.*

gas coke broken into coarse fragments The electrodes are two strips of tin about 2″ wide, slipped down on each side between the pot and the coke, bent over the edges, and fastened with a cord. When a pair of these are put in circuit with two strong Grove cells the arrangement is complete. — "*Nature.*"

Pocket microphone: Trouvé. It resembles a small dark lantern, with a carbon crayon substituted. Even when a person speaking stands from 75′ to 100′ from the microphone, it transmits his voice very well to a receiving telephone. The instrument can be used for revealing the movement of a clock, the heart or lungs. — "*La Nature.*"

The instrument is sensitive to the slightest noises in a building: a whisper, a footstep, a creak, mice, the ticks of clock, and what not A watchman with a most delicate ear.

Pendulum telephone: An upright bar of carbon suspended from a support, so that its lower end rests gently against a sharp contact piece of carbon

Hughes	"*Engineering,*" * xxv. 370; * 384, 475, 481, 518.
Hughes-Edison	"*Engineering,*" xxvi. 12, 49.
Receivers	* "*Engineering,*" xxvii. 289
Sedlaeck, Hungary	* "*Engineering,*" xxviii. 295.
As a seismometer	"*Engineering,*" xxix. 498.
Blyth	"*Iron Age,*" xxii., July 25, p. 7.
Coke	"*Iron Age,*" xxii., Dec. 26, p. 15.
Pocket, *Trouvé*, Fr.	"*Iron Age,*" xxiii., Jan. 9, p. 13.
	"*Manuf. & Builder,*" x. 151, 195
Pocket, *Trouvé*	* "*Manuf. & Builder,*" xi. 63.
In diagnosis	"*Mining & Sc. Press,*" xxxvii. 19.
Hughes	* "*Eng. & Min. Jour.,*" xxvi. 186.
Hughes	* "*Telegraphic Journal,*" vi. 225.
Hughes-Edison (by *Pope*)	"*Telegraphic Journal,*" vi. 300.
Vereker	* "*Telegraphic Journal,*" vi. 312.
Millar (Receiving)	"*Telegraphic Journal,*" vi. 389.
As a seismometer	"*Telegraphic Journal,*" vii. 68.
Crossley-Hughes	* "*Telegraphic Journal,*" vii. 144.
Pendulum	* "*Telegraphic Journal,*" vii. 170.
Hughes	* "*Engineer,*" xlv. 343, 405, 461-463.
Lancaster	* "*Engineer,*" xlv. 422.
Barker on	"*English Mechanic,*" xxvii. 517.
du Moncel	"*English Mechanic,*" xxvii. 485.
Microphone	"*Iron Age,*" xxi., June 6, p. 1; June 20, p. 9.
	"*Mining & Sc. Press,*" xxxvii. 83, 99, 403.
	"*Eng. & Min. Jour.,*" xxv. 441; * xxvi. 8, 119, 440; xxvii. 77, 129.
	* "*Sc. American,*" xxxviii. 388, 404; xxxix. 16, 20, 63, * 250.
Hughes	* "*Eng. Mechanic,*" xxvii. 235, 256.
Lancaster	"*Eng. Mechanic,*" xxvii. 347, 428.
Microphone pile.	
Lancaster	"*English Mechanic,*" xxvii. 343.
Microphone relay.	
Houston & Thomson	* "*English Mechanic,*" xxvii. 493.
Dowling	* "*Scientific American,*" xl. 324.
Hopkins	* "*Sc. American,*" xxxix. 313.
Stethoscopic	* "*Sc. American,*" xxxix. 233.
Tait	"*Scientific American,*" xl. 53.
Hughes	"*Technologiste,*" xl. 198.
As a Teleg. transmitter.	
Preece	"*Journal Soc. Tel. Eng.,*" ix. 69.
Ockoswicz, on the	"*Sc. American Sup.,*" * 3296.
Muscular contraction	* "*Sc. American Sup.,*" 3646.
Receiver, *Millar*	* "*Sc. American Sup.,*" 2832.
Detecting diffusion of gases through a septum	"*Sc. American Sup.,*" 2320.
In surgery	"*Sc. American Sup.,*" 2261.
Lancaster	* "*Sc. American Sup.,*" 2183.
Gaiffe-Edison	* "*Sc. American Sup.,*" 2187.
Hopkins	* "*Sc. American Sup.,*" 3032.
Preece	* "*Sc. American Sup.,*" 2591.
General résumé	* "*Sc. American Sup.,*" 2591, 2592.
Modifications, *Hopkins*	* "*Sc. American Sup.,*" 2593, 2594.
Simple	* "*Sc. American Sup.,*" 2594.
Stethoscopic	* "*Sc. American Sup.,*" 2594.
Musical, *Varley*	* "*Sc. American Sup.,*" 2594.

Mi′cro-phone Re′lay. A delicate microphone attached to the plate of the receiving telephone as a relay.

As contrived by Houston & Thomson. See "*Telegraphic Journal,*" * vi. 343.

The microphone as a relay for itself. * "*Telegraphic Journal,*" vi. 361.

Mi′cro-scope. Beck's "International" Microscope, shown in Plate XXIX., has a tripod, *a*, for its base, upon which is placed a revolving fitting *b*, graduated to degrees, by which means the microscope can be turned around without its being lifted from the table, and the amount of such rotation registered; upon this fitting two pillars are firmly fixed, and between them the limb *c* can be elevated or depressed to any angle, and tightened in its position by the lever *d*. The limb carries at one end the body *e* (binocular or monocular), with eyepieces and object-glasses; in its center is the compound stage *f*, beneath which is the circular plate, sliding on a dove-tailed fitting, and moved up and down by the lever *z*, and carrying the supplementary body or sub-stage *g*; and at the lower end a triangular bar carrying the mirror *h*.

The binocular body consists of two tubes, the one fitted in the optical axis of the microscope, and the other oblique. At their lower end and immediately above the object-glass there is an opening, into which a small brass box or fitting, *i*, slides: this box holds a prism so constructed that when slid in it intercepts half the rays from the object-glass, diverts them from their direct course, and reflects them into the additional or oblique tube. When the box is drawn back to a certain distance the prism in no way interferes with the field of view, and all the rays pass up the direct body, and the microscope is converted into a monocular one.

The upper or eye-piece ends of the tubes are fitted with racks and pinion for varying the distances between the two eye-pieces, to suit the differences between the eyes of various persons.

This body is moved up and down with a quick movement by means of the milled heads *k*, and with a very delicate and fine adjustment by the milled head *l*.

The compound stage is of new construction; the object is most frequently merely placed upon it, but, if necessary, it can be clamped by carefully bringing down the spring-piece *m*; the ledge will slide up or down, and the object may be pushed sideways; this arrangement forms the coarse adjustment. Finer movements in vertical and horizontal directions are effected by means of two milled heads, *n* and *o*. The whole stage revolves in a circular ring by the milled head *p*, or this can be drawn out, and then it turns rapidly by merely applying the fingers to the two ivory studs *q q* fastened on the top plate, which is divided into degrees to register the amount of revolution. The stage is attached to the limb on a pivot, and can be rotated to any angle, which angle is recorded on the divided plate *r*, or can be turned completely over, so that the object can be viewed by light of any obliquity without any interference from the thickness of the stage.

Beneath and attached to the stage is an iris diaphragm, *s*, which can be altogether removed, as shown in the illustration, from its dove-tailed fitting, so as not to interfere during the rotation of the stage The variations in the aperture of this diaphragm are made by a pinion working into a racked arc and adjusted by the milled head *t*.

Beneath the stage are two triangular bars, *u v*, the one revolving around and the other rigid in the optical axis of the instrument. On the former the sub-stage *g*, carrying all the apparatus for illumination and polarization, fits, and is racked up and down by the milled head *w*: the mirror also, if desired, slides on the same bar; the revolving motion to this bar is given by the milled head *x*, and the amount of angular movement is recorded on the circle *y*, while the whole of this part of the stand is raised and lowered concentric with the optical axis of the instrument by the lever *z*, and the amount of such elevation or depression registered on a scale attached to the limb. This bar can be carried around and above the stage and be thus used for opaque illumination.

The lower triangular bar *v* carries the mirror *h*, or a right-angle prism, when the illumination is required to be concentric with the optical axis of the instrument, and independent of the movements of other illuminating apparatus.

The mirror-box contains two mirrors, one flat and the other concave; it swings in a rotating semicircle attached to a lengthening bar, which enables it to be turned from one side to the other, and revolves on a circular fitting for giving greater facilities in regulating the direction of the beam of light reflected, the whole sliding on either of the triangular bars, and made to reverse in the socket so as to bring the center of the mirror concentric with the axis of the microscope in either case.

As the mirror alone is insufficient for many kinds of illumination, some provision has to be made for holding various pieces of apparatus between the object and the mirror. For this purpose a supplementary body, or sub-stage, *g*, is mounted perfectly true with the body, and is moved up and down in its fitting by rack and pinion connected with the milled heads *w*. This sub-stage is now regarded as one of the most important parts of the achromatic microscope: in it all the varied appliances for modifying the character and

direction of the light are fitted But a few years since it was considered sufficient for this part of the stand to be constructed so as to move up and down perfectly coincident with the optical axis of the instrument, and for that purpose it was racked in a groove planed out on the same limb as that on the upper end of which the optical portions were carried. But lately microscopists have shown the desirability of affording every facility for lateral angular adjustments; and this has led to the sub-stage being attached to an arc working in the circular plate *y*, and moved by a rack and pinion, *x*, while the amount of such angular movement is recorded on the upper surface of the plate *y*. Having once fixed the angular direction of the light, the focusing of it depends upon the lever *z*, which moves the circle up and down, and with it the arm carrying the illuminating apparatus, *in the optical axis of the instrument.*

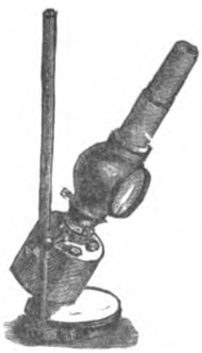
See Microscopy, *Gulliver*	"*Scientific American Sup.*," 1494.
Microscope, *Waechter* . *	"*Scientific American Sup.*," 4139.
Attachment, *Woodward* *	"*Scientific American Sup.*," 1482.
Binocular, *Taylor* . . *	"*Scientific American Sup.*," 1496.
Cheap . . . . . . *	"*Scientific American*," xxxiv. 37.
In chemistry, *Sorby* . .	"*Scientific American Sup.*," 1976.
Drawing apparatus . .	"*Scientific American Sup.*," 440.
Exhibition of	"*Scientific American*," xxxvi. 209.
Galileo's . . . . . *	"*Scientific American Sup.*," 742.
Gas . . . . *	"*Scientific American*," xxxv 328.
Home-made, *Hickels* . *	"*Pop. Science Mon.*," Nov, 1875.
Images on screen . . *	"*Scientific Amer.*," xxxiv. 101.
Janssen's . . . . *	"*Scientific American Sup.*," 727.
Leewenhoeck's . . . *	"*Scientific American Sup.*," 727.
Life slide, *Holman* . .	"*Scientific American Sup.*," 1650.
Musschenbroeck's . . *	"*Scientific American Sup.*," 727.
Objective, Russian, 32″	"*Sc. Am.*," xxxvi. 273; xli. 249.
Object-finder, *Bardeen* . *	"*Scientific Amer.*," xxxvi. 100.
Slide, *Broeck* . . . *	"*Scientific American Sup.*," 510.
Test plates, *Roger's* . .	"*Scientific American*," xxxv 154.
Vision, *Stephenson* . . *	"*Scientific American Sup.*," 1288.

Gosse's "Evenings at the Microscope."

Micro-photog., *Roch* . .	"*Scientific Am. Sup.*," 1824, 4139.
Microscopic photography	"*Scientific Amer.*," xxxvi 226.

Mi′cro-scope Il-lu′mi-na′tor. (*Optics.*) A convenient form of lamp adapted to the use of the microscope. The metallic chimney is telescopic, the condenser fits into the cell in front. The reservoir is of brass. The lamp slides vertically on a pillar, and may be inclined to direct the rays. The chimney is lined with gypsum.

Fig. 1716.



Microscopic Illuminator.

Mi′cro-scope Lamp. (*Optics.*) A lamp for convenient use with the microscope. Several have been invented, the great desiderata being: —

1. Ease of elevation or depression of the lamp by attachment to a long upright rod.
2. A flat wick, so as by turning either the edge or broadside of the flame to get intensity or volume.
3. Absence of great heat.

In a special form of lamp, on a bull's-eye stand, the lamp is attached to a bull's-eye lens, the position of which can be varied at pleasure for varying the character and direction of the rays.

Mi′cro-scope Ta′ble. (*Optics.*) A pillar and claw table, employed in connection with the microscope which stands upon it.

The top is mounted on a strong iron center which enables the observer to revolve the microscope at pleasure without vibration.

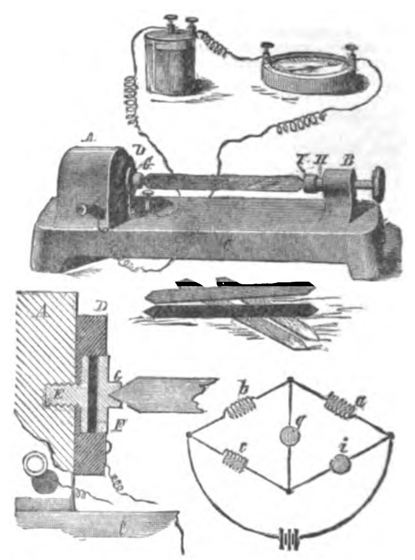
Mi′cro-spec′tro-scope. (*Optics.*) See SPECTROSCOPIC EYE-PIECE.

Mi′cro-ta-sim′e-ter. An instrument, by Edison, for the detection and measurement of infinitesimal pressure. The instrument consists essentially of a rigid iron frame for holding a carbon button, which is placed between two platinum surfaces, one of which is fixed and the other movable, and in a device for holding the object to be tested so that the pressure resulting from the expansion of the object acts upon the carbon button.

The instrument is represented in Fig. 1717 by perspective, sectional, and plan views.

A B are posts rising from plate *C*. To post *A* a vulcanite disk is attached by the platinum-headed screw *E*, which rests in a cavity in the disk. On the head of the screw is the carbon button *F*, and upon its outer face is a disk of platinum foil which is in electrical communication with the battery. A metallic cap, *G*, receives one end of the bar to be tested, the other end being in a cup, *I*, on the end of a screw, *H*, on the other head, *B*. The post *A* is in connection with a galvanometer, in turn connected with the battery. After the strip has been subjected to a small initial pressure, which deflects the needle of the galvanometer, the slightest expansion or contraction of the strip will be indicated by the needle. The warmth of the hand held a few inches from a hard rubber strip caused an expansion which was indicated by a deflection of a few degrees of an ordinary galvanometer, which was not affected in the slightest degree by a thermopile facing and near a red-hot iron. The principle of this apparatus is to be applied to delicate thermometers, barometers, and hygrometers.

Fig. 1717.



Edison's Microtasimeter

Fig. 1718 shows the apparatus as constructed for more delicate operations. The instrument is connected with a Thomson's reflecting galvanometer, and the current is regulated by a Wheatstone's bridge and a rheostat, so that the resistance on both sides of the galvanometer is equal, and the light pencil from the reflector falls on 0° of the scale. The principle is illustrated in the plan view in Fig. 1717, where *g* is the galvanometer, *i* the instrument. At *a b c* the resistance is the same. An increase or diminution of the pressure on the carbon button by an infinitesimal expansion or contraction of the substance under test is indicated on the scale of the galvanometer.

The carbon button may be compared to a valve, for, when it is compressed in the slightest degree, its electrical conductivity is increased, and when it is allowed to expand it partly loses its conducting power.

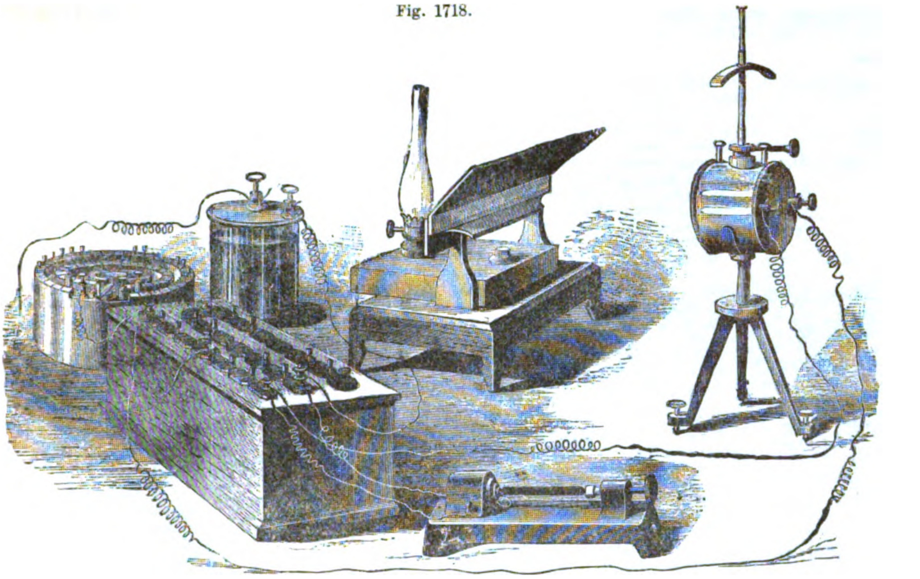
The heat from the hand, held 6″ or 8″ from a strip of vulcanite placed in the instrument — when arranged as last described — is sufficient to deflect the galvanometer mirror so as to throw the light-beam completely off the scale. A cold body placed near the vulcanite strip will carry the light-beam in the opposite direction.

Pressure that is inappreciable and undiscoverable by other means is distinctly indicated by this instrument.

See also TASIMETER, *infra*.

Cf. "*Eng. & Mining Journal*" . . .	* xxvi. 186.
"*Engineering*"	* xxvi. 99.
"*Iron Age*"	xxi., June 20, p. 15
"*Telegraphic Journal*"	* vi. 314; * vi. 458.

Fig. 1718.

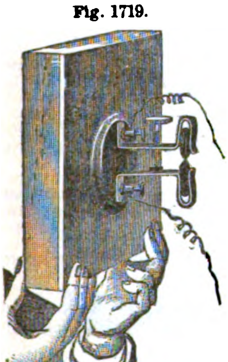


Microtasimeter with Reflecting Galvanometer.

"*English Mechanic*"	* xxvii. 414.
"*Scientific American*"	* xxxviii. 385.
"*Engineer*," *Edison*	* xlvi. 99.
"*Tasimeter*"	* xlvi., Fig. 3, 425.
"*Journal Society Telegraphic Eng.*" .	* vii. 379.

Mi'cro-tel'e-phone. The name given by its inventor, Julian Ockovowicz, of Lemberg, Gallicia, ("*Telegraphic Journal*," vii. 132) to a Bell telephone in which the current generated by the vibration of the diaphragm is caused to pass through the diaphragm as well as the core before it enters the line.

Fig. 1719.



Hopkins' Microphone.

The communication of the current with the vibrating plate is effected by means of two small springs which are lightly pressed by the membrane, and which act as a microphonic contact. 3 mm. above the iron diaphragm is a membrane of caoutchouc, so that the two inclose a film of air between them.

Dr. Hopkins' instrument consists essentially of two springs secured to a small base piece, and each supporting at their upper end a piece of ordinary battery carbon. These two pieces of carbon are placed in light contact, and the two springs are put in an electrical circuit in which there is also a receiving telephone of the Bell form. In Fig. 1719 it is shown as secured to a small sounding-board. The two carbon supporting springs are fastened to a single base by the binding posts which receive the battery wires. An adjusting screw passes through one of the springs at or near its center, and bears against a rubber button projecting from the other spring. This simplé device when placed on a table indicates in the receiving telephone the slightest touch of the finger on the table or on the instrument. Blowing on it makes in the receiving instrument a deafening roar; drawing a hair or a bit of cotton across the carbon is distinctly audible in the receiving instrument.

Cf.	* "*Iron Age*," xxii., Sept. 26, p. 15.
	"*English Mechanic*," xxvii. 511.
	"*Scientific Amer.*," xxxix. 170.
Trouvé	* "*Scientific Amer. Sup.*," 2481.
Hopkins	* "*Scientific Amer. Sup.*," 2693.

Theory of	"*Scientific American Sup.*," 3806.
Luedtge	"*Scientific American Sup.*," 3078.

Refer to CARBON TELEPHONE, Fig. 535, p. 165, *supra*.

Mi'cro'tome. An instrument for cutting very thin sections of soft substances for microscopic purposes.

	* "*Sc. Am. Sup.*," 1821.
Rivet . . .	* "*English Mechanic*," 8.

Mid'dlings. (*Milling.*) Coarse particles of the kernel from immediately adjoining the skin of the berry, and now appreciated as the most valuable part because consisting largely of *gluten*, while the interior of the kernel is composed of the *starch*, which, when dry, readily becomes a pearly powder.

Under the method of *straight grinding* almost universally practiced until within a very few years, the prime object of the miller was to make as few middlings as possible, considering them only fit to be ground into an inferior grade of flour, or high grade of feed. Consequently the grinding was done very *close* with keen, sharp burrs; shaving into powder as far as practicable all this compact horny part of the kernel, which thus became incorporated with the interior or starchy part, and through the bolt was separated from the bran or skin of the berry. The coarser particles, known as middlings, remained mixed with small particles of bran and other foreign substances, also a fine fuzz, which is found on the skin of the berry.

The new process consists in manufacturing a flour out of the middlings, having larger and more uniform granules than the flour which is made from the central part of the berry, and free from the fine impurities mixed with the first grinding.

The middlings are passed through a machine called a purifier, so arranged that a properly regulated current of air may be sucked or driven through them, separating all the fuzz and small specks, which have less weight than the particles of the kernel thus freed of impurities. The purified middlings are then reground, with care, so that the grinding may be even and the angular shape of the particles retained. After grinding, it is bolted as usual through proper numbers of cloth, and the larger particles passing over the tail of the reel are returned to the purifier and stone.

This is a general synopsis of the process, which is of course varied to suit the judgment and experience of skilled millers, some using many purifiers for frequent separations and different methods of manipulating the returns and re-grinding.

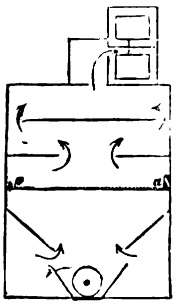
The middlings flour being sought after as superior to the straight grade, it is desirable to *grind high*, and make as much middlings as practicable, — frequently 35 to 40% is made into middlings flour.

See also HIGH MILLING, p. 458, *supra*; and references *passim*.

Mid'dlings Pu'ri-fi'er. The separation of middlings by air currents and by shaking are old devices.

The employment of the hand sieve and natural current of air, as in the ancient mode of winnowing (Fig. 7256, p. 2786, "*Mech. Dict.*"), but on a smaller scale and in more confined situation, was the natural resource before reels and bolting chests came into use. The middlings purifier proper is something more than a mere bolt; properly speaking, it is a machine for separating minute bran scales from grits by causing a broad stream of air either by blast or suction, to pass through a slightly-inclined plane sieve of meshes sufficiently large for both the bran and grits to pass through; the force of the blast being so gentle as to permit the grits to drop, while the particles of bran are kept afloat to be discharged at the lower margin of the sieve. The sieve is sometimes disposed around a cylinder, and the action promoted by a brush acting upon the surface of the sieve in connection with the blast or suction. Of this class, several of most ingenious construction, under the name of middlings-purifiers, have been recently invented and brought into use in this country.

Fig. 1720.



Principle of Middling Purifier

The accompanying figure illustrates one of the simpler forms.

a a, is the slightly-inclined sieve, through which the air is carried upward by the exhaust-fan, by which the fine bran is prevented from passing through, while the heavier grits are dropped to the trough below.

The subject has been considered on pp. 1436, 1437, "*Mech. Dict.*," where the machines of

* *Lacroix*, * *Huntley & Holcomb*,
* *Smith*, * *Wilson*,
* *Mowry*,

have been adduced as illustrating five modes, having certain points of difference in operation.

Several systems of grading middlings and bolting are described in *Rollet's* French work on milling (Paris, 1847), including those of

* *Lanturelu*, * *Benoist*.

Reference is made to the above also in "*Scientific American Supplement*," where are also shown the apparatus of

* *Westrupp*, Br., 1854. * *Cabanes*, Fr., 1855.
* *Perrigault*, Fr., 1862.

A slight, general sketch of the distinctive methods may be given, and reference for particulars can be made to the publications cited in the subsequent list: —

La Croix's device consists in the combination with the reciprocating screens of traveling air tubes under the screen placed 5″ on centers, and moving backward and forward 5″. These tubes are supplied with air at high pressure by means of two small but powerful blast fans. The air is discharged in thin sheets the entire width of the cloth, which cleans the meshes, and raises the light fibrous matter from the middlings so that it may be readily drawn off by the suction fan, which is employed on top of the machine as usual.

Walker. A distributing feed shoe: an inclined, shaking, suction blast separator suspended and vibrated upon links, and divided into sections, each of which consists of a series of slightly inclined shelves, extending to the side-boards of the suspended separator; a brush and concave arrest the middlings at their mid-passage, and they fall upon a shaking sieve where they are sorted and certain portions returned for re-dressing.

Collin's "Garden City." A succession of inclined sieves of gradually coarser quality, and suction blast of increasing strength in the descending order. The matter passing through each sieve is spouted away to its own receptacle.

Smith. Has feeding rollers, shaking bolt, traveling brushes to clean meshes of the cloth, and upward current of air to carry off impurities.

Reel & Seyler "Champion." Has a spout and rotary reel for separating the finer particles: thence to a chute where the fuzz is withdrawn by a suction fan; then to a series of grading sieves with upward blast.

Huntley, Holcomb, & Heine "Excelsior." Middlings are fed through tubes to disintegrators, two in succession; the dust and fiber are carried off through wind-trunk, and go to a feed hopper and reel to be sorted; the middlings pass to shaking sieves with upward draft.

Hunter. A blast machine with percussion sieve.

"Phœnix" has suction fan, sloped sieves, and a succession of hoppers for graded product.

"Keystone." Succession of zigzag inclined sieves and suction draft.

Affleck. The middlings are subjected to a current of air before going on to the sieve, where the purification is finished and the floury matter drawn off into a suitable bolt.

Cochrane's patent, of so much interest in regard to the suits at law in this matter, is No. 37,318, January 6, 1863. See "*American Miller*," vi. 11.

Refer to — *Bauer*	* "*American Miller*," iv. 101.
Benoist	* "*Scientific Amer. Sup.*," * 1602.
Buehlmann	* "*American Miller*," v. 181.
Cabanes	* "*Scientific Amer. Sup.*," * 1602.
Cabanes, Purifier	* "*American Miller*," v. 197.
Case	* "*American Miller*," viii. 370
"Champion"	* "*American Miller*," v. 55.
Cochran (Patent No. 37,318, Jan. 6, 1863.)	* "*American Miller*," vi. 11.
Collins, "Garden City"	* "*American Miller*," iv. 89.
Currier, Mill	* "*American Miller*," vii. 267.
	* "*American Miller*," viii. 29.
Dell, Br.	* "*Engineer*," xlvi. 403.
Downton	* "*American Miller*," vi. 21.
Electric	"*Scientific American*," xlii. 209.
Elwell, Separator	* "*Scientific American*," xxxiv. 342.
	* "*Scientific Amer.*," xxxix. 166
Fender, "Standard	* "*American Miller*," v. 83.
"Garden City"	* "*American Miller*," v. 69.
"Helvetia"	* "*American Miller*," viii. 157.
Hunter	* "*American Miller*," vi. 21.
Huntley, "Excelsior"	* "*American Miller*," iv. 137.
Jones, "Paragon"	* "*American Miller*," iv. 93.
Keller	* "*American Miller*," viii. 315.
Lacroix	* "*American Miller*," v. 83.
	* "*American Miller*," vii. 103, 266.
Lanturelu	* "*Scientific Amer. Sup.*," * 1602.
Millot, Switz.	* "*Engineer*," xlvi. 258.
Ohio Midd. Purif. Co.	* "*American Miller*," iv. 90.
Osborne	* "*Scientific American Sup.*," 3744.
"Paragon"	* "*Scientific American Sup.*," 431.
	* "*American Miller*," iv. 37.
Perrigault	* "*Scientific Amer. Sup.*," * 1602.
Pyne	* "*American Miller*," vii. 338.
Redfield	* "*American Miller*," viii. 3.
Reel, "Champion"	* "*American Miller*," v. 55.
Smith	* "*American Miller*," iv. 140.
Schoonover	* "*American Miller*," viii. 29.
Suits, arguments	* "*American Miller*," vii. 70.
"Summit"	* "*American Miller*," viii. 315.
Sutcliffe	* "*Engineer*," xli. 391.
	* "*American Miller*," v. 72.
Walworth, Br.	* "*Engineer*," xliii. 415.
Westropp	* "*Scientific Amer. Sup.*," 1602.
Wolf	* "*American Miller*," viii. 183.

Mid'ship-man's Hitch. (*Nautical.*) A kind of hitch shown at *i*, Fig. 2513, p. 1105, "*Mech. Dict.*"

Mil'dew Bronze. An imitation of the *patina* or surface effect obtained by lapse of ages and exposure of ancient bronzes.

Dissolve equal weights of nitrate of iron and hyposulphite of soda in eight parts of water; immerse the articles in this until of the right tint, then well wash with water, dry, and brush: one part chloride of iron and two parts water imparts to brass a fine antique green. Brush well and lacquer with pale gold lacquer, or polish with oil.

Mil'i-um Nee'dle. (*Surgical.*) A fine needle with curved hastate point used in skin grafting. — *Piffard.*

Milk. See the following references: —

Analysis apparatus.	
Von Baumhauer	* "*Scientific American Sup.*," 1162.
Condensed	* "*Scientific American Sup.*," 2482.
Cooler, Austrian	* "*Scientific American*," xl. 282.
Milking apparatus	
Blurton, Engl.	* "*Scientific American Sup.*," 2346.
Milker, *Mollen*	* "*Scientific American*," xxxvi. 102.
Skimmer, centrifugal.	
Wanniek, Austrian	* "*Engineering*," xxviii. 21.
Stool and strainer.	
Valentine	* "*Scientific American*," xlii. 100.
Milk sugar manufacture	"*Scientific American*," xxxvi. 56.

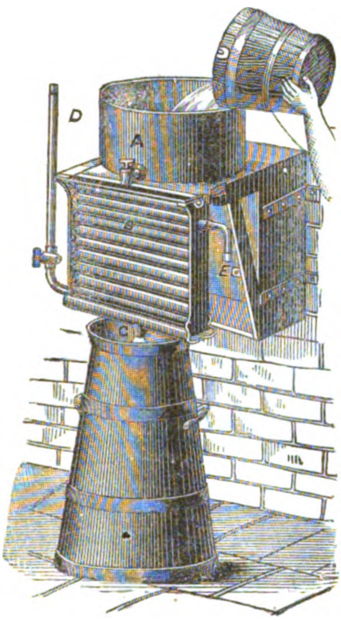
See LACTOMETER, LACTODENSIMETER, GALACTOMETER; PIOSCOPE; CREAMERY, CHEESE, CHURN, etc., and references *passim*.

Milk Car. (*Railway.*) One for carrying milk in cans. It is usually made with end platforms like a baggage car, and has the springs of a passenger car. — *Forney.*

Milk Cool'er. An apparatus for removing the natural warmth of fresh milk. Two forms are shown.

Fig 1721 is Lawrence's capillary refrigerator (Br.), which is also adapted to cooling wort. Milk as soon as milked is poured into the strainer *A*, whence it passes into a chamber

Fig. 1721.



British Milk Cooler.

which is occupied by a system of convoluted pipes, *B*, in which cold water circulates, passing by pipe *D* to *E*, and exit. The milk flows into the churn *C*. The front end of the cooler chamber is removed to expose the interior.

The Austrian cooler, Fig. 1722, is very simple, and consists of a vat or tub through which cold water is constantly circulating. On the surface of the water floats a circular

Fig. 1722.

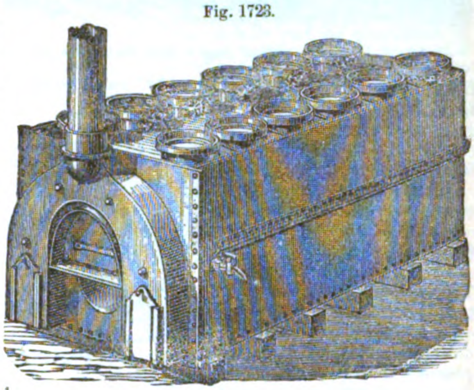
Vienna Milk Cooler.

wooden plate, provided with a number of round holes into which are inserted the vessels containing the milk. These are made of sheet zinc, two feet long, and each, according to the "*Wiener Landw. Zeitung*," contains a little over a gallon of milk.

It takes about fifteen minutes to cool the milk down to a temperature slightly above that of the surrounding water. When not in use the cylinders are turned upside down on a wooden rack to drain and dry.

Milk Glass. A semi-translucent glass used in some graduated glass instruments to contain the scale in order to render it more legible. See also CRYOLITE; HOT CAST PORCELAIN, etc.

Fig. 1723.



French Milk Heater.

Milk Heat'er (*Dairy.*) A furnace arrangement for heating milk for cheese-making.

That shown in Fig. 1723 is a French form in which the deep cans set in a water bath above a furnace. The furnace and tank are of sheet iron.

See also MILK PAN.

Fig. 1724.

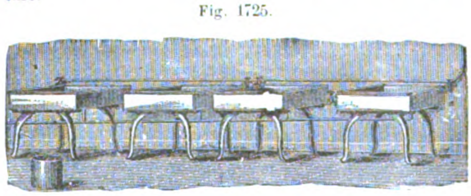
Milking Tube.

Milk'ing Tube. A tube inserted into the via lactea of a cow's teat in order to overcome the muscular contraction and allow the milk to flow without the use of the hands. The tubes are of silver, four to a set, and are telescopic to suit varying lengths of teats.

Milk Pan. A pan in which milk is set to allow the cream to rise; or in which it is heated or cooled as the circumstances may require, for churning or for cheese-making.

Figs. 1725, 1726 show the "Iron Clad" milk pans arranged in battery and having double bottoms in which by means of pipes a flow of hot or cold water is obtained. In Fig. 1725 the water proceeds from an elevated reservoir and is supplied to either or all of the pans by means of faucets. In Fig. 1726, *A* is the pipe from the boiler leading to pans. *B*, the hot water pipe spigot. *F* is the waste-water pipe, *G* the sour milk pipe. *H H* are thermometers for indicating temperature.

Fig. 1725.

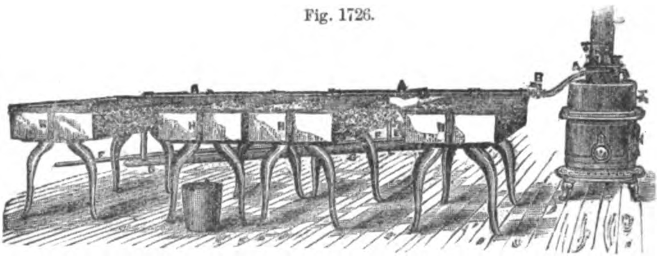


Milk Pans with Water Flow.

Milk Scale. See CREAMERY SCALE, Fig. 725, p. 230, *supra*.

Milk Strain'er. A funnel-shaped pan with wire gauze in the bottom to strain foreign matters

Fig. 1726.



"Iron Clad" Milk Pans with Heater.

from milk. That shown in Fig. 1727 has a pyramidal strainer which gives a much increased surface and corresponding efficiency.

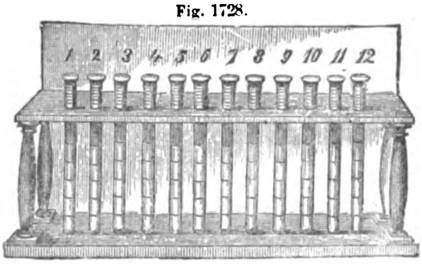
Fig. 1727.

Pyramidical Milk Strainer.

Milk Test. A *lactometer* or *lacto-densimeter*, which see. See also CREMOMETER.

Milk Test'ing Tube. A form of lactometer in which various milks or milks of different cows are placed under exactly the same conditions, in graduated tubes of the same measurements.

Fig. 1728.



Milk Testing Tube.

Mill. See under the following heads: —

Aplatisseur.
Apple grinder.
Army mill.
Aspirator.
Attrition mill.
Bean mill.
Bone mill.
Breaking-down machine.
Buckwheat huller.
Cake breaker.
Cake grinder.
Cement mill.
Charcoal grinding mach
Chilian mill.
Cider mill.
Clay mill.
Clover huller.
Coffee mill.
Concasseur.
Corn cracker.
Corn mill.
Corn sheller.
Cotton-seed huller.
Cracking machine.
Crusher.
Crushing mill.
Cylinder grinding machine.
Cylinder mill.
Decorticator.
Degerminator.
Disintegrator.
Drug mill.
Eccentric mill.
Facing machine.
Farm mill.
Feed mill.
Fertilizer mill.
Flouring mill.
Fodder mill.
Furrow-dressing machine.
Grain crusher.
Grain mill.
Grain scourer.
Grain smutter.
Granulating process.
Grape mill.
Grinding machine.
Grinding mill.
Grist mill.
Grits mill.
High grinding
Hominy machine.
Hominy mill.
Hone.
Huller.
Incorporating mill.
Kibbling mill.
Lime cracker.
Low milling.
Maize mill.
Malt crusher.
Middlings mill.
Millstone dresser.
Mixing machine.
Mortar mill.
Mortar mixer.
Oat mill.
Oat crusher.
Oil-cake breaker.
Oil-cake mill.
Ore crusher.
Paint mill.
Paint mixer.
Pearling.
Plaster mill.
Portable mill.
Powdering machine.
Process milling.
Pulverizer.
Pulverizing mill.
Rice huller.
Rock breaker.
Rock crusher.
Roller mill.
Root grinder.
Root pulper.
Salt mill.
Saltpeter and sulphur grinding mill.
Saltpeter, sulphur, and charcoal mill.
Scourer.
Sectional mill.
Semolina machine.
Smut machine.
Smut mill.
Spice mill.
Stamp mill.
Stamping mill.
Stone breaker.
Stone crusher.
Talc mill.
Vertical-stone mill.
Wheat brush.
Wheat cracker.
Wheat scourer.
Yucca grater.

See also: Mill feeder and tell-tale, *Teter* . . . * "*American Miller*," v. 123.
Middlings machinery.
Gent . . . . . . "*Scientific American Sup.*," 2578.
New process . . . . "*Scientific American Sup.*," 397.
Oliver Evans . . . . * "*Scientific American Sup.*," 2589.
Portable, *Munson* . . * "*Scientific American*," xxxix 70.
French . . . . . * "*Scientific American*," xli 243.

See also MIDDLINGS; MIDDLINGS PURIFIER; CYLINDER MILL; PROCESS MILLING; HIGH MILLING, and references *passim*.

Books on mill-wrighting: —

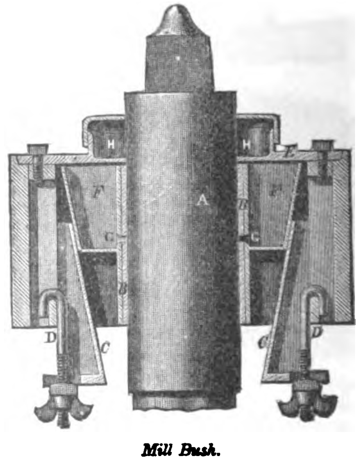
Box. "*Practical Treatise on Mill Gearing.*" London, 1867.
Craik. "*Practical American Millwright and Miller.*" 8vo. Phila., 1870.
Dixon. "*Practical Wheelwright and Engineer's Ready Reckoner.*"
Evans. "*The Young Millwright and Miller's Guide*"
Hughes. "*The American Miller and Millwright's Assistant.*"
Pallet. "*The Miller, Millwright, and Engineer's Guide.*"
Templeton. "*Engineers, Millwrights, and Mechanics' Pocket Companion.*"

Mill Board Cut'ter. A machine for cutting to size mill and card boards for binding, etc. They are made with pivoted, or with circular knives.

See BOARD CUTTER, Fig. 354, p. 113, *supra*; MILL BOARD CUTTER, Fig. 3149, p. 1440, "*Mech. Dict.*"; CARD BOARD CUTTER, Figs. 539-541, p. 166, *supra*.

Mill Bush. The lining box in the eye of a millstone. Fig. 1729 shows the parts in the bed stone and those attached to the spindle making a

Fig. 1729.

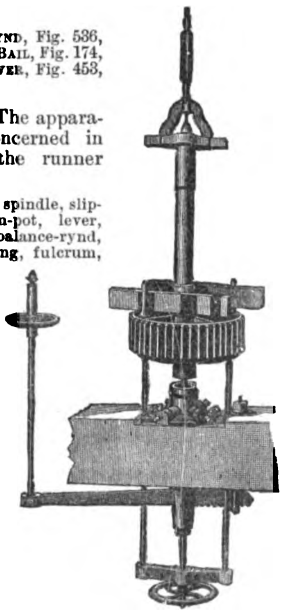


Mill Bush.

joint, by means of the parts *B F C*, and *C D E H*, to give a snug fit, and prevent flour from working downward. The balance-rynd (not shown) is placed on the cock-eye of the spindle, and supports the runner.

See also BALANCE RYND, Fig. 536, p. 216, "*Mech. Dict.:*" BAIL, Fig. 174, p. 66, *supra;* BURR DRIVER, Fig. 453, p. 143, *supra.*

Fig. 1730.



Mill Driver.

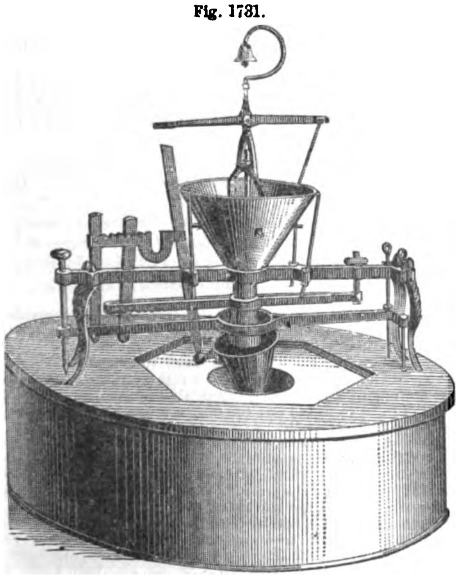
Mill Dri'ver. The apparatus immediately concerned in giving motion to the runner millstone.

The figure shows the spindle, slip-driver, set-screw, tram-pot, lever, lighter screw, bail or balance-rynd, damsel, back-lash spring, fulcrum, pinion and pinion jack. See glossary, pp. 1019, 1020, "*Mech. Dict.*"

Mill Feed'er. The customary feed of a mill-stone is by a damsel on the spindle which agitates the shoe beneath the hopper and causes the grain to dribble into the eye of the runner.

Fig. 1731 shows a self-regulating silent mill feeder which also gives an alarm by the ringing of a bell when the feed runs short. The device rests by four legs upon the husk and has an arrangement of compound levers supporting the funnel which acts as a feed hopper and discharges into the lower funnel which distributes the grain around the eye of the buhr.

Fig. 1731.



Mill Feeder.

Mill File. A thin flat file used in machine shops for lathe work and draw filing.

Mil'ling. 1. (*Grain Grinding.*) In the comparison of the advantages of high and low milling respectively, it is stated by J. J. Wyngaert, editor of the German journal "*Die Mühle,*" that the Austro-Hungarian process of *high milling,* consisting of a disintegration of the tissues by successive crackings, is especially adapted to a hard and brittle wheat, such as that in the markets of Vienna and Pesth, and not to the softer varieties, more abundant in North Germany, Britain, and the United States, and which have a tougher shell and friable interior.

"The advocates of high milling rest upon the claims of the scientific solution of the problem: the reduction of the wheat-grain by a succession of alternate crackings and sortings, in which disintegration is effected by successive steps of such slight individual advance, and the graduations of the successive products are so fine that the heat produced is inconsiderable, and the ultimate product of flour free from specks and of absolute fairness is much larger than by the low-milling process. The significance of this peculiarity of the process cannot be easily over-estimated. It leaves the integrity of the cells of gluten unimpaired. They have, therefore, their natural investment of cellular tissue to protect the sensitive nitrogenous constituents of the interior from the oxygen of the air, and from the spores of microscopic vegetation always afloat in the atmosphere. Having escaped destructive crushing, they have also escaped the heat attendant upon it, and the loss of water and chemical decomposition due to it. As the chemical changes consequent upon this exposure of the gluten bring with them products of disagreeable taste and smell, the flour produced by the high milling has escaped the deterioration consequent upon the destruction of the texture of the gluten-cells."

"The physical impracticability of producing lumps from the friable interior of the soft wheat shows at a glance the inferior adaptation of this kind of wheat to the production of the numerous grades of grits which characterize the Austro-Hungarian milling. The toughness of the shell of the soft wheat makes it practicable to obtain a product in low milling in which the fine particles of bran are relatively few, and from which a flour of high order of whiteness may be obtained. The dry, brittle Hungarian wheat, subjected to the low milling process, would, by reason of the brittleness of the shell, yield a product in which the small particles of bran would be numerous, and, being of the same size, would pass through the bolt with the flour, and make it impossible to produce a flour of perfect whiteness." — *Prof. Horsford.*

By the processes of low milling, we have the following scheme of low milling treatment: —

Cleaning.

Clean wheat. Refuse.

Pointing.

Pointed wheat. Poorest flour. Coarse bran

Grinding.

Flour No. 3, or { No. 1. No. 2. No. 3 } Dust. Fine grits ground. Hulls ground.

Flour No. 2. Dust. Flour No. 6. Bran

Dust ground.

Flour No. 1. Black dust ground.

Flour Nos. 4 or 5

A much more elaborate table, by Wyngaert, may be found in Prof. Horsford's "*Report on Vienna Bread,*" "*Vienna Exposition Reports,*" ii., § B, table opposite to p. 56.

The scheme of treatment of the "Fife" spring wheat of Minnesota is shown in the same report, p. 57.

In the process of high-milling, which is a step by step reduction of the grain, started with the pointed kernels, three products are obtained at each grinding:

Coarse fragments with much bran attached.
Less coarse fragments with less bran attached.
Minute fragments with little or no bran.

These are separated from each other by the sifting and purifying machine. Each of the several products is again subjected to grinding, and the product in each again sorted into grades, and so on until the last traces of the white interior of the berry have been separated from the dark hull and graded. See MIDDLINGS.

The table on the following page exhibits the products yielded in a comparatively primitive high milling establishment: —

HIGH MILLING PROCESS.

1) *Cleaning.*
2) *Pointing.*

Pointed wheat. — Bran. — Black flour, No. 6

3a) *First cracking.*

Groats flour. — Dust (flour). — Grits. — 1. Groats.

3b) *Second cracking.*

Groats flour, Nos. 3 and 4. — Dust (flour). — Grits. — 2. Groats.

3c) *Third cracking.*

Groats flour, Nos. 3 and 4. — Dust (flour). — Grits. — Hulls.

4) *All the grits purified and ground to dust (flour) give*

Flour No. 1. — Dust (flour).

5) *All the dust (flour) purified and ground gives*

Flour No. 2. — Black dust flour No. 5.

6) *Grinding the hulls.*

Flour Nos. 5 and 6. — Bran.

A very much more elaborate scheme may be found in Prof. Horsford's report above quoted, table opposite to p. 59.

	There were produced from wheat of average weight.	83 to 84 pounds per metze.
		per cent.
A	Lady-groats	
B	Table-groats, fine	4.25
C	Table-groats, coarse	
0	Extra imperial flour	
I	Extra fine flour	5.53
II	Ordinary fine flour	5.76
III	Extra roll or semmel flour	5.51
IV	Common roll or semmel flour	6.48
V	First pollen flour	7.12
VI	Second pollen flour	13.30
VII	First dust-flour	11.85
VIII	Second dust-flour	9.95
IX	Brown pollen flour	4.36
X	Foot-flour	6.32
F	Fine bran	8.94
G	Coarse bran	6.87
H	Chicken-feed, loss, and dirt	3.76
		100.00

The terms to indicate certain results or conditions of the material in the process of grinding grain have been multiplied since the introduction of the *high-milling* process.

Prof. Horsford in his "*Report on Vienna Bread*," Washington, 1876, uses the following: —

Groats (Ger. Schrot). Broken and bruised kernels.

Middlings (Ger. Ueberschlag). Unpurified grits.

Grits (Ger. Gries). Purified groats.

Besides these are many terms known in the trade, such as *farina, semolina, cracked wheat*, etc.

Farina. A kind of grits, finely purified.

A number of terms have comparatively lately come into milling: —

Low milling is the ordinary system of mashing and repeated scraping and squeezing and a single bolting. It is attended with heating of the product, which injures the flour.

The *high milling* is a system of successive crackings with alternate removal of the finer particles and the bran as fast as produced. It is attended with but little heating of the product. There is some cracking in low milling and some mashing in high milling.

The *half-high milling*, as its name imports, partakes more of the cracking than low milling, and more of the scraping and squeezing than high milling.

The *cylinder milling* is a system of pressing and cracking, and, where the cylinders are grooved and move with unequal velocities, of tearing. Like the high milling, it produces little heat. See under each head.

Disintegration: A system in which there are neither stones nor cylinders, but in which the pulverization is effected by means of the friction of the grain upon itself, being kept in motion by beaters revolving at a high velocity in a hollow cylinder. *Carr's* process, Fig. 1665, p. 707, "*Mech. Dict.*"

See also under the following heads: —

Aspirator.	Exhaust purifier.
Cylinder grinding mill.	Grain cleaner.
Cylinder mill.	Grain dryer.
Grain separator.	Pointing.
Granulating process.	Purifier.
Grits grading machine.	Roller mill.
Grits mill.	Smut machine.
Grits purifier.	Stone separator.
High milling.	Unbranning machine.
Low milling.	Wheat cracker.
Middlings purifier.	Wheat scourer.
Mill stone.	Wheat separator.

2. (*Fine Art Metal-working.*) Giving an ornamental ridged or ribbed surface to an object by holding it against a ribbed tool which revolves in a lathe.

3. (*Metal Working.*) The cutting of metal, etc., by means of revolving cutters. See MILLING MACHINE, "*Mech. Dict.*," *et infra.*

4. (*Leather.*) Treatment in a large wooden drum or cylinder, about 8′ in diameter, and 4′ in height, water-tight, and having wooden pins projecting radially from the interior concave surface towards its horizontal shaft. The drum is revolved by a pinion, from 8 to 20 times per minute.

The mill is used for stuffing light leather, and for other purposes. After stoning, skiving, and shaving, the sides are put in the mill with some tan liquor to soften them and make them porous.

5. A mode of finishing some descriptions of goods by means of vertical fallers. See BEETLING MACHINE.

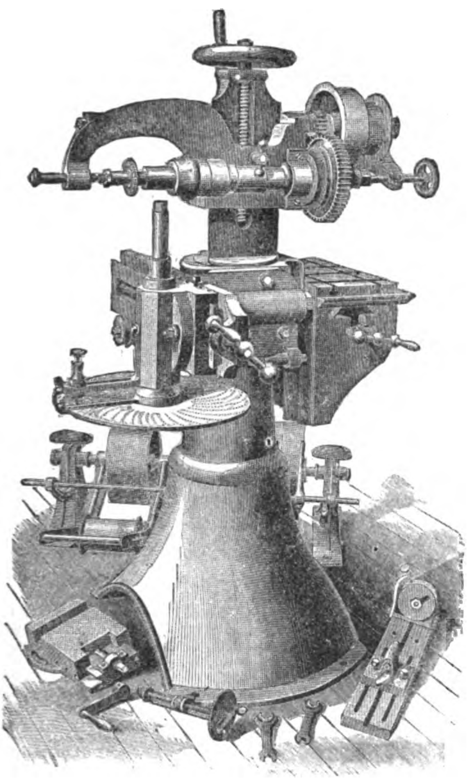
Mil′ling Ma-chine′. The subject is considered on pp. 1441, 1442, "*Mech. Dict.*," Figs. 3151, 3152. The form shown in Fig. 1732 is Lawrence's Combined Index and Plane Milling Machine.

On the circular portion of the standard is a sleeve capable of being clamped in any position, and carrying on one side the index cutting arrangement, and on the other the plane-milling table. By this arrangement of the sleeve the index can be swung round to the opposite side from the cutter, and this movement carries the milling-table under the cutter in position to be operated on, and only a moment of time is required to make the adjustment.

From the top of the sleeve, upward, the front of the standard is flat with beveled sides, and on this top part the spindle-carrier is fitted, with spindle and lateral adjustment of spindle, gears and pulley for driving the spindle, and rack-gear and handle on the back side.

The cutter-spindle carrier has a traverse of 9″, and can be operated either by a screw and hand-wheel at the top or by the lever and rack behind. On the left-hand box of the cutter-spindle is a pipe-box, bored tapering, and into which a composition-bush is fitted. Through this bush the spindle passes. On the outer end of the bush a check-nut is fitted for drawing the bush in on the taper and contracting the hole. By this method the wear of the bearing is taken up. The index is 16″ in diameter, and is drilled to cut all numbers up to 80, and all even numbers up to 150. Spur, bevel, or right or left worm-gears can be cut. It will cut gears up to 16″ diameter accurately, and by swinging the index away

Fig. 1782.



Combined Index and Plane Milling Machine.

from the cutter will cut 24″ diameter. The number of degrees in a circle are cut on the edge of the index-plate. The plane-milling table is dovetailed and gibbed into the top part of a knee-piece, which knee-piece is gibbed to one side of the sleeve, and has a traverse of 5″ on the sleeve. It is operated up or down by a hand-wheel with bevel-gears and screw. The table is 18″ × 10″, and has T-slots running both ways in the top. It has a longitudinal traverse of 18″, with a lateral adjustment of cutter-spindle across it of 5″, obtained by a screw and hand-wheel at the right hand of the cutter-spindle. It has self-adjustable, automatic feed. The extreme distance between the top of the table and the center of the cutter is 14″. The table can be set at any angle with the cutter, and, with the help of a pair of rotary centers, twist-drills or spiral-cutters can be milled. By means of the swinging sleeve true circles of greater or less diameter can be milled on the face of the work.

See also: —

Gun work, *Bement* . .	* "*Engineering*," xxii. 179.
	* "*Scientific American Sup.*," 675
Brainerd	* "*Scientific American Sup.*," 723.
Universal, *Britannia Co.* Br.	* "*Engineer*," xlviii. 344.
"Universal," *Brown & Sharpe*	* "*Iron Age*," xx., Oct. 11, p. 1.
Brown & Sharpe . .	* *Thurston's* "*Vienna Rep.*," ii. 234.
	* "*Scientific American*," xxxv. 15.
Steam chest seats. *Campbell*	* "*Mining & Sc. Press*," xxxv. 73.
Steam chests, *Campbell*	* "*Scientific Amer.*," xxxvi. 322.
Universal, *Greenwood & Batley*, Br.	* "*Engineering*," xxvii. 375.
Greenwood & Batley, Engl.	* "*Scientific American*," xl. 386
Hand	Fig. 1306, p. 433, *supra*.
Lawrence	* "*Engineer*," xlii. 364.
For lathes, *Main* . . .	* "*Scientific American*," xli. 38.
	* "*Scientific American*," xxxv. 271.
Newton & Co. . . .	* "*Am. Man.*," Jan. 31, 1879, p. 13.
Pratt & Whitney . .	* *Thurston's* "*Vienna Rep.*," ii. 223.
Tanite	* "*Sc. American*," Oct. 31, 1874.
Universal, Br.	* "*Engineering*," xxix. 155.

Mill′-run. (*Mining.*) A test of a quantity of ore run, after reduction.

Mill′stone.

A report on millstones was made by *J. M. Safford*, "*Centennial Exhibition Reports*," Group I., vol. iii., p. 176 *et seq.* See elaborate article * by Prof. Horsford in his report from the Vienna (1873), Exhibition, pp. 36–42, vol. ii.

See also: *Truax* . . .	* "*American Miller*," iv. 21.
	* "*Scientific Amer.*," xxxiv. 198.
Bolting, *Aubin* . . .	* "*American Miller*," iv. 120.
Dress, *Jones*	* "*Scientific American Sup.*," 1824.
Snavely	* "*American Miller*," v. 53.
Walker	* "*American Miller*," iv. 29.
Theory of grooves .	* "*Scientific American Sup.*," 2829.
80 illustrations . . .	* Figs. 3156, 3157, pp. 1443, 1444, "*Mech. Dict.*"
Dresser, diamond, *Harris*	* "*American Miller*," viii. 189.
Ellis	* "*American Miller*," viii. 106.
Benton	* "*American Miller*," viii. 187.
McFeely	* "*American Miller*," viii. 408.
Dresser. *Three Rivers Man. Co.*	* "*American Miller*," iv. 70.
Harris	* "*American Miller*," iv. 71, 91; v. 39.
Griscom & Co. . . .	* "*American Miller*," v. 121.
Exhaust, *Howland* . .	* "*American Miller*," iv. 95.
Exhaust and condenser *Swartwout*	* "*American Miller*," v. 63.
Glass	"*Scientific American Sup.*," 1940.
Millstone Lift	* "*American Miller*," viii. 490.
Setting, *Woodbury* . .	* "*American Miller*," v. 89.
Mill pick, *Lemoine* . .	* "*Scientific American*," xlii. 374.

Mill′stone A-larm′. A device to give notice when the supply of grain to the stone runs out or runs short.

See Fig. 3150, p. 1441, "*Mech. Dict.*" MILL FEEDER, *supra*.

Mill′stone Bush. See MILL BUSH, *supra*.

Mill′stone Crane. A device for lifting the runner off the bed-stone. See HOISTING SCREW, Fig. 1360, p. 460, *supra*.

Mill′stone Curb. The covering of the stones. A *husk* or *hurst*.

Mill′stone Dres′ser. 1. A machine for forming millstones; bringing them to shape. A species of stone-turning lathe.

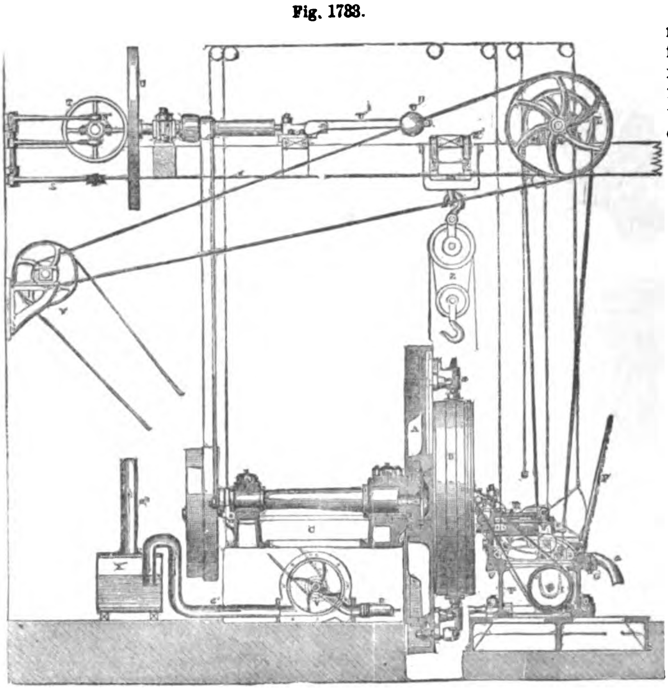
Figs. 1733–1736 show a *Rogers'* diamond tool millstone dressing machine, illustrated in the "*Bulletin de la Société d'Encouragement pour l'Industrie Nationale.*"

A is a face plate, to which the stone *B* is secured by the four clamps *a*. *C* is the bed, resting upon a masonry foundation. *D* is the rotary tool, carrying eight diamonds and revolving 3,500 turns per minute. It is mounted on a carriage, *E*, which travels across the face of the stone on slides *G*, on the support *F*. The movement of translation of the carriage is effected by the screw *H*, the rate of motion of which is proportioned to that of the stone's revolution. The diamond tool is actuated from the pulley *I* by the belt *I′*. *K* and *K′*, respectively, are fixed and loose pulleys imparting motion to the drum by means of a belt passing over the pulley *L* of the main shaft *M*. A lever, *P*, acting on pinions *P′* and *P″*, which engage in racks *Q* and *Q′*, enables the whole tool-carrying apparatus to be moved toward or from the stone, as desired. *N* is a shaft placed against a wall, which serves to set the lathe mechanism in motion, as described hereafter. On this shaft is a pulley, *T*, which transmits motion by friction to the disk *U* mounted on a shaft which is belted to the lathe arbor below. A lever, *U′*, having a counterweight, *U″*, always gives the necessary pressure to cause the contact of disk *U* and pulley *T*. This mode of transmission by friction pulley and disk imparts to the lathe arbor a variable velocity according as the tool operates upon the stone at a portion nearer to or farther from the center, so that in this way whatever part of the stone is presented to the tool, the velocity is nearly constant.

The position of the wheel *T* with relation to the disk *V* is regulated by means of the lever *S*, operated by cords *s*, which are attached to the ends of the tool carriage. A ventilator, *V*, operated by the special gearing *V′*, removes the dust produced through the tubes *v*. The air from the blower is led into a water reservoir *X*, and thence, after depositing its dust, escapes by the pipe *v″*. The traveling tackle *Z* serves to adjust the stone in the machine.

The diamond tool is separately represented in Figs. 1735 and 1736. *A* is the tool, *P* the driving pulley. Eight diamonds are mounted on the surface of the cylinder in sleeves,

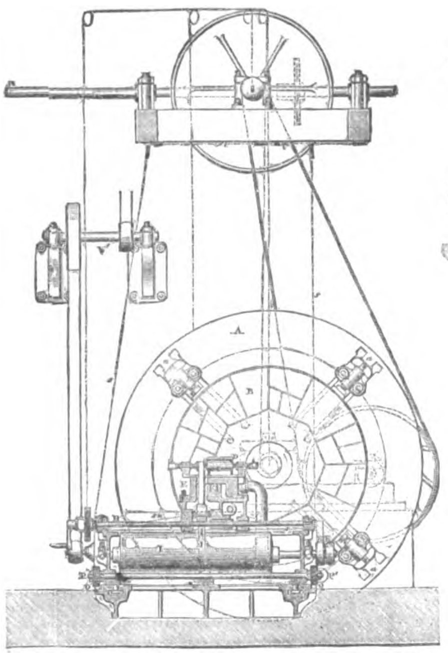
Fig. 1733.



Rogers' Millstone Dressing Machine. (*Side Elevation.*)

and in such a way that they may be caused to project more or less by means of a regulating screw. *B B'* are lubricating

Fig. 1734.



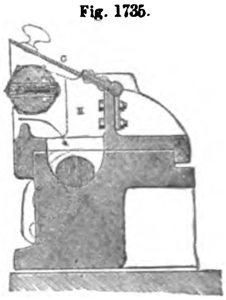
Rogers' Millstone Dressing Machine. (*Front Elevation.*)

cups, and *U* is the conduit whence dust is drawn by the ventilator from the chamber *E*, as shown by the arrows. Access is had to the tool by lifting the cover *C*.

2. A machine in which a millstone is placed while being faced. The French machine for dressing millstones by the revolving traversing diamond is shown in Fig. 1737. The cutter has a rotary motion, and also a movement of translation, on the face of the stone, parallel with the furrows; the lining being parallel on each pane.

The cutting pitch of the diamond

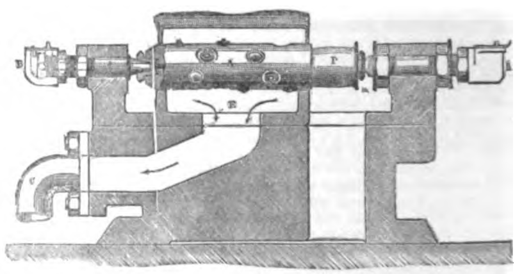
Fig. 1735.



Section of Diamond Mandrel.

is regulated by an inclined slide *H*, fixed to the cast-iron framework of the machine *I I* by the bolts *K K*. The incline of the slide is in the direction of the center of the stone, which secures uniformity in the cutting, and the inclination is regulated by means of adjustable wedges; an arrangement which secures mathematical exactness in the depth of the cut The action of the machine is similar to

Fig. 1736.



Millstone Dressing Machine. (*Enlarged View of Diamond Mandrel.*)

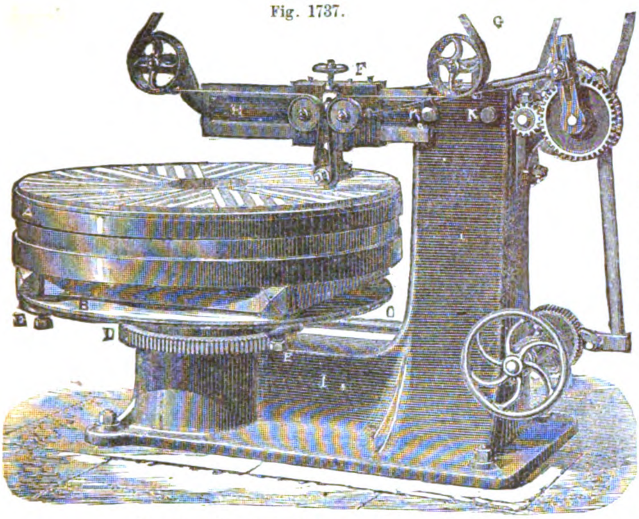
that of a milling cutter, and the course of the diamond is from the circumference to the center, and *vice versa*, the face produced on the millstone by means of the machine being partially granulated. The movement of the platform is by automatic intermittent feed connecting with pinion and master-wheel *D*. *E E* are leveling screws in the plate *B*.

The *Hodgeboom* millstone dresser is shown in Fig. 1738. The post of the machine is keyed in the eye of the millstone; whereas, in the last-mentioned instance, the stone is placed on the rotatable table of the machine. The Hodgeboom machine, however, uses wheels of 8″ diam. made of corundum with a cementing material. The wheel makes 2,000 revolutions per minute. The cross head carrying the wheel runs in covered slides with steel gib and friction rollers, and so constructed as to be impervious to the dust. The idle pulleys run on hollow spindles which are self-lubricating. The standard is in the form of a tripod and easily trammed. The cross bar is fastened to the standard by means of a face plate collar, and may be raised or lowered at will. The automatic feed is a rack bar and pinion, driven by belt, and is strong, simple, and accurate

The machine of *Hignette*, of Paris, shown at the Paris Exposition of 1878, is similarly supported on the stone, but has a rotative diamond.

Coplin's machine is on a similar principle.

Fig. 1737.



Dupety's Diamond Millstone Dressing Machine.

3. A portable machine which is laid upon the stone, and the tool reciprocated thereon to dress the working face of the stone.

The *Harris* machine employs one or more revolving diamond cutters, which are run at a speed of about 3,000 revolutions per minute, making 125 cuts to the inch the entire width of furrow, leaving the natural grit of buhrs, and the furrow true and smooth. Provision is made for dressing furrows in buhrs that run either with or against the sun, and at any angle or pitch of furrow required.

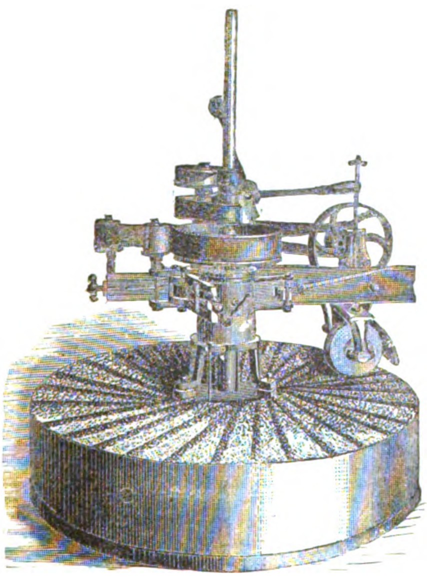
The automatic feed can be set to cut any number of cracks to the inch, from 8 to 125.

The *Larer* dressing machine has also a diamond on a carriage moving on guides.

Orff's and *McFeeley's* machines for facing and furrowing use the diamond in reciprocating carriage.

The *Griscom* buhr-dresser, Fig. 1739, shows a method of operating the diamond, which is in a carriage moving on a track, which latter occupies a segment panel in a frame which lies flatly upon the face of the stone, and is fastened by a bolt passing through the eye of the stone. Any panel on the face of the stone can be reached by the adjustment of the frame on the central bolt, and the track can be brought into parallelism with the furrow by adjustment of the central end, as a tangent to a larger or a smaller circle of which the axis of the stone is the constant center.

Fig. 1738.



Emery-wheel Millstone Dresser.

Benton's diamond millstone dresser, Fig. 1740, is designed to furrow, face, or crack, and its carriage moves in guides on a platform which is laid upon the face of the stone.

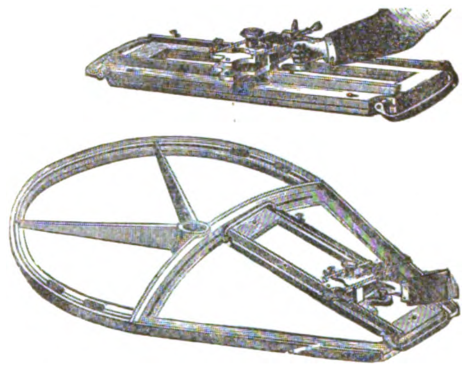
The *Harris* dresser, shown in Fig. 1741, has a carriage carrying a mill pick. This, being hinged, will make a row of cracks as the car is pushed along, and a parallel line is made by readjusting the base-piece *A*. The fore-arm of the operator rests on the pusher, and the hand grasps the pickhandle at *K*.

4. A hand tool used as means of sharpening the furrows, clearing the surface of gloss or gum, restoring the cutting quality of the buhr, etc. A *facing tool.*

Frequently a block of cemented corundum. See CORUNDUM HAND-TOOL, Fig. 701, p. 224, *supra;* FURROW RUBBER, Fig. 1120, p. 363, *Ibid.*

See: ***Benton***, **Diamond** . * "*American Miller*," viii. 358.
Coplin, emery wheel . * "*Am. Miller*," vi., May 1, 1878.
Deal, corundum block * "*American Miller*," viii. 494.

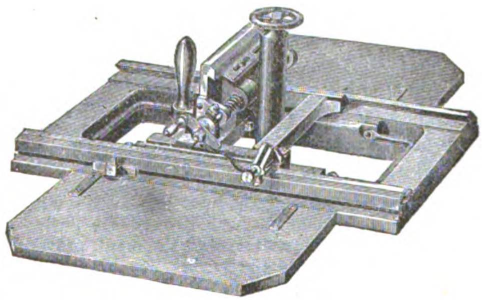
Fig. 1739.



Diamond Buhr-dresser.

Dupety, diamond . . . * "*Scientific American Sup.*," 2891.
Ellis, diamond tool . . * "*American Miller*," viii. 495.
Harris, "IXL," Diamond tool . . . . * "*American Miller*," viii. 494.
Hodgeboom . . . . . * "*Am. Miller*," iv., May, 1876.
Hoover, diamond tool . * "*American Miller*," viii. 493.
Lehman, staff . . . . * "*American Miller*," viii. 495.
McFeely, diamond . . * "*Am. Miller*," viii., opp. p. 113.

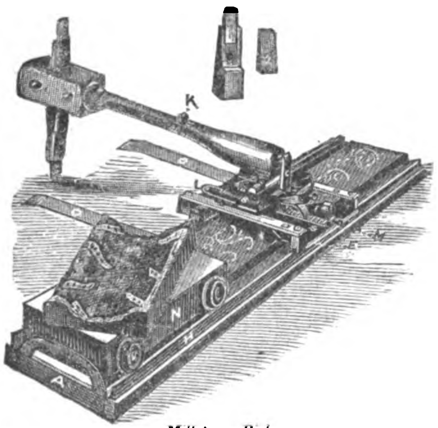
Fig. 1740.



Diamond Buhr-dresser.

Miller, rubber	* *American Miller*," viii. 490.
Millot, diamond . . .	* "*Scientific American*," xxxv. 383.
Roger, diamond . . .	* "*Scientific Amer.*," xxxviii. 5.
Suggestions	*American Miller*," viii. 435.
Teter & Allen, corundum block	* "*American Miller*," viii. 496.

Fig. 1741.

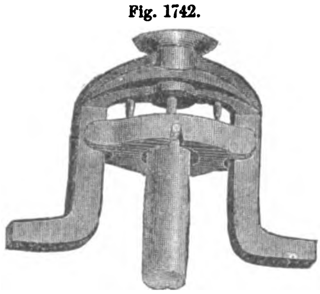


Millstone Pick.

Mill'stone Dri'ver. That device on the millstone spindle which impinges against the bail of the runner to drive the latter.

Fig. 1742 shows the *Dane* driver, which has notches to clasp the arms of the bail.

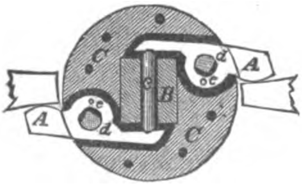
Fig. 1742.



Dane Mill-buhr Driver.

Fig. 1743 is the *Forrest* balance driver, which has lugs, *A A*, working on knife-edged pivots; these are smaller than the

Fig. 1743.



Forrest Driver.

holes which allow the lugs to move without friction against the sides of the apertures. *C* is the plate secured on spindle *B*. See BUHR DRIVER, Fig. 453, p. 143, *supra*; BALANCE RYND, Fig. 503, p. 216, "*Mech. Dict.*"; GRINDING MILL, Plate XXII., opp p. 1020, *Ibid.*; MILL DRIVER, *supra*.

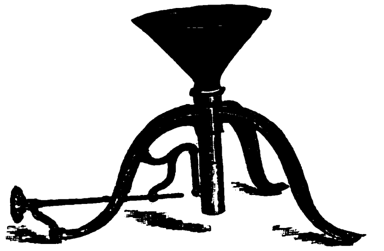
Mill'stone Ex-haust'. A means for withdrawing the air from the husk, around the periphery of the stone, in order to cool the meal, prevent choking, and expedite the work. See Figs. 3165–3167, pp. 1445, 1446, "*Mech. Dict.*"

Brubaker . . . . . . * "*American Miller*," vii. 157.

Mill'stone Feed. A means of regulating the quantity of grain fed into the eye of the millstone.

The device rests by three legs upon the husk, and the conductor leads downward into the eye. The gate is adjusted by a regulating screw. See MILL FEEDER, *supra*.

Fig. 1744.



Noyes' Millstone Feeder.

Mill'stone Fur'row-ing Ma-chine'. A machine for cutting the furrows in the face of a millstone. These are of peculiar shapes, and various contours. See Fig. 3156, p. 144, "*Mech. Dict.*" Some machines both cut and dress, furrow and face. See MILLSTONE DRESSER.

Mill'stone Hoist. See HOISTING SCREW, Fig. 136, p. 460, *supra*.

Mill'stone Spin'dle. See MILL DRIVER, *supra*.

Mill'stone Ven'ti-la'tor. A device for forcing a current of air in at the eye of a millstone and carrying it out at the skirt. See Figs. 3163–3167, pp. 1445, 1446, "*Mech. Dict.*"

Min'cing Knife. (*Whaling.*) For cutting the blubber into small pieces.

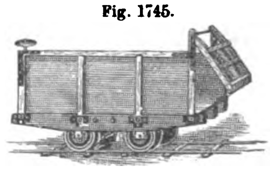
Domestic; disk blade . . * "*Iron Age*," xix., Feb. 22, p. 11.

Min'cing Ma-chine'. A machine with knives on a roller, used in cutting blubber small for trying.

Min'cing Spade. (*Whaling.*) Used in cutting up the blubber for trying out.

Mine Car. (*Railway.*) A small four-wheeled car for carrying minerals in mines.

Fig. 1745.

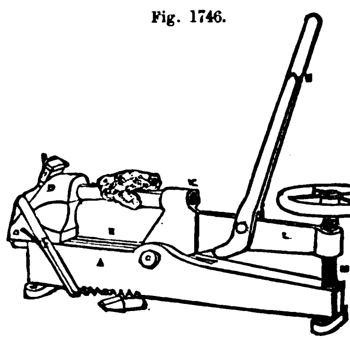


Mine Car.

Mine Lo'co-mo'tive. See MINING LOCOMOTIVE.

Min'e-ral Dres'ser. A little machine consisting of a pair of chisels, one of which is adjustable and the other movable; used to split geological

Fig. 1746.



Mineral Dresser.

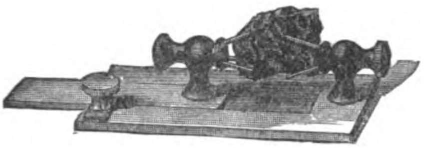
specimens with certainty, in removing superfluous portions, or exposing crystals or fossils.

The bed, *A*, has a chisel head, *B*, fastened by a link; the other chisel is on a head, *K*, moved by bar *H* and lever *L*. The screw, *M*, gives a shearing action.

Canfield . * "*Engineering and Mining Journal*," xxii. 188.
* "*Iron Age*," xvii., June 8, p. 1.

Min'e-ral Hold'er. (*Microscopy.*) A means for holding a rough piece of mineral so that it can

Fig. 1747.



Mineral Holder.

be readily revolved while under examination with the microscope.

Min'e-ral Wool. (*Glass.*) Filamentous slag made by a steam blast on a falling stream of melted slag from an iron furnace.

The "hair of Pélé," the effect of the eddying gusts of wind upon the spray pellets of the masses of slag ejected from the crater of Kilauea, is a natural and constantly produced material of the same character as the artificial slag wool.

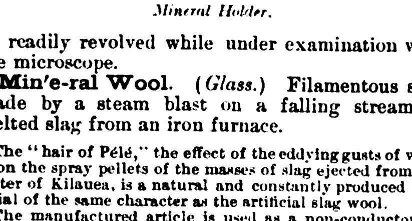
The manufactured article is used as a non-conductor, to prevent freezing of water-pipes, tanks, etc.; to prevent cooling of steam-pipes, boilers, cylinders, etc.; to prevent dampness, to keep out vermin, and to prevent the spread of fire, it being incombustible. It is formed by allowing a blast or jet of air or steam to impinge upon the surface of molten slag, which is thereby blown into filaments, producing a light material having a glassy fiber.

Player's U. S. Patent, May 31, 1870. Re-issued February 1, 1876.

The method of manufacture at the Krupp Works, Essen, Prussia, is as follows: The pig-iron furnace is provided with a tap an inch in diameter, out of which a continual stream of slag is allowed to flow, and to fall a distance of 2′ 6″, at which point the falling stream of slag is met by a strong blast of cold air, the effect of which is to separate the slag into myriads of hair-like threads, as white as snow, resembling the finest wool.

Fig. 1748 shows the method adopted at the Clove Furnace, Orange Co., N. Y. The wool-house is 100′ from the furnace.

Fig. 1748.



Mineral Wool Apparatus.

The slag is run into box cars, rolled to the wool-house, and there tapped. A small stream issues on to the runner, falls 3½″, and is then encountered by a jet of steam which scatters it in threads into the house, which is 30′ × 40′, and 21′ to the comb. A sheet-iron extension 10′ long reaches to the slag car. The size of the nozzle has an important bearing upon the formation of *shot*, as the pellets of slag are termed.

See:	. . . . . .	"*Man. & Builder*," ix. 42; * x. 5.
Roof lining	. . . . .	"*Iron Age*," xxi., May 16, p. 18.
	*	"*Scientific Amer.*," xxxviii. 278.
Uses of	. . . . . .	"*Am. Man.*," March 19, 1880, p. 7; April 2, 1880, p. 12.

Mi'ner's Bar. A crow-bar with narrow and relatively wide chisel ends at the respective extremities.

Mi'ner's Forge. A portable forge for use in a mine, to dress picks, etc. See PORTABLE FORGE, and references *passim*.

Mi'ner's Inch. The term is somewhat arbitrary, the value varying in different localities.

Customary: The amount of water flowing in one second through an orifice an inch square, under a head of 6″, measuring from the upper line of the orifice. Approximately, 9 to 10 ounces by weight per second.

"In round numbers, the miner's inch is equivalent to a discharge of 95 cubic feet per hour; one cubic foot is 7½ gallons. A miner's inch would equal a discharge of 712.5 gallons per hour." — "*Mining and Scientific Press*," xxxvii. 152.

See also *Ibid.*, xxxv. 297.

Mi'ning. See:—

Cages, wire-rope connections for, *Baumann*, Ger.	*	"*Engineering*," xxx. 118.
Comstock Code	*	"*Scientific American Sup.*," 1158.
Miner's inch		"*Min. & Sc. Press*," xxxvii. 152.
Deep		"*Scientific American Sup.*," 2681.
Dial, *Davis & Cochrane*	*	"*Engineering*," xxii. 111.
Engine, Portable, *Garrett*, Br.	*	"*Engineering*," xxvii. 573.
Tuxford, Br.	*	"*Sc. American*," xxxvii. 134.
Dump, *Lee Bros.*	*	"*Iron Age*," xxiii., May 1, p. 11.
Locomotive, narrow gage. *Lewin*, Br.	*	"*Engineering*," xxv. 45.
Locomotives, Austria	*	"*Engineering*," xxv. 507.
Mach., *Dubois & François*	*	"*Iron Age*," xxii., Sept. 26, p. 1.
		"*Scientific American Sup.*," 980.
Machinery, heavy		"*Scientific American Sup.*," 1859.
Machine, *Lechner*	*	"*Scientific Amer.*," xxxix. 102.
Pump, *Blake*	*	"*Manufacturer & Builder*," x. 193.
	*	"*Scientific American Sup.*," 994.
Cope & Maxwell	*	"*Mining & Sc. Press*," xxxvi. 17.
Gould & Curry mine		"*Min. & Sc. Press*," xxxiv. 266.
Knowles	*	"*Scientific American*," xxxiv. 51.
Pumps, mode of operating, *Moore & Dickey*	*	"*Scientific American*," xlii. 338.
Pump, *Silver*	*	"*Scientific American Sup.*," 353.
Shafts, sinking. *Kind-Chaudron*		"*Scientific American Sup.*," 1041.
Depth of European		"*Iron Age*," xix., June 14, p. 1.
Ventil. (Cleveland, Eng.)		"*Scientific American Sup.*," 107.
		"*Scientific American Sup.*," 346.
	*	"*Scientific American Sup.*," 1112.
Root	*	"*Scientific American Sup.*," 1315.
Wedge	*	"*Scientific American Sup.*," 1907.

Treatise on the applications of electricity to the firing of charges, mines, torpedoes, etc *Comte du Moncel's* "*Exposé des Application de l'Electricite*," v. 582-638. Paris, 1878.

Mi'ning En'gine. 1. A hauling engine for subterranean work in drifts and adits.

2. A hoisting engine in shafts.

3. A pumping engine to clear mines of water.

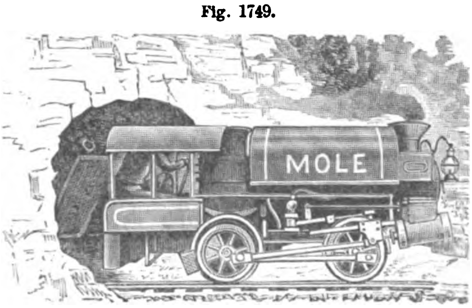
4. A mining locomotive.

Many instances are given under special names.

Mi'ning Lo'co-mo'tive. A narrow-gage locomotive built compactly, and of moderate height, to traverse the drifts of mines.

While there is much variation as to gage, number of dri-

Fig. 1749.



Mining Locomotive.

vers, weight, power, etc., the size of that shown in Fig. 1749 is within the ranges

Cylinders, diameter	5″ to 9″.
Stroke	10″ to 14″.

Diameter of drivers	22″ to 28″.
Wheel base	4′ to 5.25′.
Length over all	10′ to 15.1′.
Height	5′ to 0.5′.
Weight (running)	7,000 to 20,000 lbs.
Hauling capacity on level . .	175 to 500 tons.

See list under LOCOMOTIVE; NARROW-GAGE LOCOMOTIVE.

Mi'ning Wedge. A gad for driving into a natural seam, or a channel cut or bored, to split off a mass of coal, or what not.

A wedge for bringing down coal, on the principle of the plug-and-feather, is shown in * "*Scientific American Supplement*," 1907.

Min'now Pro-pel'ler. A bait for trolling, having a bright *spoon* which rotates by contact with the water. Behind the propeller is a feather bait with hooks. Fig. 1750 shows Chapman's minnow propeller.

Fig. 1750.

Minnow Propeller.

Min'ute Clock. A stop clock used in making tests of gas.

Goodwin's "*Amer. Gas-light Journal*," * July 3, 1876, p. 7.
Minute clock, comb. with meter and gas index, *Ibid.*, p. 7.

Mir'ror. See pp. 1452, 1453, "*Mech. Dict.*"

(*Surgical.*) To reflect light into a cavity, as the larynx, the meatus auditorius, the eye, the rectum. The laryngoscope, endoscope, ophthalmoscope, etc., use mirrors.

See also: —

Mirror barometer . . .	* "*Scientific American Sup.*," 2847.
Folding, *McEvoy* . . .	* "*Scientific American*," xlii. 354.
Holder, *Webb & Myrick* .	* "*Scientific American*," xliii. 403.
Japanese magic, *Mallet* .	* "*Engineer*," xlvii. 307.
Japanese	* "*Scientific American*," xl. 280.
Japanese magic . . .	"*Sc. Am. Sup.*," 1326, 2654, * 2847.
Manufacture, silver . .	"*Scientific American*," xxxv. 35.
Mercury	* "*Scientific American Sup.*," 574.
Mirror telegraph . . .	"*Scientific Amer.*," xxxix. 310.

See also POLEMOSCOPE.

Mir'ror Gal'va-nom'e-ter. An instrument for measuring the deflection of the astatic needle under conditions of electric excitement. A mirror is attached to the needle, and the reflected pencil of light becomes as it were a pointer traversing a scale.

The first use of a mirror attached to a moving body to indicate angular displacements was by Galileo in a pulsometer, the small mirror being laid on the pulse, the beam of reflected light was received on a wall or screen. See *Sphygmograph*.

"*Engineering*," vol. xxiv., p. 346, refers to the application of the idea by Gauss, in a telescope or eye-piece, and by Tyndall in his lectures, in throwing upon a screen the image of a dial and needle of an ordinary astatic galvanometer. See also "*Engineering*," xxii. 115.

Mr. Charles Brook used the mirror in his photographic self-recording galvanometers, in 1851, to reflect a spot of light upon a moving strip of sensitized paper.

Sir William Thomson used the spot of light, thus reflected, on an index traversing a scale, in his sub-oceanic telegraph instruments, *b*, Fig. 2150, p. 939, "*Mech. Dict.*"

See also instruments by W. J. Wilson and Prof. Silvanus P. Thomson, described in "*Engineering*" above cited. Also paper by Judd, "*Journal Society Telegraphic Engineers*," v. 248.

Mi'ter. A scribe or guide for an oblique cut. The term *miter* may be held to include only the angle of 45°, the half of the rectangle, and the *bevel* to refer to chamfers or oblique angles generally. The custom, however, is not absolute.

Fig. 1751 is a combination instrument consisting of a rule, square and miter, capable of many uses.

Fig. 1751.

Iron Frame Miter and Square.

Mi'ter Board. A miter box in which a piece is laid while the saw reciprocates between guides which cause it to make the kerf at the prescribed angle.

In Stevens's miter-board, Fig. 1752, one of the guides is adjustable on a graduated quadrant so as to set the guide to saw at any required angle with the base.

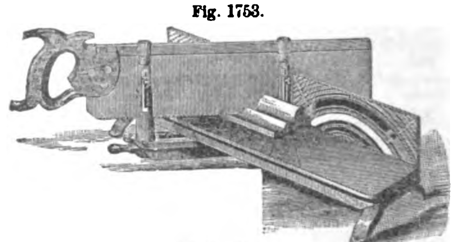
Fig. 1752.

Miter Board.

Mi'ter Box. A tool with a bed and a fence, against which, as a base, an object is held, while a saw working in guides makes a kerf at any determined angle.

In the Langdon miter box, Fig. 1753, this angle is adjustable, one of the guides being set in accordance with the scribe lines on the bed.

Fig. 1753.

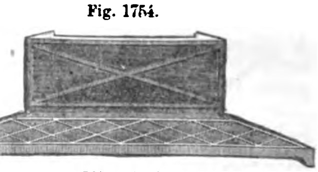


Miter Box.

Mi'ter-box Saw. A wide-bladed tenon saw for cutting miters. See Fig. 1753.

Mi'ter Jack. A templet used in making and fitting all kinds of small miters on moldings. Fig. 1754.

Fig. 1754.



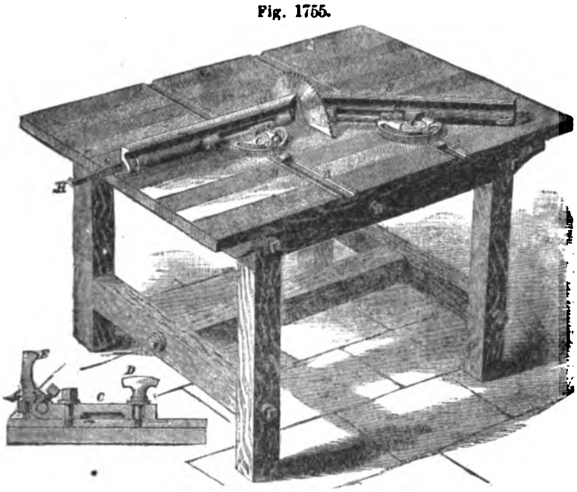
Miter Jack.

Mi'ter-ing Ma-chine'. A machine on which stuff is sawed to a determined angle. Its most frequent use is to saw off the ends of pieces obliquely in order that they may be united to form a frame. The uses are very various. See p. 1453, "*Mech. Dict.*"

The mitering machine, Fig. 1755, has a table, a circular saw, and two fences adjustable to any angle, and capable of a movement of translation across the table, in order to saw off the end of a piece of stuff held against the fence and moved toward the saw.

Miter cutter, *Fox* . . .	* "*Scientific American*," xli. 184.
Miter jack	* "*Manuf. & Builder*," x. 88.
Miter machine, *Tiernay* .	* "*Scientific Amer.*," xxxvii. 214

Fig. 1755.



Mitering Machine.

Mi-trail-leuse′. The subject has been considered on pp. 1454–1456, * "*Mech. Dict.*," where the French army, the Abbertini, and the Taylor systems are shown. See also MACHINE GUN, pp. 569, 570, *supra.*

Mixed Clay Ware. (*Ceramics.*) Ware made of portions of clay of different colors, to give various marbled or mottled effects; or to give the parts of a vase or other object different colors.

See of the former order, SCRODDLED WARE and TORTOISE-SHELL WARE.

Pâte changeant is a porcelain which has a peculiar changeable color as viewed by solar or gas-light, or at different angles.

Mix′ing Ma-chine′. 1. A machine for compounding. See list under MILL, *supra.* Also DOUGH MIXER, *Ibid.*

2. (*Gunpowder.*) A revolving hollow copper drum with interior spokes to mix a batch of the dry materials; say 50 lbs. in all, at one operation.

See "*Ordnance Report*," 1879, Appendix I., Plate II., Fig. 4; and description on p. 99.

Gunpowder, Fr.	* "*Engineering*," xxxv. 37.
And grinding pan, *Mather*, Br.	* "*Engineering*," xxix. 205.
And knead., *Pfleiderer*, Br. .	* "*Engineering*," xxviii. 483.
Pottery clay	* *Laboulaye's* "*Dict.*," iii., "*Poterie*," Figs. 2163–2166.

Mod′el-ing Clay. Dry clay kneaded with glycerine.

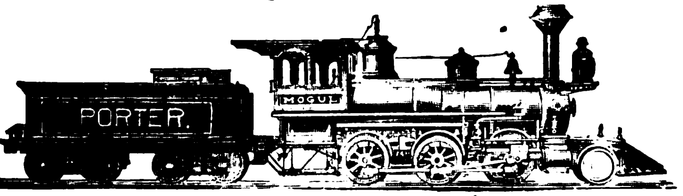
Plastilina: Clay, 3; sulphur, 6; oxide of zinc, 1; fatty acids, 2; fats, 10. First saponify the zinc white with oleic acid, which then mix with the other fatty acids, add sulphur in flowers, and the clay in a dry powder.

Or: Glue, 8, with zinc oxide, 1; add oleic oil, 4; wax, 2; sulphur, 6; clay, 3.

Mo-gul′. The name of a class of locomotives adapted for heavy freight traffic. It originated in the Baldwin Locomotive Works with the "E. A. Douglas," built in 1867. It is made in several sizes, but with the typical three pairs of connected drivers and a swinging pony truck in front.

Utilizing, as it does, nearly the entire weight of the engine for adhesion, the main and back pairs of driving wheels being equalized together, as also the front driving wheels and the pony wheels, and the construction of the engine, with swing truck and one pair of driving wheels without flanges, allowing it to pass short curves without difficulty, the *Mogul* is generally accepted as a type of engine especially adapted to the economical working of heavy-freight traffic.

Fig. 1756.



Mogul Locomotive.

Mo′hair.

"Mohair, the fleece of the Angora [Asia Minor] goat, is not a mere substitute for wool, but occupies its own place in the textile fabrics. It has the aspect, feel, and luster of silk, without its suppleness. It differs materially from wool in the want of the felting quality; so that the stuffs made of it have the fibers distinctly separated, and are always brilliant. On account of the stiffness of the fiber, it is rarely woven alone; that is, when it is used for the filling, the warp is usually of cotton, silk, or wool, or the reverse. The distinguishing qualities of the fiber are luster, elasticity, and durability. These qualities fit the material for its chief use, — the manufacture of *Utrecht velvets*, commonly called *furniture plush*, the finest qualities of which are composed principally of mohair, the pile being formed of mohair warps, which are cut in the same manner as silk warps in velvet." — *Hayes'* "*Centennial Reports*," v. 78.

See also *Hayes'* "*The Angora Goat: its Origin, Culture, and Products*," published in vol. xi. of the "*Proceedings of the Boston Natural History Society.*"

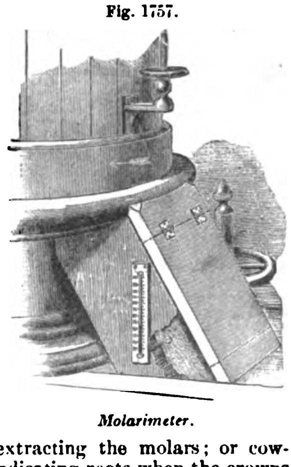
Mo′hair Gla-cé′. (*Fabric.*) A goat's-hair and cotton French dress goods.

Mo′hair Lus′ter. A black dress goods, resembling alpaca, consisting of mohair woven with cotton warp. Also called *brilliantine.*

Moist Bat′te-ry. (*Electricity.*) A battery invented by M. Trouvé, consisting of a pile of zinc and copper plates separated by paper disks; the paper in contact with the copper being saturated with a solution of sulphate of copper, and that in contact with the zinc serving to hold the zinc sulphate produced during the action of the battery.

"*Scientific American*," * xxxvii. 323.
"*Telegraphic Journal*," * v. 78.
Niaudet, Am. transl., * 112.

Fig. 1757.



Molarimeter.

Mo′lar For′-ceps. (*Dentistry.*) Heavy forceps for extracting the molars; or cow-horn forceps for eradicating roots when the crowns have decayed below the alveolar process.

Mo-la-rim′e-ter. (*Milling.*) An instrument invented by E. Campbell, for ascertaining the temperature of the meal as it flows from the mill spout. Fig. 1757.

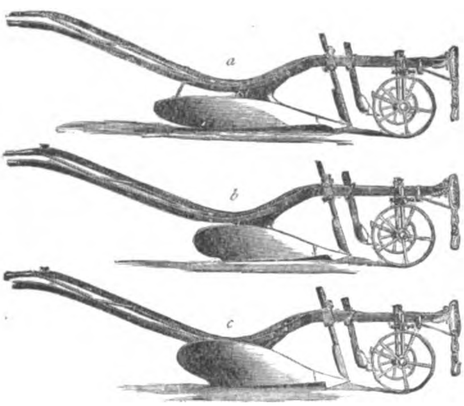
It is a thermometer with a bent leg; the bulb exposed to the flow of meal in the spout, and the graduated limb exposed to observation on the outside of the spout.

"*Leffels' Milling and Mech. News*" . . . . * viii. 85.

Mold'-board. The spiral wing on the side of a plow body, to raise, curve, and press over the furrow slice cut by the share and colter.

The following are recognized in Britain and France: —

Fig. 1758.

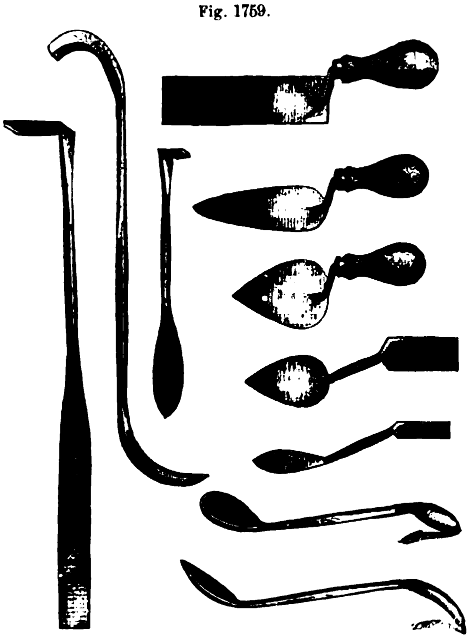


Mold-boards.

a. Long breast: *versoir allonge*.
b. Short breast: *versoir court*.
c Deep breast: *versoir profond*.
Medium breast: *versoir mixte*.
The latter is not shown in the illustration.

Mold'er's Tools. Various sizes and shapes of

Fig. 1759.

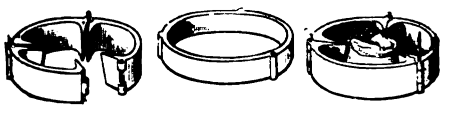


Molder's Tools.

trowels, cleaners, feeding rod, ladle, loosening bar picker, piercer, rammer, slicker, strickle, vent wire, etc.

Mold'ing Flask. (*Dentistry.*) A jointed receptacle in three parts, secured by steady pins, in

Fig. 1760.



Molding Flask.

which the vulcanite model and plaster mold are secured in making dentures ready for the muffle.

Mold'ing Ma-chine'. 1. (*Wood Working.*) A planing machine for sticking moldings on boards. See examples, pp. 1467, 1468, "*Mech. Dict.*"

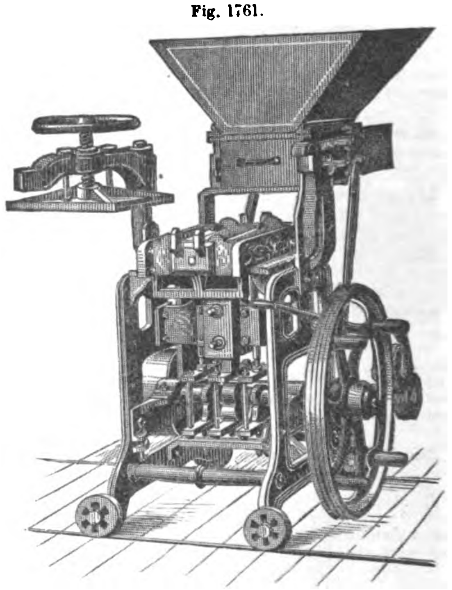
Bentel, Margedant & Co. * "*Manufact. & Builder*," viii. 151.
Houston, Smith & Co. . * "*Manufact. & Builder*," viii. 177.
Upright, *Blaisdell* . . . * "*Scientific American*," xxxvi. 86.
Paneling, *Boult* . . . * "*Scientific American*," xl. 323.
Coleman & Morton, Br. "*Iron Age*," xxiv., July 3, p. 13.
Gear wheels . . . . . * "*Iron Age*," xxiv., Oct. 9, p. 9.
Polisher, *Dayton* . . . * "*Scientific Amer.*," xxxiv. 175.
Goodell & Waters . . . * "*Manufact. & Builder*," xi. 52.
Richards . . . . . . * "*Engineering*," xxv. 261.
Richards & Atkinson, Br. * "*Engineering*," xxviii. 224.

See also Reversing Machine, *infra*.

2. (*Foundry.*) A machine for making loam molds from patterns. See Figs. 3195, 3196, 3202, pp. 1466–1468, "*Mech. Dict.*"

Aiken & Drummond's machine is shown in Fig. 1761. The ordinary snap or iron flask is used. The pattern is forced

Fig. 1761.



Foundry Molding-machine.

down into the sand, making a compact face, and a soft back for the escape of the gases. The flask being put in place, the sand is dropped into it from the hopper, the pattern adjusted, platen brought over, pressure applied, relieved, the pattern withdrawn, flask closed and removed.

The match machine, for foundry use, is made with a plunger and follower, the patterns being attached to an independent head, which is fitted to rest on the plunger head. Metal plates are fitted to surround the patterns, and are attached to the follower-head. The follower and pattern-heads work independent of each other in a box, which serves as a guide and gage for the proper amount of sand to supply the reduction in compression. On this box adjustable pins and sockets are placed to hold flasks. The sand hopper is furnished with a drawer having an independent bottom. When the drawer is pulled out, it leaves the bottom at the edge of the flask, where it passes over and deposits the sand. It is then retracted, striking off the surplus sand, and engaging the bottom at the proper place, carries all back into the hopper. A swinging binder-plate is then brought over, and holds the flask in place to resist the pressure, while the revolving of the shaft, on which is a series of cams, raises the pattern-head and follower simultaneously, forcing the patterns and sand into the flask, and as the shaft continues its revolution the patterns are withdrawn from the mold, while the molded sand is protected by the follower plate, which is afterward withdrawn, leaving the mold complete and ready to be carried away. The match molders are intended to mold for such castings as gas, steam, and water-pipe, fittings, cocks, valves, and other plumbers' goods, household and carriage hardware, etc.

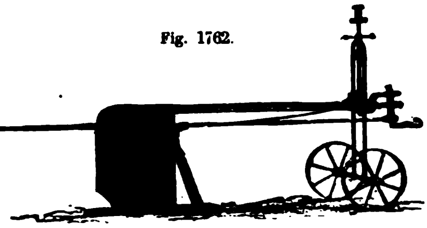
Molding mach., founder's

Aiken & Drummond .	* "*Iron Age*," xxi., April 4, p. 1.
Pipe, *McNeal & Archer* .	* "*Iron Age*," xxi., May 2, p. 6.
Gelatine for plaster . .	"*Scientific American Sup.*," 2080.
Foundry, *Sebold & Neff*	* "*Scientific American Sup.*," 3918.
Woolnough & Dehue .	* "*Engineering*," xxix. 355.

Mole Plow. (*Agriculture.*) An implement which makes an underground channel for water to follow and relieve the soil.

Instances are shown on p. 1469, "*Mech. Dict.*" The French mole plow, shown in Fig. 1762, has a wide, deep, and thin

Fig. 1762.



French Mole Plow.

plate which connects the mole with the beam and makes but a narrow incision in the soil.

Mon'o-gram Ma-chine'. A foot press for stamping monograms, initials, sizes, etc., on paper or manufactured articles.

Mon'i-tor Car. (*Railway.*) One with a clear-story or central elevation above the surrounding portions of the roof.

Monk'ey Wheel. A simple tackle-block over which a hoisting rope runs. A *whip-gin, gin-block,* or *rubbish pulley.*

Mon'ni-er Pro'cess. (*Metallurgy.*) A process of reduction of auriferous copper ores.

It consists, substantially, as follows: 1. Calcination of the metallic sulphides with a portion of sulphate of soda, or other similar salt. 2. Lixiviation of the calcined ore. 3. Evaporation and crystallization of the sulphates. 4. Reduction of the sulphate of copper. 5. Smelting into ingot copper. 6. Amalgamation of any gold residuum. The working details are explained at length in "*Mining & Sc. Press.*"

Mon'o-lith. See statement and instances, "*Mech. Dict.*," p. 1473.

A block of sandstone at the Dark Hollow Stone Quarry, near Bedford, Ohio, was lifted April, 1880. It was 40' by 60' square, 30' deep. Estimated weight, 6,000,000 pounds. 185 slip wedges were used in detaching it. It was cut up into building stones, loading nearly 300 cars.

A block of granite, 59' long by 5½' square at the base and 3½' at the top, has been taken from the quarry of Vinalhaven. It is for the shaft of the General Wool Monument, at Troy, N. Y.

Mon'o-phote Reg'u-la'tor. (*Electricity.*) A voltaic-arc regulator adapted to but a single light on a circuit: as distinguished from *polyphote* regulator.

The current is regulated by its intensity. Traversing an electro-magnet and a voltaic arc, should it grow weak the electro-magnet weakens also, and allows the carbons to approach each other.

Foucault's and *Duboscq's* apparatus have springs to maintain the normal distance between the carbons. In *Siemens'*, *Maxim's*, *Jasper's*, *Crompton's*, *Carré's*, and others, the positive carbon holder acts by its own weight to preserve the normal distance. The regulating is done by electro-magnet or by solenoid; currents continuous or alternating, in different systems.

Mon-tag'nac Coat'ing. A fabric named from its inventor, M. Montagnac, of Sedan; also known as *cloth velvet.*

The pile of the surface is usually furnished by fibers of cashmere wool, incorporated in the yarns of the fabric, and they are straight and perpendicular to the surface, the cloth having the aspect of a silk-velvet, but with a softness peculiar to the cashmere fiber. The pile is developed on the surface by *battage*, or beating the moistened cloth with elastic rods.

Moon Knife. (*Leather.*) A circular knife, 10″ or 12″ in diameter, having a round 4″ or 5″ hole in the center to introduce the hands in working it. It is concave, presenting the form of a conical zone. The concave part is applied to the skin. The edge is turned over a little to prevent it from entering too far into the leather. It is used for shaving off the coarser, fleshy parts of the skin.

Moor'ing Swiv'el. (*Nautical.*) A link of iron in a mooring chain to allow turning without kinking. See Swivel, Fig. 6137, "*Mech. Dict.*"

Mooring anchor, *Protheroe*. Br. . . "*Engineer*," xliii. 392.

Mor'bus Cox-a'ri-us Splint. (*Surgical.*) One for diseases of the hip joint. It requires an extension apparatus, and in some approved forms consists also of a pelvic band, perineal strap, knee cap, and foot-piece.

Fig. 1763.

Morbus Coxarius Splint.

Sayres' long splint, for hip-joint disease, Fig. 175, p. 111.
Andrews' morbus coxarius splint, Fig. 191, p. 126.
Holthouse's spiral spring extender, Fig. 145, p. 89.
Hutchison's hip-joint apparatus, Fig. 89, p. 47.
Bauer's hip-joint apparatus, Fig. 85, p. 48.
Hamilton's wire-gauze splint, Fig. 84 *a, b,* p. 43.
Davis' hip-joint splint, Fig. 81, p. 41.
Sayers' short hip-joint apparatus, Fig. 82, p. 42.
All in *Tiemann's* "*Armamentarium Chirurgicum.*"
Dr. *Stephen Smith's* morbus coxarius apparatus throws the extension or weight upon the gluteal muscles. See also Leg Support, etc.

Mor'tar. 1. A cement. See p. 1477, "*Mech. Dict.*"

Black brick and Black mortar. — Brick becomes black through the process of baking when the brick clay has been mixed with either the protoxide of iron, the oxide of cobalt, or the peroxide of manganese; 1 part of the iron or manganese to 10 of clay is sufficient. Sometimes two or three of these ingredients are used together. To make black mortar, mix the lime with fine anthracite coal-dust instead of sand.

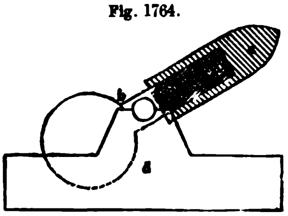
Sawdust instead of hair used as a bond in French mortar: cement, 1, lime, 2; sawdust, 2; sharp sand, 5.

Selenitic Mortar: Sulphate of lime or sulphuric acid is mixed with the water, and ground to (for 4 minutes) a thin paste; add sand or burned clay, and continue the grinding for 10 minutes. The mortar sets quickly; is very tenacious; resists great pressure. — *Col. Scott.* London "*Mech. Magazine.*"

See: Mortar? What is .	"*Building News*"; "*Van Nostrand's Mag.*," xxiii. 413.
"*Mortier*"	*Laboulaye's* "*Dict.*," iv., ed. 1877.
Mixer, steam, *Barrows & Stewart*, Engl. . . .	"*Scientific American Sup.*," 389.
Poole & Hunt . . .	* "*Manuf. and Builder*," x. 31.
	* "*Min. and Sc. Press*," xxxvi. 369.
Mill and engine, portable, *Barrows & Stewart*, Br.	* "*Engineer*," xlii. 272.
Mill, *Ward*, Br. . . .	* "*Engineering*," xxi. 77.
Portable, *Llewellyn & Cubitt*, Br. . . .	* "*Engineering*," xxiii. 428.

2. A form of ordnance, p. 1488, *"Mech. Dict."*

Fig. 1764.



Mortar.

a. Projectile in section.
b. Mortar.
c. Powder chamber.
d. Bed.

Fig. 1764 is a section of a small Austrian rifle mortar in which the projectile covers the outer part of the mortar. The embraced portion is a hexagonal spiral, like a Whitworth bolt, and the projectile is of corresponding shape, and fits it like a cap, and slips off when fired. The counterbalance, *b*, is to give preponderance to the rear of the trunnions.

Prussian rifled mortar of 21 cm. *"Ordnance Report,"* 1878, Appendix L., p. 93, and Plate VII. *a*, Fig. 8.

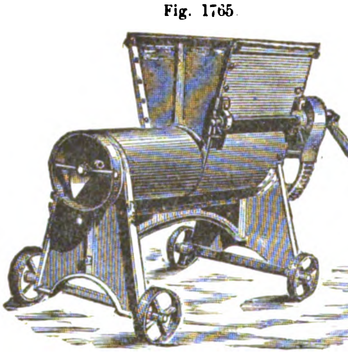
Mor'tar Car'riage. (*Military.*) The distinction between cannon and mortar carriages has been less marked since the mortar has been lengthened, rifled, and used for direct and curved fire, with solid and hollow shot, as well as shell.

Mortar carriages of modern form, Austrian, German, Krupp's, and Russian, are to be found in Plates XLI.-XLV., *"Ordnance Report,"* 1877.
Russian rifled mortar and carriage, *Ibid.*, p. 521, and Fig. 12.
See also: *"Scientific American Supplement"* . . 514.

Mor'tar Mix'ing Mill. A mill for intimately mixing the ingredients of mortar. Figs. 3230, 3231, p. 1480, *"Mech. Dict."*

Reynolds, London, portable mortar mill is shown in Fig. 1765. It is hand-worked, and is moved to the building spot.

Fig. 1765.



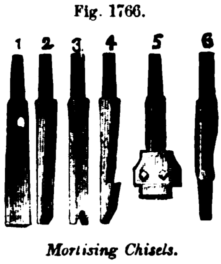
Mortar Mixing Mill (English).

The hopper being filled with the materials, the spindle in the center of the cylinder, having 14 wrought blades, is set in motion by the handle, and the mortar is ready for use when discharged from the outlet.
Mortar machine at Dunkerque and Gravelines. *"Vienna Exposition Report,"* chap. viii., Plate XVII., vol. iii., § C., p. 59.
See also Béton, Cement, Concrete, Mortar, etc., *"Mech. Dict.,"* *et supra.*

Mor'tis-ing Chis'el. The chisels used in mortising machines are known as follows: —

1. Core punch.
2. Ordinary chisel.
3. Sash chisel.
4. Lip chisel.
5. Blind stile chisel, with removable cutters.
6. Hollow chisel, for making sash and door pins.
Corner chisel (not shown).

Fig. 1766.



Mortising Chisels.

Mor'tis-ing Ma-chine'. Mortising machines are divided into *reciprocating* and *rotary.*

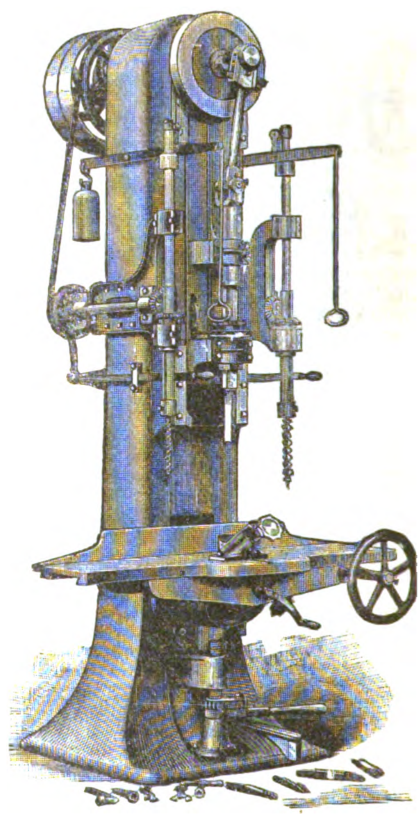
1. Reciprocating: —

a. Graduated Stroke. The chisel bar has a graduated reciprocating motion commencing from a still point, and progressing downward into the timber, returning to the starting point at each return stroke. This differs from a variable eccentric inasmuch as it requires a stroke but little longer than the depth of the mortise.
Variable cranks and eccentrics that operate the chisel-bar by an increased throw in both directions, also come under this category.
b. The chisel has a continuous motion, and the reciprocating parts, including the crank wheel, chisel-bar and connections, are brought down towards the timber, the chisel having a continuous motion, with a uniform range and positive eccentric.
c. The chisel-bar or its connection is elongated to give the stroke, the bar and chisel having a continuous reciprocating motion, but capable of being extended to the required depth of mortise.
d. Machines in which the wood is moved up to the chisel, which has a continuous reciprocating motion. The latter is the most simple when the work is light.

2. The European machines are usually rotary, the action being a species of routing, the auger cutting on the side.

The car mortising and boring machine of *H. B. Smith* is shown in Fig. 1767. It has an auxiliary boring attachment,

Fig. 1767.



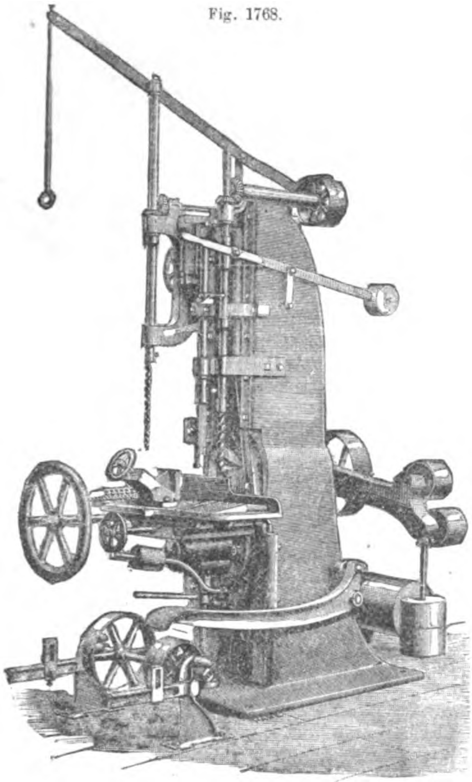
Reciprocating Car-mortising Machine.

and is intended for car and other heavy work, being capable of making a $2\frac{1}{2}''$ mortise through $12'' \times 12''$ stick of timber.
The head-stock, carrying the crank-shaft and chisel-bar, is fed down to the work by power, and has a quick return movement. Power for this purpose is taken from the crank-shaft, a lever at the base of the machine serving to apply the power for starting a screw in either direction for raising or lowering the head stock. The head-stock is stopped auto-

matically when it reaches its highest point, and an adjustable cam is provided for limiting its downward motion; so that the chisel may be made to penetrate any desired depth to 6″, an index on the frame showing to what depth it is cutting.

The table is adjustable vertically by means of a powerful screw and double ratchet lever. A rack and pinion feed is

Fig. 1768.



Reciprocating Car mortising Machine.

provided for moving the lumber horizontally under the chisel, an adjustable clamp holding it securely to the table. The table also adjusts to and from the machine and tilts for bevel work.

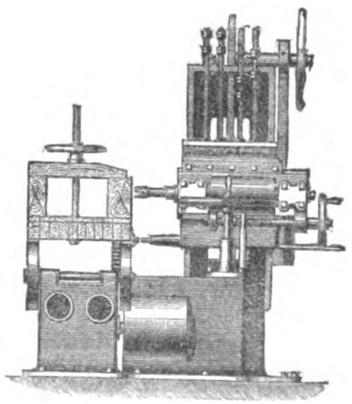
The reciprocating mortising machine of *Richards, London, & Kelley* is shown in Fig. 1768. It has also a boring spindle and auxiliary boring attachment for joint bolt-holes. It is a strong, heavy machine, especially adapted for railway-car work and similar duty. It receives chisels to any width, and has two boring spindles, one fixed and the other to traverse 12″. The feed movement is operated by treadle, and may be locked to avoid jarring the foot of the operator. The joints are compensating and operated without noise. The crank-shaft is placed in the base of the column, and the machine stands upon its base without top bracing.

See also HUB-MORTISING MACHINE, Fig. 1391, p. 472, *supra*.

Figs. 1769, 1770 are respectively side elevation and transverse vertical section of one of the rotary chisel class of mortising machines built by *Richards, London, & Kelley*, and adapted for boxing, facing, recessing, and mortising.

In machines of this class no laying out of the work is needed. A templet is placed upon the machine, and the stops are set for the position, length, and width of each mortise; after which any number of pieces are worked with-

Fig. 1770.



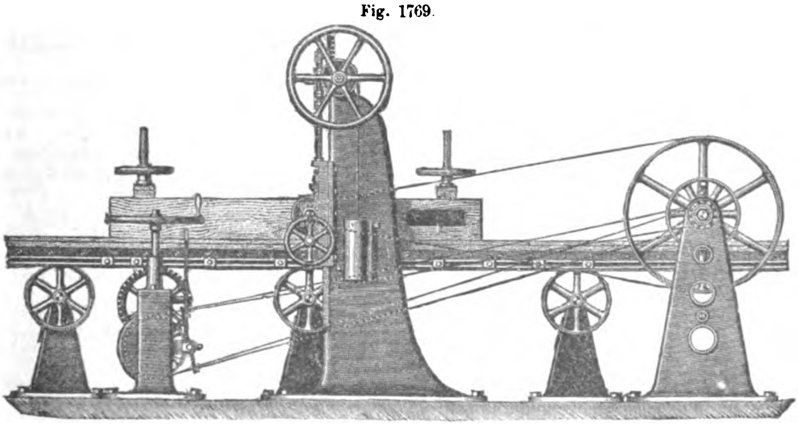
Rotary Chisel Mortising Machine. (*Transverse Vertical Section.*)

out a single mark of any kind on the timber, and without any danger of mistakes. The boxing, or facing, can be done at the same time, and with the same tools.

Fig. 1771 is an end elevation of another machine of this class, built by Ransomes (Br.). The work is clamped in a carriage which has a longitudinal reciprocation on ways for length of mortise. The chisel is a router with side-lip, and the chisel spindle passes through the driving pulley, which is splined thereon. The motion of the timber carriage is by means of the lever, which is shown erect in the view, and that of the chisel is effected by the hand-wheel which is brought conveniently near to the work.

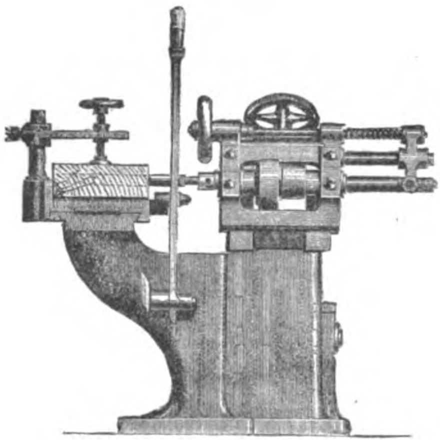
Fig. 1772 shows a combined mortising and tenoning machine. The work is dogged, as in the last-mentioned example, to a bench, which has, however, in the present case, an adjustment in either of two directions, longitudinally or transversely; the latter for the especial purpose of bringing the work within the range of the rotary tenoning cutters.

Fig. 1769.



Rotary Chisel Mortising Machine. (*Side Elevation.*)

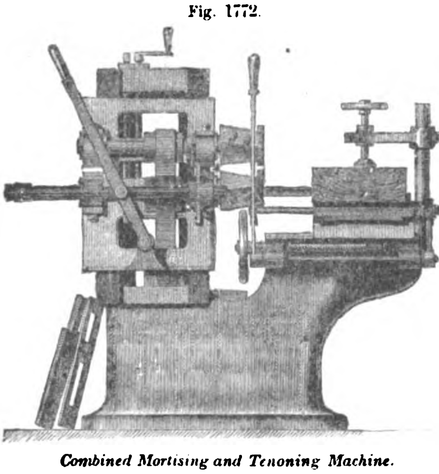
Fig. 1771.



Horizontal Mortising Machine. (Rotary Movement.)

These rotate on horizontal spindles in the upright frame, being capable of a movement of vertical translation to adjust their distance apart for making tenons of varying thickness. The lever shown in front is that by which the chisel is projected and withdrawn. The lever on the right of the one mentioned gives the longitudinal traverse of the carriage for length of mortise; or, for traversing the work past the tenon cutters, as the case may be.

Fig. 1772.



Combined Mortising and Tenoning Machine.

See: car, *Lane & Bodley* * "*Engineer*," xli. 450.
And boring, *Goodell & Co.* * "*Manuf. and Builder*," viii. 57.
Robinson, Br. . . . . * "*Engineer*," xlv. 276.
And tenoning, *Carter*, Br. * "*Engineer*," xlii. 258.
Car, *Ransome*, Br. . . * "*Engineering*," xxvi. 174.
Green . . . . . . * "*Scientific American*," xxxix. 311.
Smith . . . . * "*Scientific American*," xxxv. 114.

Mo-sa'ic Gold. 1. A yellow metal for cheap jewelry. A factitious gold. See recipes, MOSAIC GOLD, p. 1484, "*Mech. Dict.*," and ALLOYS, JEWELERS, p. 63, *Ibid.*

2. A sulphuret of tin used in bronzing frames and as a gold color for printer's work. Two recipes for the dry process are:—

Tin foil	40
Sulphur	35
Sal ammoniac	25

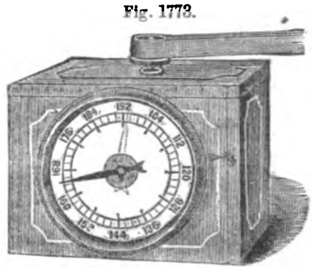
Zinc putty	80
Sulphur	60
Sal ammoniac	30

In the wet process a solution of chloride of tin is treated with sulphureted hydrogen gas.

Moth'er. The hen-mother at Baker's Cresshill poultry farm is of hollow zinc, filled with hot water and lined on the under side with blanketing.

Mo'tion In'di-ca'tor. An apparatus to indicate upon a dial the rate of revolution — per minute, for example — of the machine to which it is attached. It does away with the element of time in observation, in this respect differing from the mere *counter*. The finger on the dial stands at the figure representing the beats per the unit of time for which it is calculated and constructed. Fig. 1773 shows the Bowsher motion indicator.

Fig. 1773.



Motion Indicator.

See's motion timer, a modification of the metronome, * "*Scientific American Supplement*," 181.

Mo'to-graph'ic Re-ceiv'er. An invention of Edison, by which the volume of sound is increased in a telephonic receiver.

Called also ELECTRO-MOTOGRAPH, which see.

The vibrations of a mica diaphragm are communicated to a metallic rod, one end of which rests on a revolving cylinder with a chemically prepared surface. The contact of the cylinder and rod gives rise to friction which draws upon the diaphragm, but when an electric current passes, the friction is lessened and the diaphragm moves towards its normal position.

The current is governed by the sound waves and the motion of the receiving diaphragm also, and thus the sound waves are reproduced by the receiving instrument in augmented force.

See ELECTRO-CHEMICAL TELEPHONE, Figs. 947–950, pp. 305, 306, *supra*.

See * "*Engineer*," . . . . Nov. 23, 1877.
* "*Engineer*," . . . . xlvii. 213.
* "*English Mechanic*" . . . . xxv. 276.

Mo'to-phone. A name given by its inventor, T. A. Edison, to a small machine driven by the voice. The phonographic vibrations of a diaphragm are caused to rotate an axle by means of a stylus and ratchet wheel.

Mo'tor. A prime mover. An engine. See under various heads: AIR; STEAM; ELECTRO; HOT-AIR, etc., etc.

See: Small "Simplex."
Davey, Br. . . . . * "*Engineering*," xxx. 251.
Hydr. steam, etc., *Knecht.* * "*Scientific American*," xli. 278.
Transmitting, paper on.
Robinson, Engl. . . "*Scientific American Sup.*," 1078.

Mo'tor Print'er. A small electro-motor running a press for copying messages. An electro-motor printer. "*Scientific American Sup.*," 367.

Moul'le-ton. (*Fabric.*) A fine wool French dress goods, with a satin weave.

Moun'tain Gun. (*Ordnance.*) A light cannon capable of being transported on mule back. For this purpose it is detached from its carriage and the weight distributed among several animals.

The Ashantee gun is shown in Fig. 8242, p. 1485, "*Mech. Dict.*"

The new Woolwich mountain guns, made from the designs of Sir William Armstrong, instead of weighing merely 200 lbs., like the mountain gun used in Abyssinia and Zululand, will weigh 400 lbs. each. As, however, an essential condition of mountain artillery is that every part of it shall be carried on the backs of mules, these guns are made in two pieces, screwed together, and strengthened at the joint by a third piece in the shape of a ring or collar. The breech end of the gun when disjointed weighs 200 lbs., and the barrel with collar amounts to about the same weight, which is regarded as a fair burden for a mule over hilly country. These guns, like their smaller namesakes, are of the small caliber adopted for 7-pounder projectiles, but their greater length and weight enable them to do much more effective work.

* "*Scientific American Sup.*" . .. . 2521.

Moun'ted Pow'er. A horse power adapted to be used without dismounting. See Horse Power.

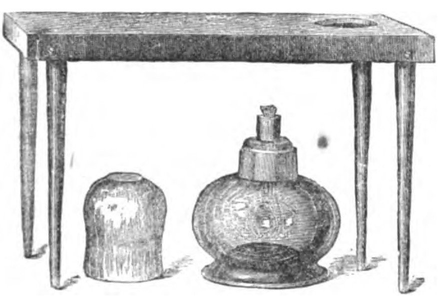
Mount'ing In'stru-ment. (*Optics.*) An instrument for pressing down glass covers on microscope slides.

Fig. 1774.

Mounting Instrument.

Mount'ing Stand. (*Optics.*) A small table sliding up and down on a brass rod or stand, or independently on its own legs, and supplied with a chamber below for holding sand for equalizing the temperature when the lamp accompanying it is applied beneath. The stand shown in Fig. 1775 has folding legs, so as to go in a microscopist's traveling case.

Fig. 1775.

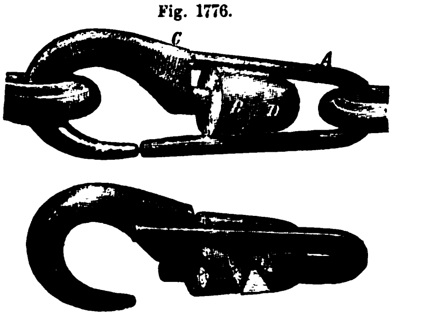


Mounting Stand.

Mouse Mill. A small electro-magnetic engine and electro static induction machine used in the siphon recorder. *Sir William Thomson, "Journal Soc. Teleg. Engineers,"* * v. 185.

It is propelled by a battery and its purpose is two-fold: (1) to generate statical electricity by means of induction wherewith to highly electrify the ink so that it may flow through the delicate capillary siphon pen. To generate the necessary electricity the drum is caused to rotate by electro-magnets, and this rotation is taken advantage of to (2) draw the paper past the point of the siphon.

Fig. 1776.



Self-locking Hook.

Mous'ing Hook. A hook having a member which normally closes the opening.

In the *Raines* mousing hook a draft upon the hook brings the mousing-arm in apposition with the point of the hook. The parts *B D* slide on each other, being respectively attached to *A* and *C*. The cut shows the device closed and open.

Mousse-line'. (*Fabric.*) A fine wool French goods, taffeta woven. *Moulleton* is woven with a satin armure.

For muslin see "*Report of East Indian Section*," Paris Exposition," p. 84.

Mousse-line' de Bège. (*Fabric.*) A French dress goods.

Mousse-line' Glass. (*Glass.*) A very thin blown-ware with ornamentation resembling the patterns of lace or printed goods.

The process is as follows: —

After carefully cleaning the surface of a plate of glass, an even layer of vitrifiable color is laid over it, with the aid of gum water. The glass is then submitted to a gentle heat until the water has evaporated, when a stencil of the desired pattern is laid over the surface, and with a stiff brush the pigment is removed from the parts which are to be transparent. The glass is next inclosed in a frame, and above it is extended a piece of tulle, or, if desired, embroidered lace, the embroidery in the latter case being so disposed as to harmonize with the ground pattern previously made. The whole is then hermetically closed in a box which contains in its lower portion a reservoir holding a certain quantity of dry color in the form of an impalpable powder. This is blown evenly upon the glass by an air-blast, adhering to it wherever the surface is not protected by the threads of lace. In this way the pattern of the latter is defined. In order to fix the powder the sheets of glass are exposed to steam, which moistens the gum and causes the powder to adhere. The color is then burnt in a special furnace. — *M. Aubriot.*

Mousseline glass was exhibited in Paris in 1878, in great beauty and variety by the "*Cristallerie de Clichy*," and by *Bandoux*, of Lodelinsart.

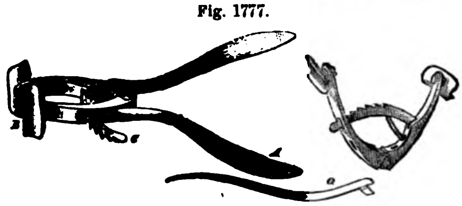
Lockert, on . . . . . . "*Technologiste*," xl. 51.

Mous-tache' Pro-tect'or. 1. (*Dentistry.*) A shield to keep the moustache out of the way of the operator during operations on the teeth.

2. A shield on a drinking cup, to keep the moustache from dipping in the liquid.

Mouth Gag. (*Surgical.*) For holding the mouth open during operations. *Speculum oris.*

Fig. 1777.



Dr. Weir's Mouth Gag.

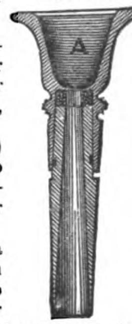
Dr. Weir's gag has two leaves with a spring catch. It is operated by two detachable handles. The illustration shows all parts and positions. See Gag, and references *passim*.

Mouth'ing Machine. (*Sheet-metal Working.*) A machine for crimping bottoms and swaging or mouthing the tops of open-top cans, to receive the covers.

Mouth Mir'ror. (*Dentistry.*) A small mirror to introduce into the mouth, to enable the observation of parts which have a rear presentation.

Mouth Piece. The lip of a wind instrument. That shown in Fig. 1778 is so constructed as to enable the performer to enlarge or contract the opening in the throat,

Fig. 1778.

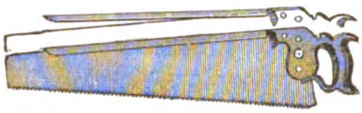


Conn's Mouth-piece.

or bottom of cup, at will, while playing, thus facilitating the reaching of the higher notes, and requiring less pressure of the lips to produce them. It has two metallic pieces with an interposed elastic ring.

Mov'a-ble-back Saw. A saw, the stiffening back of which can be removed so as to convert it from a tenon saw to an ordinary hand saw.

Fig. 1779.



Hand Saw, with Movable Back.

Mov'a-ble Dam. A barrage.

The Davis Island Dam, on the Ohio, near Pittsburg, is the first attempt to introduce the *movable* dam system into this country. The system is known as the *Chanoine*, and is in use on the rivers of France, especially the Seine and Loire. It consists of a dam formed from wickets, and so arranged that when the water is high the wickets are lowered, and boats can pass over the dam freely. When the water is low the wickets are raised, a pool is formed, and the boats pass through the locks. See BARRAGE, *supra*.

The entire length of the dam is 1200′, and two stone piers divide this into three sections of 400′ each. That section nearest the lock is called the Pass, and this, besides the other two sections, is to be closed by the movable wickets whenever the stage of water in the river is less than 6′. Each wicket is a little dam by itself, hinged so as to lift up and oppose the water, or lie down and permit the river to flow over it. Each wicket is 13′ long and 3′ 8″ wide, made of oak. They are to stand on end, side by side, across the river, with a space between each of 4″. One by one they are raised, and when raised, they are retained in rigid position by the pressure of water above and a wrought iron prop below, until a *tripping bar* is brought into play and the entire dam falls down flat on the sill.

The lock has a clear length of 600′ between the gates, and a clear width of 110′, and can hold 12′ depth of water. The gates that shut off the water at either end of this lock are each in one solid piece, 118′ long, $10\frac{1}{2}$′ wide, 14′ high, and weigh 80 tons. The openings in the lower part of the gate recesses, and for filling and emptying the lock, are $4\frac{1}{2}$′ in diameter. The filling culvert, a lofty, arched water-way, takes the water from these openings and conducts it to the lock, which is filled through 10 inlets, each 3′ × $3\frac{1}{2}$′, and 17′ below the coping. The lock has required over 11,000 cubic yards of cut stone and rubble, and 10,000 barrels of hydraulic cement.

The gates of the lock slide back into the gate recesses in the shore wall, and when in position across the lock, rest on a shoulder built in the river wall. They are operated by turbine water wheels. It is estimated that the gates can be closed or opened, and the lock filled or emptied in four minutes

Description of the new system of wickets adopted for the La Mulatière dam on the Saône, at Lyons, by A. Pasqueau, Engineer des Ponts et Chaussées. Translation in "*Report of Chief of Engineers, U. S. Army*," 1880, * ii., pp. 1753-1762.

See also the same for 1879, * ii., p. 1338.

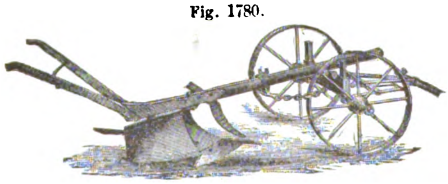
The movable dam at Poses, France, on the system of M. Caméré, is shown in the last-mentioned report, * p. 1342.

See BARRAGE, p. 76, *supra*, and Plate IV., opposite said page

At Port-à-L'Anglais, on the Seine. "*Report of Chief of Engineers, U. S. Army*," 1876, Appendix R, * p. 14 *et seq.*: in connection with the works on the Davis Island dam on the Ohio.

French . . .	"*Van Nostrand's Magazine*," xxii., 11.
Poirée system	* "*Van Nostrand's Magazine*," xviii., 339.
Chanoine . .	*Ibid*, xviii., 459–481.

Fig. 1780.



Movable Point Plow.

Mov'a-ble Point Plow. One which has a long bar the forward end of which forms the plow-point, and can be thrust forward as it becomes worn. Made by Guilleux, Segré, France.

Mow'er. The subject of mower has been considered and the history detailed on pp. 1487-1493, "*Mech. Dict.*" Plate XXX. has diagrammatic views of 40 principles of cutting; and Plates XXXI.-XXXIII., have 36 illustrations. The classification of mowers is given on p. 1488, *Ibid.*

The McCormick iron mower is shown, in company with the McCormick single-wheel reaper, in Plate XXX. opposite. The mower is a front cut, jointed bar, iron frame machine, with inclosed gearing. The smaller size, 4′ cut, weighing 580 pounds.

The frame is of cast and wrought iron, and the gearing inclosed in a cast-iron case. The draft is directly upon the cutting apparatus through a draft-rod connecting the double-tree strap to the finger-bar brace. The cutter-bar has a rolling motion given to it by a roller on the end of the long connecting pin, which works up and down in the front end of the inside shoe; by this device the bar conforms itself to the unevenness of the ground, and always cuts a close stubble

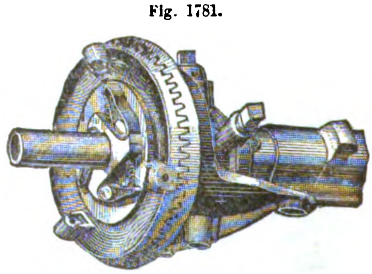
By means of the tilting lever, the points of the guards can be thrown up or down; and with the lifting lever the bar may be raised bodily from the ground, in order to pass over rocks or other obstructions; thus, through these two levers, the cutting apparatus is entirely under the control of the driver, and may be instantly changed, as occasion may demand, to suit the necessities of grass or ground.

The pitman box is light, strong, and durable; has no bolts, and yet can be quickly taken off and put on; the wrist pin has a screwed cover; the crank shaft box is bored large, so that a babbitt metal bushing is inserted, in which the shaft works; when worn, the bushing can be easily removed and replaced by a new one.

The Whiteley machine, "New Champion," is shown in Figs. 1781-1783. It is a front-cut machine, in respect of the cutter-bar being in advance of the gearing and carriage portion. The peculiarity of the machine is in the gearing.

There are practically but two pieces between the axle and the knife, one being a small bevel cog wheel secured to the axle, and the other a similar wheel made to gear into the former. This second wheel, or disk, does not rotate, however, but being hung on what is called a gimbal joint, like a ship's compass, it begins, on starting the machine, a succession of rapid serpentine vibrations around the face of the other wheel, much as a dinner plate or coin will act when rung down upon a table; and an arm extended from this vibrating disk down to the knife, gives it the required rapid, reciprocating motion. There is only one rotating bearing besides the axle on the machine, and that is not a part of the movement proper, but belongs to a small fly-wheel, which only assists in giving the required regularity and

Fig. 1781.



"New Champion" Mower. (Gearing.)

steadiness of motion. There are always 11 teeth in contact, and thus the wear is distributed over a large surface.

The finger-bar is operated and controlled by two levers, one for foot and the other for hand, and by the use of these levers either end of the finger-bar may be thrown up at any angle or to a vertical position without throwing the machine out of gear or stopping the knife. The finger-bar may also be folded and secured for transportation by the driver without leaving his seat, and by the use of the tilting lever the height of cut may be changed and controlled instantly. By the use of this lever the cut may be lowered and the points

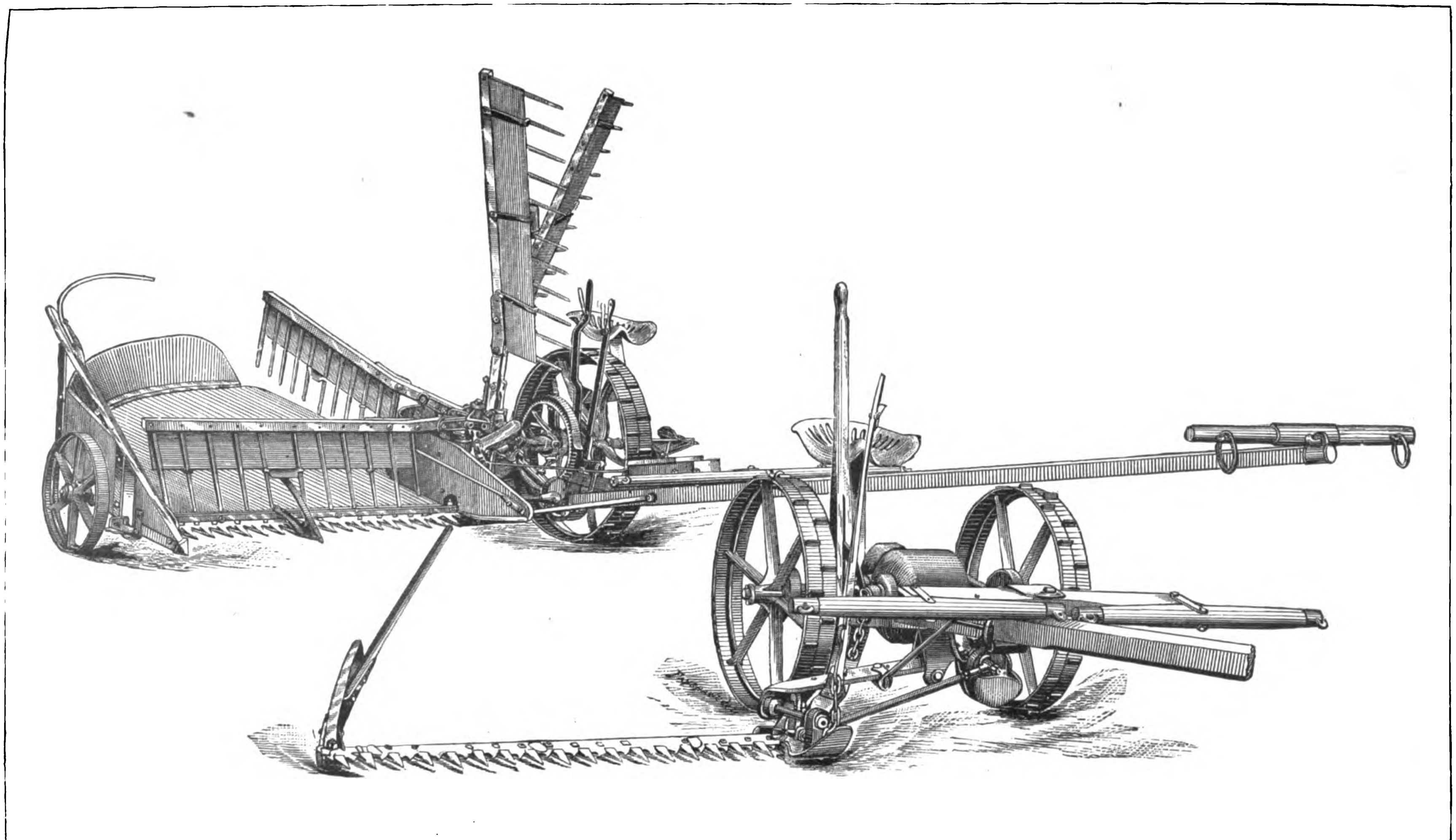
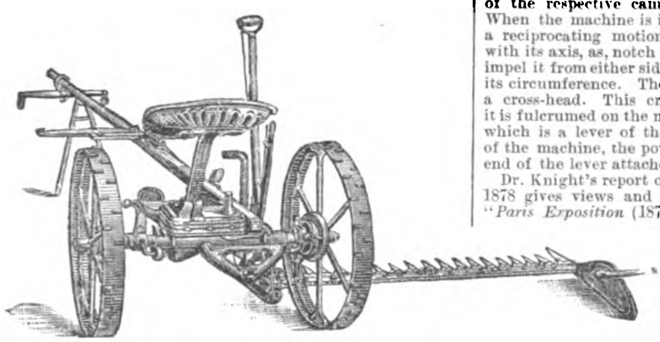


PLATE XXX. McCORMICK'S MOWER AND SINGLE-WHEEL REAPER. See page 620.

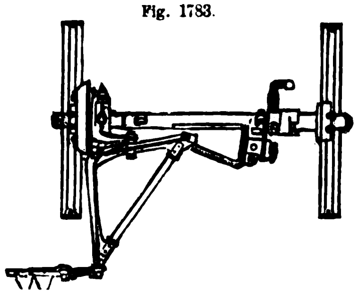
Fig. 1782.



"*New Champion*" *Mower*. (*Perspective.*)

of the guards turned down for picking up badly lodged grass, or the cut may be raised and the points of the guards turned up so as to cut high or readily pass over obstructions; or when desired, the tilting lever may be so arranged as to allow the finger-bar and guards to oscillate and perfectly follow the uneven surface of the ground. The gearing is inclosed within itself. The draft of the team is not upon the pole, but through a draft-rod directly connected to the

Fig. 1783.

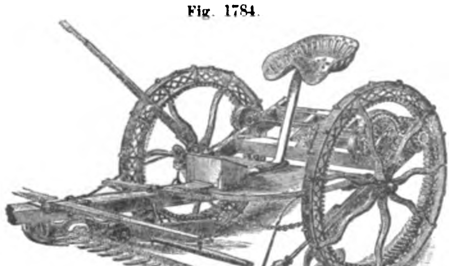


"*New Champion*" *Mower*. (*Plan.*)

cutting apparatus in such a way that a portion of the weight of the finger-bar is carried or suspended by the draft of the team.

Wilbur's "Eureka" mower is a direct draft front-cut, which cuts the grass behind the horses and in front of the running gears of the machine. One horse walks in the grass and the other upon the stubble, the double-tree being long, in order to throw one horse outside the swath, which is 6′ wide. The machine, being center-cut, is, of course, reversible, and may cut back and back, throwing the off and the near horse alternately upon the stubble.

Fig. 1784.



Eureka.

The peculiarity of the mowing machine motion of *Goodwin* is the method of converting the rotary motion of the driving wheels into the reciprocating movement of the knife without the intervention of spur gearing and without crank.

On the axle are two circular plates. These are fast to the axle, and have on their inner faces a series of inclined faces which may be termed *star-cams*. Between these two wheels is another *star-cam* which has faces on each side facing those of the respective cams between which it is sandwiched. When the machine is in motion the wheels rotate and give a reciprocating motion to the cam in a direction parallel with its axis, as, notch by notch, it slips past the cams which impel it from either side, all the faces bearing equally around its circumference. The cam is prevented from rotating by a cross-head. This cross-head is pivoted. At its butt-end it is fulcrumed on the main frame of the machine cross-head, which is a lever of the third order: fulcrumed on the frame of the machine, the power exerted by the cam and the outer end of the lever attached to the reaper knife.

Dr. Knight's report on Class 76 at the Paris Exposition of 1878 gives views and descriptions of the following. See "*Paris Exposition* (1879) *Reports*," vol. v., pp. 150-155: —

"New Champion" mower.
Whiteley . . . United States.
One-horse mower.
Walter A. Wood . United States
"New Buckeye" mower.
Aultman & Co. . United States.
"Eagle" mower.
Wm. Anson Wood, United States.
"Paragon" mower.
R. Hornsby & Sons . . England.
"La Française" mower, *J. Cumming* . . . . . France.

See also comparison of machines, Paris Exposition, *Knight*, "*Scientific American*," June 22, 1878.

For table of Dynamometrical tests, see p. 288, *supra*.

Mo′zam-bique′. (*Fabric.*) A French worsted dress goods woven on a gauze or taffeta loom. It has a cotton warp and an English combing wool weft.

Mu′ci-lage Brush. One with a reservoir in the handle, to keep the brush supplied.

Mucilage on government postage stamps: —

Dextrine	2 oz.
Acetic acid	1 oz.
Water	5 oz.
Alcohol	1 oz.
	9 oz.

Mucilage . . . . . "*Scientific American*," xxxv. 23.
"*Scientific American Sup.*," 2511.
Bottle. *Wight*. . . * "*Scientific American*," xxxiv. 246.

Muck I′ron. Crude puddled iron ready for the squeezer or rollers.

Fig. 1785.

Mucilage Brush.

Mu′cy-line. A sizing for woolen yarns.

It is composed of 18 pounds stearine, 18 pounds of soft soap, 10 pounds glycerine, ¼ ounce sulphate of zinc, and 50 pounds of water. The stearine is mixed carefully with the glycerine. The soap is then added. To this is added the water, in which the sulphate of zinc has been dissolved, amid constant kneading of the mass till a stiff and homogeneous paste is produced. For use, 32 pounds of this paste are taken and diluted with 36 pounds of water, which is used cold or warmed to 66° or 70° Fah., according to the season. The solution is filtered or clarified by decantation, and this clear liquid, which has a specific gravity of 1.025, constitutes the mucyline.

Mud′dler. A churning stick for chocolate. A smaller one for mixing toddies.

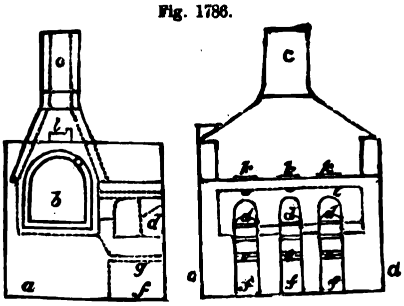
Muf′fle. (*Ceramics.*) A small furnace and chamber for baking metallic colors for pottery.

The figure shows two forms, one of them with a refractory clay chamber isolated from the fire. The other furnace has several chambers *d d*, with grating *e*, cinder holes *f f*, and openings *k k* to allow volatile matters to escape. See PORCELAIN MUFFLE, *infra*.

The other view has grating *g*, cinder hole *f*, charging hole *d*, muffle chamber *b*, escape for fumes *l*.

The fuel is exclusively wood or charcoal, the fire gentle at first and then intense. The heat is judged by practiced observation of the color of the fire or by the shades of color which the powder of cassius takes in the fire, being exposed on a removable slip of porcelain. See also PORCELAIN MUFFLE.

Fig. 1786.



Muffles for Vitrifiable Colors.

See: Faïence . . . . * "*Scientific American*," xl. 258.
For copper, *Silliman* . * "*Eng. & Min. Jour.*," xxii. 264

Muir'head Bat'te-ry. (*Electricity.*) A compounded Daniell's battery, in which the series of rectangular elements are inclosed in a tight box.

See Prescott's "*Electricity*," * p. 63; *Niaudet*, * p. 107.

Mule. A machine for drawing and twisting into yarn the roving from the roving-frame or jack-frame and winding it upon spindles in the form of cops automatically.

These machines are in two principal parts, the stationary and the movable.

The stationary parts comprise the head-stock, creels, rollers, and roller-beams for reducing the thickness of sliver. The part called the head-stock contains all the mechanism for effecting the different changes necessary for spinning.

The English mules exhibited by Dobson and Barlow at Philadelphia, were for coarse and fine counts respectively. The coarse mule contained 216 spindles, 1⅞" gage, and was arranged with double boss top rollers and single creels for spinning 1's to 50's. The fine mule contained 314 spindles, 1¼ inch gage, single boss top-rollers, creels for double roving, double speeds, supplementary stretch, roller turning motion to deliver yarn while twisting at the head-stock, faller motion to lift the fallers free from snarls, and is arranged to spin from 50's to 250's.

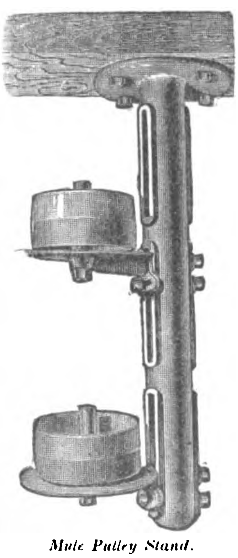
In the headstock each motion is separate and distinct from the others, is so placed as to be easy of access, and can be detached and removed without disturbing the other motions. The headstock stands very low, which gives steadiness to the working parts and enables a longer strap to be used, which is a special benefit in low mills.

The principal novelty in these mules is an improved method of working the changes, which dispenses with the well-known troublesome cam-shaft.

A long lever is placed lengthwise inside the head-stock framing and makes three changes.

The first change is made when the carriage arrives out by lifting a latch lever, the long lever rises to a second latch and detaches the drawing out motion. When the requisite turns of twist are put in, the backing off takes place, and the locking of the fallers again liberates the catch and allows the long lever to rise again, putting out of gear the backing off and putting into gear the drawing-up cone. The mule recedes inwards to the beam, and the long lever is again unlatched and falls down to its original position, disconnecting the drawing-up motion, and putting into gear the drawing-out motion.

Fig. 1787.



Mule Pulley Stand.

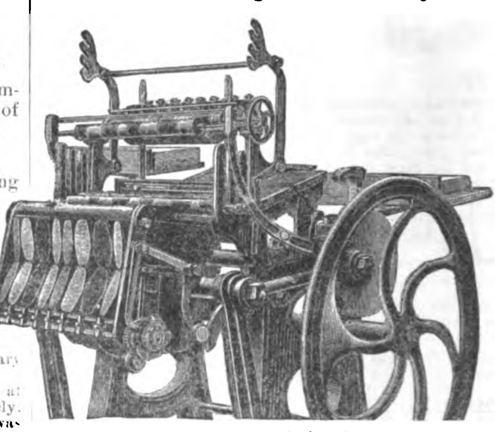
Lees, Br., "*Sc. Am.*," xxxvii. 211; *Spencer*, "*Engr.*," i. 437.

Mu'ley Axle. (*Railway.*) One without collars on the outer ends of the axle. See AXLE BOX.

Mule Pul'ley Stand. A form of stand for pulleys which revolve in planes at varying angles. In Fig. 1787, each pulley is on a plate which has a perfect adjustability on the post, either for height or for angle.

Mul'ti-coil Spring. One which consists of a number of coils as in *p, q, r, s, t, u*, Fig. 1143, p. 483, "*Mech Dict.*," in contradistinction to a compound spring in which several types of springs are united for a simple effect, as in *k, l*, Fig. 1142; *m, n, o, q, r*, Fig. 1143; and *d, d*, Fig. 1144, p. 483. *Ibid.*

Fig. 1788.



Multicolor Printing Press.

Mul'ti-col'or Print'ing Press. A chromatic printing press. Bacon's press, shown in Fig. 1788, is for printing in bands or stripes of color; not a press such as is used in chromo-lithography, for printing in over-laid colors by successive operations. See p. 545, "*Mech. Dict.*"

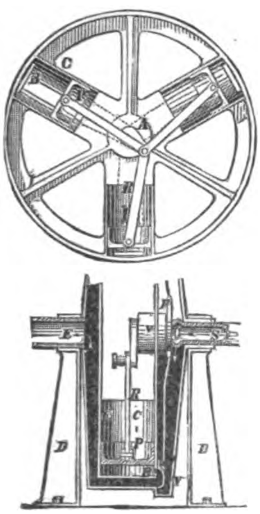
The working table, instead of being in a single piece, is composed of a number of narrow ovoid plates held in a frame, and so hinged as to move easily on each side at every revolution of the table. The end piece near the ink-trough is stationary. The various colored inks are placed in the ink-trough, which is divided into cells by metallic partitions. Directly over the trough is an iron frame carrying a set of screws and nuts. By tightening these screws, which are placed over the metallic partitions, the inks as they flow beneath are prevented from mixing. The inking rollers, instead of being fixed at a certain angle relative to the table, are arranged so as to run perfectly straight, the distribution being effected by a certain limited motion of the plates at each revolution. The different inks are spread on the multiple table in the usual way. Motion is communicated to the movable plates by a small lever which hangs under the table, and which rests on a small vertical iron plate affixed to a cross-stay of the machine.

Mul'ti-cyl'in-der En'gine. A steam engine with a plurality of cylinders; the term is, however, rarely applied to engines with less than three cylinders.

The Billing engine, shown in Fig. 1789, operates in a manner the reverse of that of ordinary motors, inasmuch as it is the engine that revolves while the shaft and crank are stationary. In the illustration three cylinders are employed, but as many may be used as can be grouped around the rim of the fly-wheel without causing too great complication of parts. Dead centers are avoided and the machine reduces itself to a self-rotating pulley-wheel.

A is the stationary crank, *C* is a light wheel, on which the three cylinders are grouped; the cylinders take steam at the rear end only, *B* being the steam-port and the dotted lines indicating the steam passages. The engine has bearings in the wheel-hubs, through one of which, *S*, the steam enters, as shown by the arrow, and through the other, *E*, the exhaust is had. The crank-shaft is merely a continuation of the steam-pipe, a suitable stuffing-box being provided at *Y.* On the pipe, also, and inside the steam chamber is fixed the eccentric *F*, which gives motion to simple valves *B* at the cylinder ends. The exhaust-pipe may be run through a stuffing-box and used as a shaft for pulleys. See Revolving Cylinder Engine, Figs. 4298-4301, p. 1931, "*Mech. Dict.*"

Fig. 1789.



Three Cylinder Engine.

See also Six Cylinder Engine; Three Cylinder Engine; also Fig. 890, Plate XI., op. p. 282, *supra.*

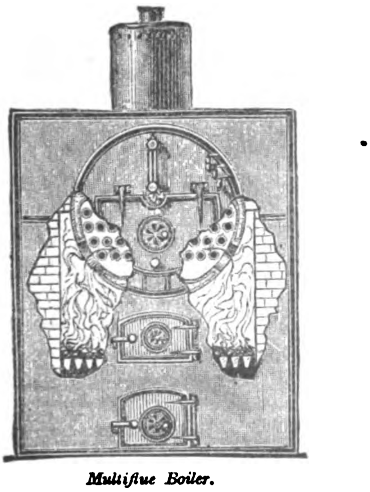
In the Payton & Holmes' multiple cylinder steam engine, (Br.), either two or four cylinders are used, the four cylinders being placed in pairs at right angles, one crank and eccentric answering for both. Steam is admitted only on the top side of the pistons of one pair of cylinders from the top port, and to the top of the other pair of cylinders from the bottom port. The engines can be reversed by a two-way cock for each pair of cylinders, placed behind the ports, and which, by moving a certain distance, reverses the steam current from the top of one pair of cylinders to the top of the other pair, or by sliding an inclined key fixed on a sleeve along the shaft within the eccentric.

Payton & Holmes, Br. * "*Engineer*," xlvii. 385.
Bacon . . . . . . * "*Scientific Am. Sup.*," 349.

Mul'ti-flue Boiler. The horizontal multiflue boiler has its principal exemplars in the boilers of locomotives and portable engines. See Fig. 2927, p. 1346, "*Mech. Dict.*," Fig. 5638, p. 2329, *Ibid.*

See also *A B C*, Fig. 5628, Plate LXI., "*Mech. Dict.*"
Observe the distinction between *flue* and *tube.*
The vertical multiflue boiler has flues or flame pipes traversing vertically the boiler space above the fire, being secured in their respective ends in the crown sheet or lower flue plate and the upper flue plate.
The *Lowe & Watson* multiflue boiler is shown by part elevation and part section in Fig. 1790. The furnace is beneath the front ends and the products of combustion pass from them by side openings into a combustion chamber which occupies a portion of the end of the boiler, then rearward by flues similar to those of a locomotive, and then beneath the boiler, and so to the stack.

Fig. 1790.



Multiflue Boiler.

SS. "Jason," *Cochrane*, Br. * "*Engineer*," xlix. 279.
Piedbœuf, Ger. . . . . . * "*Engineer*," l. 228.

Mul'ti-fur'row Plow. (*Agric.*) One having several bodies for plowing two or more furrows at once. See Gang Plow.

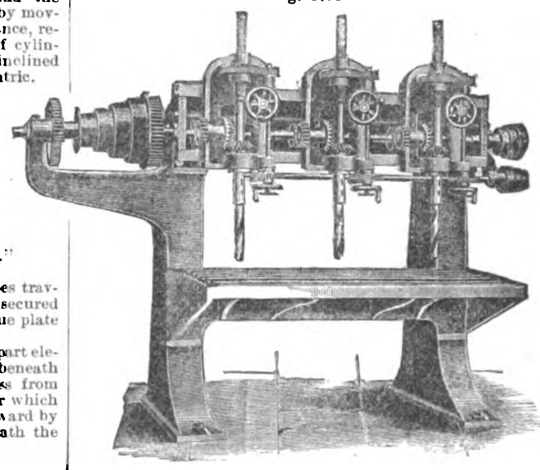
Mul'ti-ple Dril'ling Ma-chine'. A machine tool with a multiplicity of drills adjustable as to distance apart and adapted for drilling holes at a regulated distance apart on a number of bars which require exact conformity in all respects, as in bridge, trestle, and car work.

The London "*Engineer*" shows a machine especially adapted for drilling plates in position, on straight or hog-backed girders. The drills may be adjusted at any distance apart, and to suit varying pitches of holes, and while they may be brought together within 3¾", the driving wheels, by passing each other upon different levels, may be nearly 6" in diameter. The feed is automatic or independent at will.

See: *Buckton* . . . . * "*Engineer*," xli. 116.
Fetu & Deliège, Fr. . . * "*Engineering*," xxviii. 195.
Boring mach., *Richards* * "*Engineering*," xxvii. 506.

Mul'ti-ple Tel'e-phone. A form of telephone by M. Trouvé, intended to increase the capacity of the Bell and render it available for long distances. It has been adapted to M. Trouvé's military telegraph.

Fig. 1791



Multiple Drilling Machine.

"Instead of the single vibrating diaphragm used by Prof Bell, M. Trouvé substitutes a cubical chamber, each face of which (with one exception) is a vibrating membrane. Each of these membranes, being thrown into vibration by the same sound, influences a fixed magnet and electric circuit, the same as in the Bell arrangement. By associating all these currents, a combined current of single intensity proportional to the number of magnets influenced is produced. Instead of the cube, a polyhedron having an indefinite number of vibrating membranes may be used, and thus intensity augmented as desired.

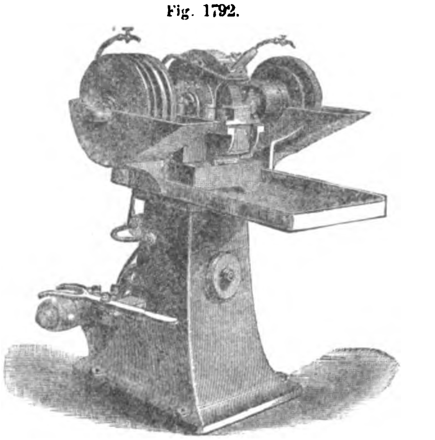
"Suppose now a line established on which is disposed a telephone constructed as above described, the membranes and magnets of which are divided into two series, and the circuits so arranged that, by pronouncing a word, currents are produced on the same wire in opposite directions. When a dispatch is received to be transmitted further on, the operator talks in the telephone in the usual way; and his speech, by the arrangement of circuits above noted, is heard both at the station to which he is forwarding the message and also at the one from which the message was sent, so that the possibility of error is thus rendered nil. M. Trouvé has adapted this apparatus to his military telegraph."

Mul'ti-ple Wheel Tool Grind'er. A grinding machine furnished with a variety of wheels, of differing qualities, fineness, size, shape, or what not, to suit varying requirements.

Fig 1792 is a tool grinder made with six emery wheels, by Thomson, Sterne & Co., of Glasgow, Scotland.

The wheels have different shapes and width of face, four being for gouges of varying size and for molding irons: one has a square face for straight edged irons (plane irons); one is a fine emery hone to replace the "water-of-Ayr" stone.

Fig. 1792.



Multiple Wheel Tool Grinder.

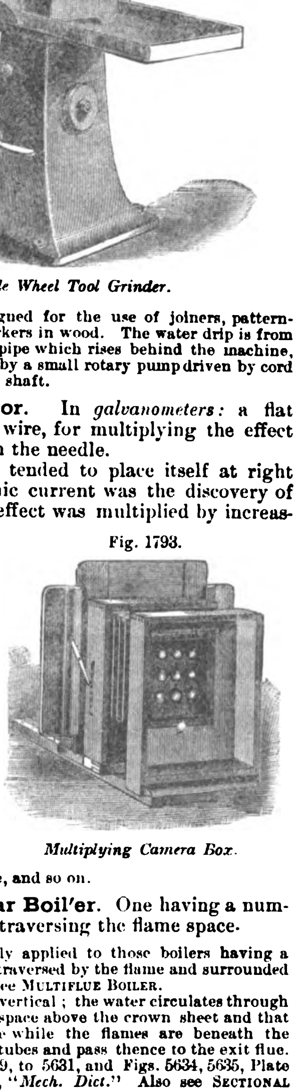
It is especially designed for the use of joiners, pattern-makers, and other workers in wood. The water drip is from branches of a vertical pipe which rises behind the machine, the water being lifted by a small rotary pump driven by cord from the emery wheel shaft.

Mul′ti-pli-ca′tor. In *galvanometers:* a flat coil of conducting wire, for multiplying the effect of the current upon the needle.

That the needle tended to place itself at right angles to a galvanic current was the discovery of *Oersted;* that the effect was multiplied by increasing the number of convolutions of the conducting wire, was the discovery of *Schweigger.*

Mul′ti-ply-ing Cam′e-ra Box. (*Photography.*) A chamber with numerous lenses all focalized by the same adjustment.

Fig. 1793.



Multiplying Camera Box.

For instance the nine-tube multiplying camera box will take 72, 36, or 18 gems on a 7″ by 10″ plate. 9 on a 5″ by 7″ plate, and so on.

Mul′ti-tu′bu-lar Boil′er. One having a number of water tubes traversing the flame space.

A term unfortunately applied to those boilers having a number of small *flues* traversed by the flame and surrounded by water. For these, see MULTIFLUE BOILER.

The boiler is usually vertical; the water circulates through the tubes between the space above the crown sheet and that below the steam dome while the flames are beneath the crown and around the tubes and pass thence to the exit flue. See also from Figs. 5629, to 5631, and Figs. 5634, 5635, Plate LXI., opposite p. 2326, "*Mech. Dict.*" Also see SECTIONAL BOILER.

Ormerod, Grierson & Co., Br. . * "*Engineer,*" xlii. 379.

Mun′cke Bat′te-ry. (*Electricity.*) One in which the elements are of horse-shoe shape, one arm copper and the other zinc, soldered together at the bow. These are laid mutually interlocking on a frame which is lowered into the trough of acidulated solution. *Niaudet,* * Am. trans., p. 18.

Mur′rhine. The agate cups of the ancient Cambay and Broach in India. Glass, and glass vases, in imitation of murrhine vases, are cited by Arrian in his Periplus of the Erythrean Sea, as exported by the Egyptian traders to southern African Red Sea ports.

Mur′rhine Glass. (*Glass.*) An imitation in glass of the celebrated ancient drinking cups, made probably of onyx or agate.

The reference by Pliny, "*Album et murrhina aut hyacinthos sapphirosque imitatum et omnibus aliis coloribus,*" is believed to describe the various kinds of glass so highly valued in his time.

At the Paris Exposition of 1878 were specimens of Roman murrhine glass, thus described:—

"There were silver goblets, or cups, with elliptical perforations half an inch long at the sides, through which an inner lining of sapphire or ruby glass protrudes like gems. The whole surface seems set with round cut and polished sapphires or rubies. The glass lining of the silver is perfect throughout, but bulges and protrudes through the openings. It is evident that the silver goblet is first made and polished, with the openings left in the sides, and then, being warmed, is lined with glass by blowing a bulb inside of it, the lining protruding through the spaces. These linings were, of course, very tight and close fitting, and could not be removed without breaking or melting the silver. These cups are copied from an original in the British Museum. Sapphires, emeralds, amethysts, and rubies were thus imitated.

"A cup in imitation of onyx — a copy of one in the treasury of St. Mark's — was mounted in silver gilt by Signor Castellani; another, also copied from one in St. Mark's treasury, and mounted in silver by Castellani, has the colors of topaz and emerald. A *pateræ* in murrhine colors, white, blue, and yellow, is a facsimile of the original in the National Museum at Naples." — *Prof. Blake.*

Mus′cle, Ar′ti-fi′cial. (*Surgical.*) An elastic caoutchouc band connecting two parts of an apparatus to draw them together, as in the case of club-foot apparatus, where a continuous strain is applied to correct deformity.

Mush′et Steel. (*Metallurgy.*) Steel made by fusing malleable iron with charcoal, graphite, or other carboneous matters in crucibles.

Mush′room. (*Electricity.*) An excrescence formed on the end of an electric-light carbon electrode. Such form from time to time, and becoming detached fall to the floor, or are caught in the glass globe. Also called *tack-heads.*

Mush′room Strain′er. An inverted dish strainer for cistern pumps, so named from its resemblance to a mushroom.

Fig. 1794.

Mushroom Strainer.

It will draw water from a level within 3″ of the bottom without disturbing the sediment. It screws on to the bottom of the pipe and is intended to rest on the floor of the cistern.

Mu′sic. See under the following:—

Agraffe.
Angelophone.
Autophone.
Bell.
Call bell.
Carillon.
Chimes.
Citole.
Clapper stay.
Clock-chime.
Cornet.
Diapason clock.
Gong.
Harmonic engine.
Harmonicon.
Harmonium.
Harp.
Horn.
Marimba.
Melodiograph.
Musical condenser.
Octave coupler.
Organ.
Organ blower.
Organ pipe.
Parlor organ.
Pedal.
Pianoforte.
Piano mover.
Pitch.
Reed.
Resonator.
Sounding board.
Tremolo.
Transposer.
Tuning fork.
Violin.
Xylophone.

See: block for printing.
Eckhardt . . . . . * "*Scientific American*," xxxv. 274.
Octave coupler . . . * *Laboulaye's* "*Dict.*," iii., ed. 1877, "*Orgues*," Fig. 3770.
Opera House, Paris . . * "*Scientific American Sup.*," 1501.
Paper punched for organ.
Needham . . . . . * "*Scientific American*," xxxix. 134.
Printing plates . . . "*Scientific American Sup.*," 1418.
Tone, Photography of.
Stein . . . . . . "*Scientific American Sup.*," 958.
Condenser (telephone).
Varley . . . . . . "*Scientific American*," xl. 6.
Musical tone telegraph.
Gray . . . . . . * "*Scientific American Sup.*," 92.
La Cour . . . . . * "*Scientific American Sup.*," 145.

Mu'si-cal Con-den'ser. A sort of telephone, invented by Varley, for the conveyance of musical sounds. It consists of receiving and transmitting apparatus. See description in "*L'Electricité*," reproduced in * "*Scientific American*," xl. 6.

Mu'sic Print'ing. Alisoff's (St. Petersburg) method of preparing clichés for music is as follows: —

The staffs, notes, and all signs are printed on fine paper, and kept in cases, like type. A glass ruled with vertical and horizontal guide lines on the reverse side, is used on which to set up the music. The gum on the face of the glass renders the paper transparent, so that the guide lines can be seen. When a page is set up it is removed, and is reproduced by photographic relief process. The cliché is made much larger than the negative required, to give facility in setting and sink small inequalities by reduction.

Mus'lin Glass. (*Glass.*) French, *mousseline.* Glass blown very thin. See MOUSSELINE.

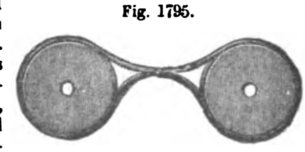
Muz'zle-piv'ot-ing Gun. A cannon which admits of firing through a very small embrasure, as the piece traverses upon a pivotal point at the muzzle.

Instance, Austrian piece, p. 537, and Fig. 43, Appendix L, "*Ordnance Report*," 1877.
Krupp . . . . . . * "*Engineer*," xlviii. 122.
Eads . . . . * Fig. 3411, p. 1566, "*Mech. Dict.*"

Muz'zle Sight. (*Rifle, etc.*) A front sight near the muzzle of the piece. It may be globe, open, etc. See list under SIGHT.

My'dri-a'sis Spec'ta-cles. *Mydriasis* is an exaggerated and chronic dilation of the pupil. Spectacles for its relief are blackened disks, pierced with small holes, which contract the area of light admitted. An affection just the opposite — the pupil being contracted to an exaggerated degree — is called *myosis.*

Fig. 1795.



Mydriasis Spectacles.

My'o-graph. An instrument for recording muscular movement.

M. Helmholtz appears to have contrived the first instrument of this character. One end of a muscle of a frog he fixed to an immovable point, and the tendon of the other end to a lever whose movements, excited by electricity, were traced on a turning cylinder. See Fig. 1, p. 51, "*Scientific American*," xxxvi. 51.

M. Marey, in his myograph, has replaced the weight which was placed on the muscle by a spring. The registering apparatus is substantially similar to that shown in M. Marey's *cardiagraph*, which see.

For other physical recording apparatus, see PNEUMOGRAPH; SPHYGMOGRAPH; PLETHYSMOGRAPH.

* "*Manufacturer and Builder*" . xi. 205.
Laboulaye's "*Dict. des Arts*," *etc.* iv., cap. "*Graphiques.*"

N.

Nach'et's Prism. (*Microscopy.*) A means for throwing and revolving an oblique pencil of converging rays upon an object under examination by the microscope. *a* Fig. 3963, p. 1803, "*Mech. Dict.*"

Næ'vus Nee'dle. (*Surgical.*) A cauterizing dermal needle for obliterating a nævus or birthmark. Heated by blow-pipe.

Nail. See, for history, and for list of varieties, pp. 1505, 1506, "*Mech. Dict.*"

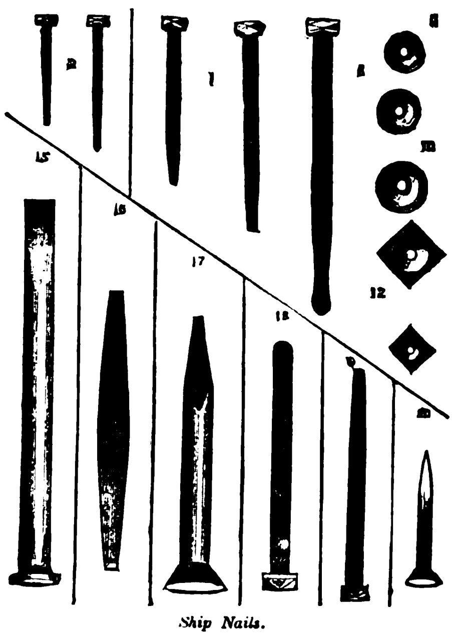
The Paris *pointes*, nails made from round wire, are now made channeled or polygonal by drawing or rolling. *Chelot.* The economy is 12 per cent. in material, and the efficiency is increased 20 to 35 per cent. according to the wood into which they are driven.

INDEX TO FIGS. 1796, 1797.

Wrought and Cut, Copper, Zinc, and Cast Metal Nails and Rivets used in Dockyards.

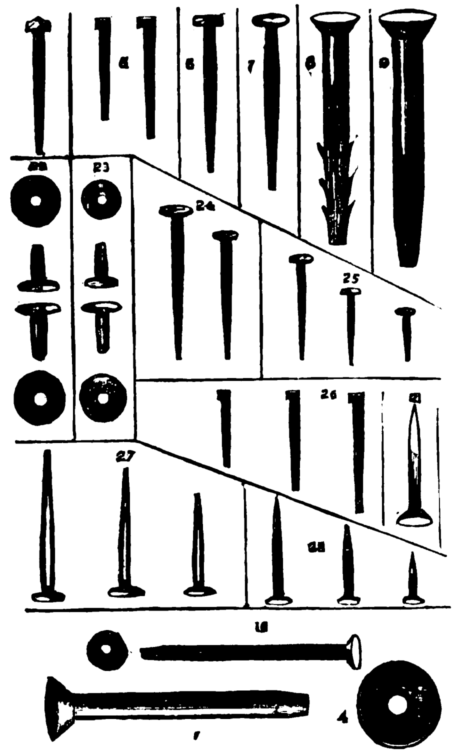
1. Rose-head copper boat nails (dumps or clench).
2. Rose-head copper flat points.
3. Deck-head copper flat points or spikes.
4. Cut copper clasp nails.
5. Cut copper brads.
6. Cut copper rose-head boat nails.
7. Cut copper flat-head boat nails.
8. Wrought copper lightning-conductor nails.
9. Wrought copper stem nails.
10, 11. Copper rose-burrs or round roves.
12. Copper square roves.
13. Wrought copper clench nails, countersunk flat-heads, round points.
14. Wrought copper clinker nails and washers.
15. Cast composition butt bolts.
16. Cast composition dowels.
17. Cast composition stem nails.
18. Cast composition spikes or flat points.
19. Cast composition dumps or boat nails.
20. Cast composition sheathing nails.
21. Cast composition slating nails.
22. Wrought copper hose and strap rivets.
23. Tinned copper hose and strap rivets.

Fig. 1796.



Ship Nails.

Fig. 1797.



Ship Nails.

24. Cut copper slating nails.
25. Cut copper or brass tacks.
26. Cut brass brads.
27. Cut zinc slating nails.
28. Wrought copper tacks.

The following varieties bear names indicative of material, application, shape, size, character of head, etc.

Band nail.
Barbed nail.
Barrel nail.
Basket nail.
Bessemer-steel nail.
Black nail.
Blued nail.
Blunt nail.
Boat nail.
Brad.
Brass nail.
Brush nail.
Brush tack.
Card tack.
Carpet nail.
Carpet tack.
Casing nail.
Chair nail.
Channeled nail.
Channel nail.
Charcoal iron nail.
Cheese-box nail.
Chisel-point nail
Cigar-box nail.
Clasp nail.
Clinch nail.
Clinker nail.
Clout nail.
Coated nail.
Coffin nail.
Coffin-lining nail.
Collar shoe nail.
Concave-head nail.
Conical nail.
Cooper's tack.
Copper nail.
Copper-plated nail.
Copper tack.
Countersunk-head nail.
Cut nail.
Cut tack.
Deck-head nail.
Diamond-head nail.
Double-pointed tack.
Drive nob.
Dump.
Escutcheon pin.
Felting nail.
Fencing nail.
Fine nail.
Finishing nail.
Flat-head nail.
Flat-head tack.
Flat nail.
Galvanized nail.
Gimp nail.
Gimp tack.
Glazier's point.
Hame nail.
Heel nail.
Hob-nail.
Hook-head brad.
Hungarian nail.
Japanned nail.
Lace tack.
Last nail.
Leathered tack.
Lightning conductor nail.
Lining nail.
Lining tack.
Looking-glass tack.
Machine finishing nail.
Miner's tack.
Nugget-head nail.
Oval-head nail.
Pail tack.
Picture-frame nail.
Plated nail.
Riveting knob.
Roofing nail.
Rose-head nail.
Saddle nail.
Serrated head nail.
Shank tack.
Sheathing nail.
Ship nail.
Shot-head nail.
Shoe nail.
Shoe tack.
Silver nail.
Slating nail.
Smooth nail.
Spike.
Steel nail.
Stem nail.
Swedes-iron nail.
Tack.
Tinned nail.
Tinned tack.
Tobacco nail.
Trimming nail.
Trunk nail.
Tufting button.
Tufting nail.
Twopenny to Twenty-penny.
Upholsterer's nail.
Upholsterer's tack.
White-metal nail.
Window-glass point.
Wire-nail.
Wrought nail.
Zinc nail.
Zinc-shank nail.
Zinc shoe nail.

See also: —

English hist. and meth.	"*Scientific American*," xxxvii. 73.
Nail driver	"*Scientific Amer.*," xxxix. 280.
Nail driver (under water)	* "*Min. & Sc. Press*," xxxvii. 209.
Extractor, *Tinker* . .	* "*Scientific American*," xxxv. 258.
Machine, self-feeding.	
Grant	"*Iron Age*," xxii., Dec. 5, p. 7.
Haddock	* "*Iron Age*," xix., March 29, p. 9.
Forging machine, *Taylor & Challen*, Engl. .	* "*Scientific Amer.*," xxxvii. 210.
Taylor & Challen, Br.	* "*Engineering*," xxiii. 480.
Picker	"'*Iron Age*," xix., June 7, p. 3.
Selector	* "*Iron Age*," xxii., Nov. 7, p. 1.
Works, Birmingham, England	"*Scientific American Sup.*," 89.

Nail Gun. A device for nailing down flooring boards.

The nail is placed on the end of a tube and a rod slipped down within drives the nail home.

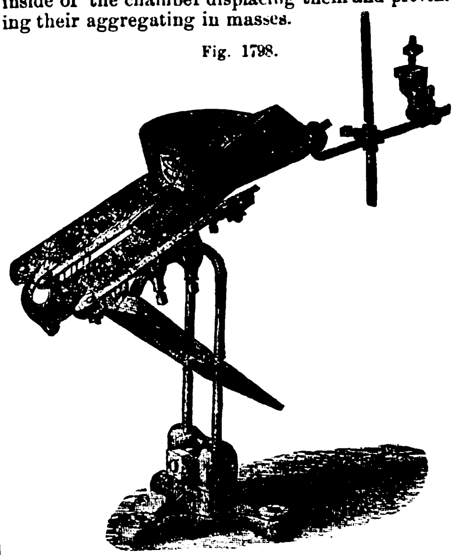
Nail In'stru-ment. (*Surgical.*) The list includes: —

Nail extracting forceps.
Sequestrum forceps.
Scalpel.
Nail cleaner and file.
Nail nippers.
Spring for inverted nails.
Splinter forceps.

It embraces the instruments of the chiropodist and the manicurist.

Nail Pol'ish-ing Ma-chine'. A tumbling box. A hexagonal chamber 19″ in diameter and 30″ long, with heads. In it the nails are placed and tumbled about against each other, points on the inside of the chamber displacing them and preventing their aggregating in masses.

Fig. 1798.



Nail Selector.

Nail Se-lec'tor. A machine, or an attachment to a nail machine, to pick out perfect nails from headless and ill-formed nails, slivers, and first cuts.

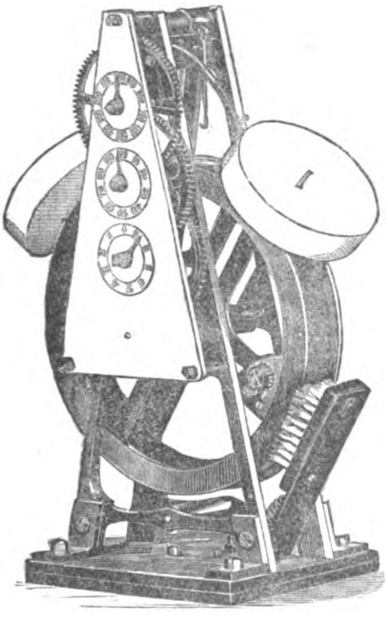
It consists of two pairs of parallel plates set at angles to each other and inclined to the floor, forming a sort of trough with a slot running the entire length of the plates. At the top and immediately under the bed plate of the nail machinery is a pan or receiver to catch the nails as they drop from the machine. The bucket is attached to the rear of the bed plate, while the upright rod is in the path of, and receives a stroke from, the griping lever. Thus every movement vibrates the selector and feeds the nails into these troughs, the plates of which are so set as to allow the points to drop into the slots, but not to permit the heads to pass through; that is, the nails are held by their heads as they are conducted down the slots in Indian file. The dirt and headless nails and slivers fall through the slot under the machine, into a receiver, while the perfect nails, held by their heads, slip to the lower end of the trough where the slot expands to a large oval, allowing the perfect nails to fall into the pan for removal.

The same plan is used in machines for feeding wood-screw-blanks.

Nap Me'ter. An instrument invented by Prof. Kittary and used for testing the wearing quality of cloth, by the Russian war office.

The instrument consists of a double-flanged wheel, faced with leather between the flanges, and having two rasps hung and weighted so as to bear upon that face; also an ordinary set of counting-wheels and dial-plates, to show the number

Fig. 1799



Russian Nap Meter.

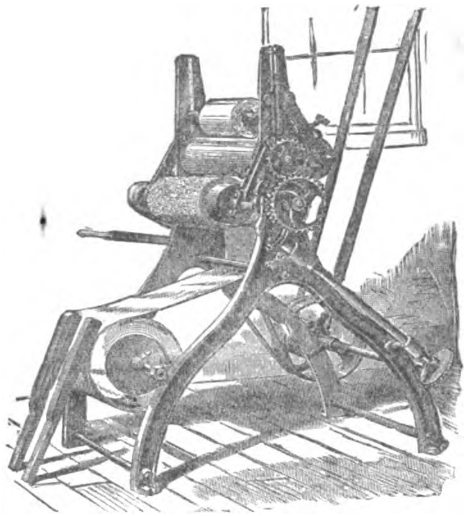
of revolutions of the flanged wheel. The cloth to be tested is wound in a narrow strip around the leathern face and secured, a light brush is provided to remove the dust, the rasps brought to bear upon the cloth, and the number of turns of the crank required to wear the cloth threadbare and smooth gives a comparative test of its durability and wearing qualities.

Nap'per. A machine for cleaning, napping, and surfacing hosiery goods.

It consists primarily of a roller on which the goods are flatly stretched, and a brush, consisting of card clothing, applied to the cloth. The machine takes in any width of cloth, from 24″ down, brushes the cloth in a flattened web, works on both sides at once, cleans off the specks, burrs, seeds, etc., raises a nap, restores the pliancy and softness — of which the washing has deprived the goods — and leaves the web in a smooth roll ready for the cutter.

The goods are smoothly stretched both in length and width over a roller having a firm and true surface. The brush cards are attached to a wooden roller, the bearings of which are adjustable parallel with the cloth roller. A lever on the left allows the pressure to be relaxed when a seam occurs.

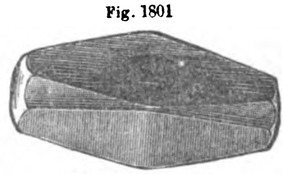
Fig. 1800.



Napper and Brusher.

Nap'ping Ham'mer (or *Knapping*). A stone-breaker's hammer, as for macadamizing, for instance.

Fig. 1801



Napping Hammer.

Naph'tha. A grade of petroleum obtained by distillation, and having a gravity from 65° to 62° *Beaumé*.

It may be considered the third in the series of products as practically utilized.

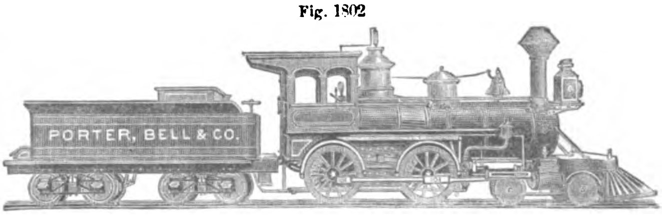
Gasoline, gravity 90° to 80° *B.*
Benzine, gravity 74° to 68° *B.*
Naphtha, gravity 65° to 62° *B.*
Kerosene, gravity 59° to 38° *B.*
See also KEROSENE; PETROLEUM.

Nar'row Gage Lo'co-mo'tive. Fig. 1802 shows a narrow-gage freight locomotive.

These engines are equalized between rear and center drivers: they also have a cross equalizer at front drivers. The center drivers are without flanges. They are easy on the track, and curve well up to a speed of 15 to 20 miles per hour. Having all their weight on drivers, and a short wheel base, they are specially adapted to hauling heavy loads on steep grades and short curves.

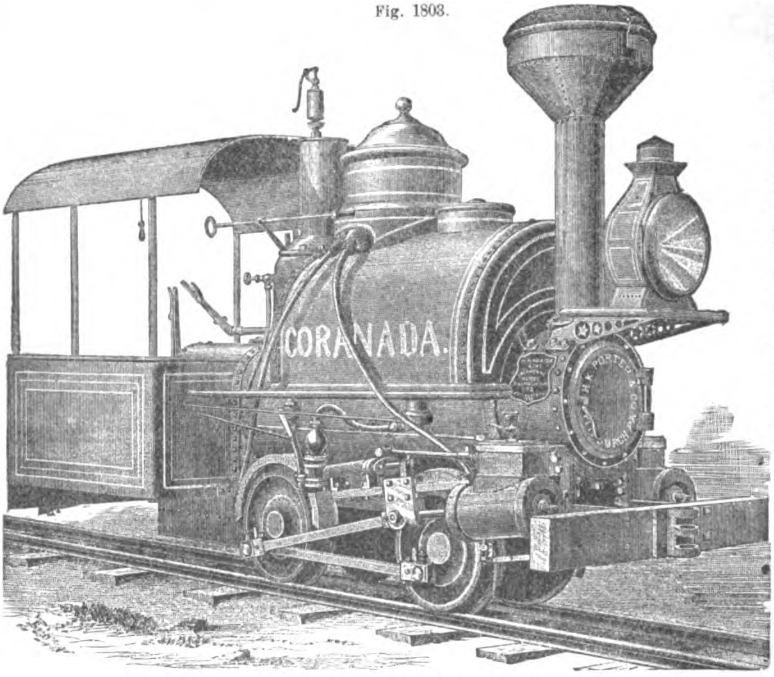
They are made of varying sizes and powers.

Fig. 1802



Narrow Gage Freight Locomotive.

Fig. 1803.



Locomotive for 20″ Gage Railroad. Arizona.

Cylinders, diameter	10″ to 12″
Stroke	16″ to 16″
Drivers, diameter	33″ to 36″
Wheel base	28′ to 29′
Weight working	28,000 to 36,000 lbs.

A locomotive for 20″ gage, built by Porter for the Longfellow Mining Company of Arizona, is shown in Fig. 1803.

The following is a description: —

Gage of track	20″
Cylinders, diameter	6″
Stroke	10″
Wheel-base	45″
Diameter of boiler at smoke-box end	23″
Number of flues	29
Diameter	1¾″
Length	72″
Fire-box, inside measurements, length	28″
Width	19″
Depth	27½″
Driving wheels, diameter	22″

Water supplied by one full-stroke pump and one number two injector.

Tank capacity, 200 gallons.

Fuel, wood; fuel room for about one fourth of a cord of engine wood.

Weight in working order, about 9,000 pounds.

Extreme width over all, 65″ at back bumper, 46″ at cylinders.

Extreme height, 100″.

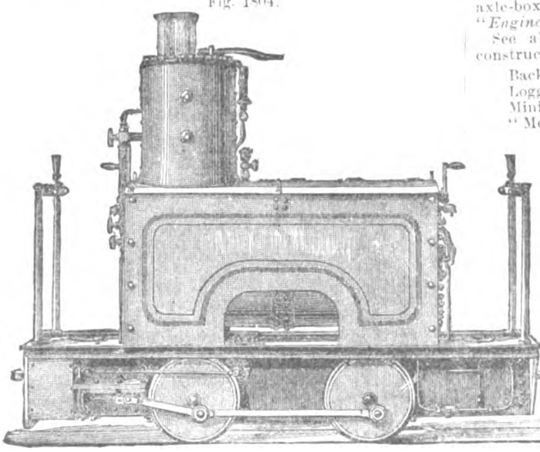
Extreme length, 158″.

Width in clear between frames, 13″.

Throw of eccentrics, 2⅝″.

The railroad is 5½ miles long, with maximum grades of 4½ per 100 and minimum curves of 90′ radius, with 16-lb. rails, and is used for the transportation of copper ore, the loaded cars coming down grade. The locomotive boiler is set on a slight incline, so that the water will be level when it is on an average grade, and the engine is intended to back up the grade. The locomotive was taken apart and boxed for shipment: as it had to be prepared for hauling by wagons several hundred miles from the railroad terminus. The frames, with cylinders and entire link motion, were all placed in a box about 8 × 4 × 3′, and weighed about 2,000 lbs.

Fig. 1804.



British 18″ Gage Locomotive.

Fig. 1804 shows a yard engine used on an 18″ railway in the Crewe Works of the London and North Western Railway, England.

The boiler is cylindrical, and is traversed by a hexagonal flue strengthened by small cross-tubes, which present very efficient heating surface. From the flue three chimneys pass up through the steam dome, each chimney being provided with its own blast nozzle. The flue is fixed on the barrel by bolted joints so that it can be readily taken out for cleaning the cross-tubes when necessary.

The cylinders are 5.5″ diameter, 6″ stroke; wheels 15″ diameter. The effective pull estimated at 1,089, steam being 90 lbs. A regulator handle as well as a reversing lever is provided at each end of the engine so that the latter can be driven from either foot-plate. The water is carried in tanks between the frames, and the boiler is fed by a simple kind of injector. The engine is carried on four cushion springs, which are simply placed in recesses cast in the top of the axle-box guide, and bearing directly on the axle-boxes. — "*Engineering*."

See also other heads descriptive of special features of construction or adaptation: —

Back truck.	Plantation.
Logging.	Pony truck.
Mining.	Switching.
"Mogul."	Tank.

See: Billerica, track	* "*R. R. Gaz.*," xxii. 1.
Cars	* "*R. R. Gaz.*," xxii. 50, 37.
Locomotives	* "*R. R. Gaz.*," xxii. 11, 19.
Switches and frogs	* "*R. R. Gaz.*," xxii. 65.
Ribeauville, Alsace	* "*Sc. American*," xlii. 228.
Canada	"*Van Nostrand's Mag.*," xvii. 560.
Locomotive, Festiniog, R. R., Wales.	* "*Sc. Amer. Sup.*," 1535, * 1619.
Progress	"*Sc. Am. Sup.*," 993.
Rostoken, Hungary	"*Van Nostrand's Mag.*," xvi. 475.
Hungary, etc.	"*Van Nostrand's Mag.*," xxii. 7.
Locomotive for India, British	* "*Sc. American Sup.*," 835.
In India	"*Van Nostr. Mag.*," xv. 68.
General subject & statistics, *Morandière*	"*Van Nostr. Mag.*," xviii. 168.

The report of M. Jules Morandière shows that the narrow gages vary between 1.5′ and 6′, and cites 20 different gages between these limits, in 17 countries. The following are the statistics of the narrow gage railways in 24 countries cited, at the date of the report (1878).

Name of Country.	Number of Miles. Open to Traffic.	In Construction.
Great Britain	26	–
France	43¾	89½
Algiers	20½	155¾
Belgium	77	–
Norway	192½	–
Sweden	163	–
Russia	208¼	–
Austro-Hungary	52¾	18¾
Prussia	20	–
Italy	7½	–
Island of Sardinia	18	–
Switzerland	22	–
Greece	5½	–
Portugal	–	–
India	820½	1,902
Australia	328	–
New Zealand	244	–
Cape of Good Hope	67	–
Canadian Dominion	457	373
United States	2,040	7,552
Central America	37¼	155
Venezuela	–	–
Peru	17¼	–
Chili	118	–
Bolivia	–	155
Brazil	20	411
Havana	–	–
Java	34	–

"*Mémoirs de la Société des Ingenieurs Civils,*" 1878.

" On the Denver and Rio Grande Railroad it is stated that 16 cars on the 4′ 8½″ gage unload and fill 20 cars on the 3′ gage. Thus, say —

Empty Cars, Weight.	Paying Load.	Total Dead Weight.	Total Paying Load.	Total Cars and Load.
	tons.	*tons.*		
16 cars, wide gage, 8½ tons	10	136	160	296
20 cars, narrow gage, 5 tons	8	100	160	260
Saving in total weight	–	–	–	36 tons.

Which is equivalent to 22 tons additional freight, or 23 per cent. more, assuming the cars loaded to the full capacity, and the comparison is more favorable when the cars are not filled. — *Capt. Galton's* report, "*British Reports on Centennial Exhibition.*"

Na′sal Feed′ing Ap′pa-ra′tus. One of the alternatives in case of lock-jaw, mania, choking paretics, paralysis of the throat, fractured jaw, etc.

The nasal operation may be by a simple funnel, a tube in the pharynx, or a tube directly into the stomach.

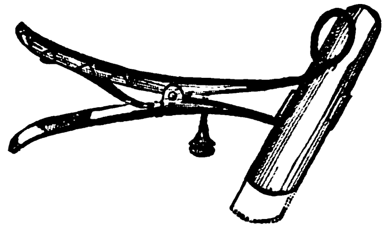
Dr. Newington's feeding device with two nasal tubes, used in Bethlehem Hospital, London, is described in * "*Lancet.*" See also * "*Scientific American Supplement,*" 2648.

Na′sal In′stru-ments. (*Surgical.*) Includes the following: —

Nasal speculum.
Nasal douche.
Nasal clamp.
Epistaxis tampon.
Laryngeal syringe.
Posterior nares syringe.
Nasal electrode.
Polypus forceps.
Polypus canula.
Epistaxis canula.
Rhinoscope.
Rhinoscopic mirror.
Nasal syringe.
Nasal feeding tube.

Na′sal Spec′u-lum. A bivalvular speculum for distending the alæ of the nose.

Fig. 1805.



Nasal Speculum.

In Dr. Shurly's nasal speculum one valve is a ring; the other a shell; they are made in pairs, rights and lefts.

See also *a, b, c c*, Fig. 5361, p. 2260, "*Mech. Dict.*"

Na-trom′e-ter. An instrument for estimating the quantity of soda contained in salts of potash and soda. *Pessier* has invented a standard form.

Nat′u-ral Steel. (*Metallurgy.*) 1. Steel made directly from the ore by the *blomary* process.

2. Steel obtained by the finery process; the carbon being removed from the molten cast iron by a blast of air directed upon the metal, which is covered with a layer of charcoal.

Nau′ti-cal. See under the following heads: —

Anchor.
Anchor and cable, parts of, and appliances.
- Anchor lift.
- Anchor shackle.
- Arm.
- Bill.
- Blade.
- Bower.
- Bull-rope.
- Buoy rope.
- Cable shackle.
- Capstan.
- Cat.
- Cat back.
- Clutch.
- Compressor.
- Controller
- Deck stopper.
- Devil's claw.
- Dog stopper.
- Fish.
- Fluke.
- Forelock.
- Grapnel.
- Kedge.
- Kevel.
- Link.
- Messenger.
- Moorlng swivel.
- Nippers.
- Palm.
- Passing nippers.
- Pawl.
- Pee.
- Point.
- Racking turns.
- Ring.
- Shackle.
- Shank.
- Sheet anchor.
- Slip stopper.
- Spare anchor.
- Square.
- Stock.
- Stopper.
- Stream anchor.
- Stud.
- Swifter.
- Swivel.
- Throat.
- Warping.
- Whelps.
- Wing stopper.

Anti-racer.
Arm.
Armor.
Armor compound.
Armor plate.
Artificer's knot.
Back board.
Ball-joint hinge.
Beacon.
Bees.
Bench-hook.
Bench sail-hook.
Binnacle.
Block (varieties; see list under "TACKLE").
- Bouche.
- Bushing.
- Channel.
- Cheeks.
- Coak.
- Gorge.
- Pin.
- Score.
- Sheave.
- Shell.
- Strap.
- Swallow.

Block-hook.
Boat.
- Back-board.
- Boat launching apparatus.
- Boat lowering apparatus.
- Bottom board.
- Canoe.
- Cat boat.
- Cat rig.
- Center board.
- Clamp.
- Collapsible boat.
- Davit.
- Ducking boat.
- Folding boat.
- Gunwale.
- Head sheet.
- Ice boat.
- Kyak.
- Launch.
- Launch engine.
- Lazy painter.
- Life boat.
- Life raft.
- Mast hinge.
- Nautilus.
- Oar.
- Painter.
- Poppets.
- Portable boat.
- Portable raft.
- Rowing gear.
- Rowlock.
- Rudder lanyard.
- Skiff.
- Slings.
- Sneak box.
- Steadying line.
- Step.
- Stern benches.
- Stern sheets.
- Stretcher.
- Surf boat.

Thwarts.
Well sneak.
Yawl.
Boat hook.
Boat knot.
Boat launching.
Boat lowering apparatus.
Boat plug.
Boatswain's toggle.
Boat yoke.
Boom tackle.
Bouche.
Bower.
Bowline knot.
Bowline on a bight.
Bowline tackle.
Bowsprit shrouds.
Box.
Brace-block.
Breast rope.
Builder's knot.
Bull's-eye.
Buntline leader.
Buoy.
Bushing.
By-pass.
Cable shackle.
Calking-iron.
Canoe.
Cant splice.
Capshore.
Capstan.
Capstan knot.
Carrick bend.
Catamaran.
Cat boat.
Cat rig.
Center board.
Chain pipe.
Chain stopper.
Chain tag.
Channel.
Cheek.
Chock.
Cigar steamer.
Clamp.
Cleat.
Clew.
Clew-thimble.
Clove hitch.
Clutch.
Coach whip.
Coak.
Collapsible boat.
Collar.
Companion ladder.
Composite.
Compound armor.
Conning tower.
Cut-splice.
Cutting punch.
Cyclad.
Davit.
Deck hook
Deck light.
Deck plate.
Deck pipe.
Deck stopper.
Devil's claw.
Diamond knot.
Diving apparatus.
Diving bell.
Diving dress.
Dog shank.
Dog stopper.
Double knot.
Double purchase.
Double-rail stancheon.
Double whip.
Drawing splice.
Dredge.
Dredging machine.
Drilling scow.
Ducking boat.
English knot.
Eyelet grommet.
Eyelet hole.
Eye seizing.
Eye splice.
Fake.
Faking box.
Ferry boat.
Fid-hole.
Figure-of-8 knot.
Flemish knot.
Floating dock.
Flush-deck windlass.
Fog alarm.
Fog bell.
Fog horn.
Fog signal.
Fog trumpet.
Fog whistle.
Folding boat.
Forelock.
Four-stranded splice.
Gaff-topsail hook.
Galley knot.
Gasket.
Gin block.
Gorge.
Goring cloth.
Grafting.
Grapnel.
Grommet.
Gun-tackle purchase.
Gunwale.
Half hitch.
Hammock clew.
Hammock cloth.
Hanging block.
Harbor gasket.
Harness hitch.
Hawser.
Hawser bend.
Hawsing beetle.
Hawsing iron.
Head earrings.
Heaver.
Hitch: —
Clove hitch.
Half hitch.
Harness hitch.
Marlinspike hitch.
Midshipman's hitch.
Hook: —
Bench hook.
Block hook.
Gaff-topsail hook.
Match hook.
Self-mousing hook.
Sister hooks.
Horse hammock.
Hydraulic steering gear.
Ice boat.
Ice yacht.
Illuminator.
Iron clad.
Iron strapped block.
Jib hank.
Jib head.
Jumper stay.
Kedge.
Kedging.
Knot: —
Artificer's knot.
Boat knot.
Bowline knot.
Bowline on a bight.
Builder's knot.
Capstan knot.
Carrick bend.
Clove hitch.
Diamond knot.
Dog-shank.
Double knot.
English knot.
Figure-of-8 knot.
Flemish knot.
Galley knot.
Half-hitch.
Harness-hitch.
Hawser bend.
Hitch.
Lark's head.
Lashing knot.
Loop knot.
Marlinspike hitch.
Matthew Walker knot.
Midshipman's hitch.
Overhand knot.
Prolonge knot.
Reef knot.
Rosette.
Sheep shanks.
Shortening knot
Shroud knot.
Six-fold knot.
Sprit-sail-sheet knot.
Tack knot.
Twist knot.
Wall and crown.
Wall knot.
Weaver's knot.
Kyak.
Lacing.
Lanyard.
Lark's head.
Lashing.
Lashing eye.
Lashing knot.
Launch.
Launch engine.
Lazy painter.
Life boat.
Life buoy.
Life preserver.
Life raft.
Life-saving apparatus.
Life-saving suit.
Lift jigger.
Lizard.
Lobster claw.
Long rolling splice.
Long splice.
Loop knot.
Lubber's mark.
Luff tackle.
Luff tackle purchase.
Luminous buoy.
Main keel.
Marine drag.
Marine governor.
Marine signal.
Marlinspike.
Marlinspike hitch.
Mast.
Mast-head.
Mast-head pendant.
Mast hinge.
Mast lining.
Mat.
Match hooks.
Matthew Walker knot.
Midshipman's hitch.
Mooring swivel.
Mousing hook.
Nautigon.
Nautilus.
Nettle stuff.
Nippers.
Oar.
Outrigger hoist.
Overhand knot.
Painter.
Palm.
Parceling.
Passing nippers.
Pawl.
Paunch mat.
Pendant tackle.
Pin.
Pinkie.
Point.
Ponton.
Popofka.
Poppets.
Portable boat.
Portable raft.
Port hinge.
Post.
Pressure log.
Preventer fid
Preventer stay.
Pricker.
Prolonge knot.
Propeller.
Propeller coupling.
Propeller mechanism.
Propeller shaft.
Puddening.
Pudding splice.
Purlin.
Quarter.
Quarter tackle.
Racking.
Racking turns.
Raft.
Reef earrings.
Reefing apparatus.
Reef knot.
Reef-tackle purchase.
Reeving line.
Reliever.
Relieving tackle.
Reversing gear.
Rigger screw.
Rigging stopper.
Ring splice.
Roband.
Rosette.
Rose lashing.
Round scuttle.
Round seizing.
Rowing gear.
Rowlock.
Rudder.
Rudder brace.
Rudder gudgeon.
Rudder screw.
Sailing car.
Score.
Screw propeller.
Screw steering apparatus.
Scuttle.
Self-mousing hook.
Seizing (varieties, see list): —
Cross seizing.
End seizing.
Eye seizing.
Flat seizing.
Gasket.
Harbor gasket
Fox.
Lacing.
Laniard.
Lashing.
Lashing eye.
Mat.
Nettle stuff.
Parceling.
Puddening.
Puss.
Quarter seizing.
Racking.
Roband.
Rose-lashing.
Round seizing.
Sennit.
Serving.
Spanish fox.
Splice.
Throat seizing.
Whipping.
Worming.
Sennit.
Serving.
Setting die.
Shackle.
Shaft.
Sheath.
Sheave.
Sheave-hole.
Sheepshanks.
Sheet anchor.
Sheet slip.
Sheet traveler.
Shelf piece.
Shell.
Ship.
Ship ring-bolt.
Ship scraper.
Ship's spike.
Shore.
Shortening knot.
Short splice.
Short stay.
Shroud knot.
Side scuttle.
Single whip.
Sister block.
Sister hooks.
Six-fold knot.
Skiff.
Sky-light guard
Sky-light lift.
Slings.
Slip stopper.
Snatch block.
Sneak box.
Sound house.
Sounding.
Sounding apparatus.
Spanish fox.
Spanker gaff.
Spare anchor.
Spider hoop.
Splice: —
Cant splice.
Cut splice.

Splice: —
Drawing splice.
Eye splice.
Four-stranded splice.
Grafting.
Long rolling splice.
Long splice.
Pudding splice.
Short splice.
Tapered splice.
Sprit-sail gaff.
Sprit-sail sheet knot.
Stanchion.
Steamboat.
Steamer.
Steam ferry.
Steam tug.
Steering apparatus.
Step.
Stern benches.
Stern sheets.
Stern walk.
Stopper.
Storm valve.
Strap.
Strap-bound block.
Stream anchor.
Stretcher.
Stud.
Submarine armor.
Surf boat.
Swallow.
Swimming apparatus.
Swivel.
Swivel block.
Sword mat.
Tack knot.
Tackle: —
Block.
Boom tackle.
Bouche.
Bowline tackle.
Brace block.
Bushing.
Channel.
Cheek.
Coak.
Double purchase.
Double whip.
Gin block.
Gorge.
Gun-tackle purchase.
Hanging block.
Iron-strapped block.
Lift jigger.
Luff tackle.
Luff-tackle purchase.
Mast-head pendant.
Pendant tackle.
Pin.
Quarter tackle.
Reef-tackle purchase.
Relieving tackle.
Score.
Sheave.
Shell.
Single whip.
Sister block.
Snatch block.
Strap.
Strap-bound block.
Swallow.
Swivel block.
Tail jigger.
Threefold purchase.
Top burton.
Top-burton tackle.
Top tackle.
Treble purchase.
Truss tackle.
Two-fold purchase.
Whip-on-runner.
Yard tackle.
Tail jigger.
Tapered splice.
Thimble.
Three-fold purchase.
Throat seizing.
Thrum mat.
Thrust bearing.
Thwarts.
Tiller.
Top burton.
Top-burton tackle.
Top lining.
Top maul.
Top rim.
Top tackle.
Towing.
Treble purchase.
Trip hook.
Truss tackle.
Try-sail gaff.
Turnbuckle.
Twice-laid.
Twin boat.
Twin steamer.
Twist knot.
Two-fold purchase.
Upper deck.
Wall and crown.
Wall knot.
Warping.
Water ballast.
Water-deck iron.
Weaver's knot.
Wedge.
Well sneak.
Whip-on-runner.
Whipping.
Whisker gaff.
Wing stopper.
Wire-rope towage.
Withe.
Worming.
Yacht.
Yard-arm.
Yard-tackle purchase.
Yarn.
Yawl.

Nau'ti-cal Alarm. See under various heads: BUOY; FOG TRUMPET; SIRENE, etc. See also MARINE ALARM.

Nau'ti-gon. An instrument invented by Dr. Hill, of Harvard, for solving by inspection, without the use of tables, any problem in spherical trigonometry, with sufficient accuracy for the principal problems of practical navigation.

"*Scientific American*"	xxxvi. 85.
* "*Scientific American Supplement*"	314.

Nau'ti-lus. A name for the diving bell. See cap. "*Plongeur*," *Laboulaye's "Dictionnaire des Arts*, etc.," Figs. 3686, 3687.

Nav-i-ga'tion-al Sound'ing Ma-chine'. A machine for taking soundings *en route*. The invention of Sir William Thomson. See FLYING SOUNDER.

Nav'i-sphere. A nautical instrument, by M. de Magnac. It is designed to indicate, without calculation, the names of the stars above the horizon at a given moment (with altitude and azimuth), the angle of route for going from one point to another by the arc of a great circle, and the approximate distance between these points. Spherical triangles may also be solved with it. For a detailed description see the "*Comptes Rendus*" of the Academy; and for an abstract, London "*Nature*."

Nav'vy. A species of excavator, which see.

Steam navvy . . "*Scientific American*," xxxvi. 399.

Neb'u-li-zer. (*Surgical.*) A spray instrument. See ATOMIZER.

Ne-ces'saire. (*Optics.*) A circular base of polished wood, in which 6 re-agent bottles are arranged with ground capillary tube stoppers, and the whole covered with a low bell-glass to exclude dust.

Ne-cro'sis For'ceps. (*Surgical.*) An instrument for gnawing away portions of diseased bone. They are of various shapes: front cutting, side-cutting, curved on the flat, serrated, knee-curve, gouge-shaped, etc. See list under FORCEPS.

Nee'dle. The process of needle-making in 35 operations is described under cap. "*Aiguilles*," *Laboulaye's "Dict. des Arts et Sciences*," i., ed. 1877.

The following is the series of operations in the works of the *National Needle Co.*, Springfield, Mass.: —

Blank.	Brass brushed.
Reduced blank.	Eye-polished.
Reduced and pointed, blank.	First inspection.
Grooved.	Hard straightened.
Eye-punched.	Finish-pointed.
Hardened and tempered.	Finished.
Hard-bur dressed.	

See *Dr. Knight's* Report on "*Sewing Machine Needle Machinery*," at the National Needle Co.'s works, Springfield, Mass., "*Centennial Exhibition Reports*," vol. vii., Group XXII., p. 59, *et seq.*

Open-eyed needles for threading without reeving; numerous instances, Fig. 3305, p. 1517, "*Mech. Dict.*"

(*Surgical.*) The uses of the needle in surgery, for operation and suture are numerous. The names signify the material, construction, or application. Among them are the following, the greater number of which may be found under their alphabetical heads in this or former volumes: —

Acupuncture.	Hypodermic syringe.
Aneurism.	Iris.
Angular.	Ligature.
Artery.	Milium.
Canulated.	Nævus.
Cataract.	Open eyed.
Couching.	Paracentesis cornea.
Discission.	Perineal.
Eye.	Seton.
Fistula.	Staphylorraphy.
Harelip.	Stop.
Helical.	Suture.
Hernia.	Tattooing.

See also ACUS, *supra*; also NEEDLE. 2. SURGICAL, p. 1517 "*Mech. Dict.*;" NEEDLE FORCEPS, Fig. 3306, p. 1518, *Ibid.*

See: Clamp for sewing machines, *Morton*	* "*Scientific Amer.*," xxxvii. 182.
Sewing machine needle making	* "*Scientific American Sup.*," 544.
Machinery	* "*Scientific Amer.*," xxxvii. 130.
Cap. "*Aiguilles*"	* *Laboulaye*, i., ed. 1877.
Making	* "*Scientific American Sup.*," 856.
	"*Scientific American*," xxxv. 403.

Nee'dle An-nun'ci-a'tor. 1. A form of optical telegraph in which a finger moving on a dial indicates a letter or a message. See DIAL TELEGRAPH, Fig. 806, p. 254, *supra*. Fig. 6238, p. 2506, "*Mech. Dict.*," Fig. 1667, p. 708, *Ibid.*

2. A form of annunciator in which several messages, numbers of rooms, or office departments may be placed on a board and a needle caused to point to either, at the option of the sender.

Nee'dle Car'ri-er. A *porte-aiguille*. A needle forceps. In the instance given, Dr. Turnipseed's clamp needle-carrier for operation in vesico-vaginal fistula, the needles clamped in the ends of the arms have a mutually approaching transverse

Fig. 1806.

Clamp Needle-carrier.

motion as the loops of the handle are partially rotated by pressing together.

Nee'dle For'ceps. An instrument to hold a needle in sewing up wounds.

In the instance, Fig. 1807, *Dr. Thornton Parker's*, the threaded needle is held by a screw clamp, and may have any

Fig. 1807.

Dr. Parker's Needle Holder.

convenient angle of presentation. The hollow handle holds needles.

Dr. Wight's needle forceps has serrated jaws, and a catch

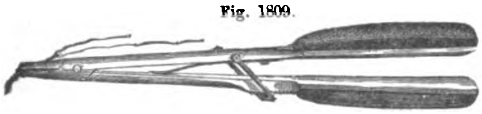
Fig. 1808.

Dr. Wight's Needle Forceps.

on each bow to lock the forceps shut. Used also in removing pieces of necrosed bone, in arresting arterial hemorrhage, etc.

Fig. 1809 shows the needle forceps of *Dr. Anatole de Gaine,*

Fig. 1809.

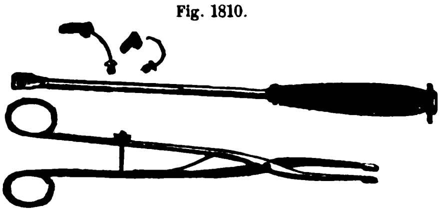


Dr. De Gaine's Needle Forceps.

of St. Petersburg. The needle is held at any angle, and the handles are locked by link and ratchet.

Dr. Turnipseed's needle holder, needles, and clamps, for uterine operations, are shown in Fig. 1810. The needles pro-

Fig. 1810.



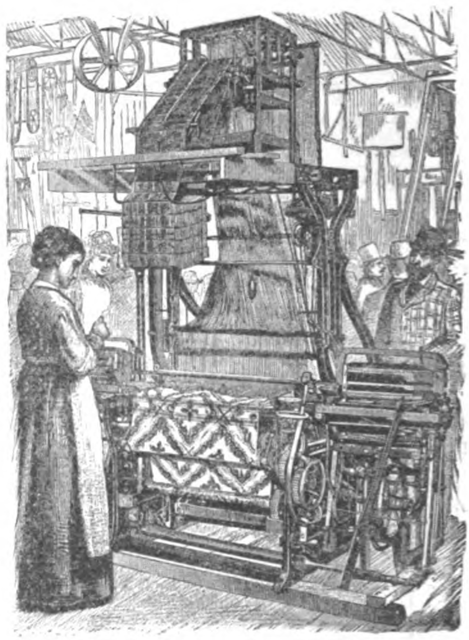
Dr. Turnipseed's Needle Forceps.

jecting transversely to the line of the handle, are thrust through the lips of the wound by a partial rotation of the handle, and the ends of the needles received in clamps, which are pressed down upon the needle, preventing retraction. The clamp closer is shown below.

Nee'dle Loom. A loom in which the weft is thrust through the shed by a rod, known as a *needle.* Fig. 1811 shows a four-harness Jacquard loom of Dienelt & Eisenhardt, for weaving ingrain carpets. It has a capacity for 16 weft threads of varying colors.

The pattern mechanism acts upon separate lifters, through which the 8 colored threads of the weft respectively pass. The colored yarn which is required for the next throw is

Fig. 1811.



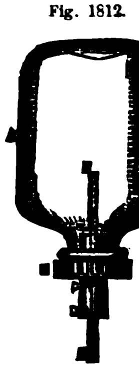
Ingrain Carpet Needle Loom.

elevated so as to be caught in the slot of the reciprocating needle and carried half way through the shed, where it is caught by a hook which has advanced from the other selvage to meet it, and the loop is drawn back to the selvage by the hook, laying two threads in the shed. The loop of the weft is then caught by a latch-needle, which is moved in a direction across the path of the weft and is knit in with the former loop.

See also Carpet Loom, p. 169, *supra.*

Nee'dle Lu'bri-ca'tor. A form of lubricator consisting of a strong globe of glass having a neck or outlet fitted with a stopper of wood, through which is a conical metal tube, forming the only exit for the oil. In order to regulate the supply of oil, a metallic feed-rod (needle) passes through the tube, and rests upon the shaft to be lubricated.

Fig. 1812.



Needle Lubricator.

Neg'a-tive. 1. (*Electricity.*) In the battery, the copper, carbon, or platinum plate.

See list in Negative columns, tables of Galvanic Batteries, pp. 367–373 *supra.*

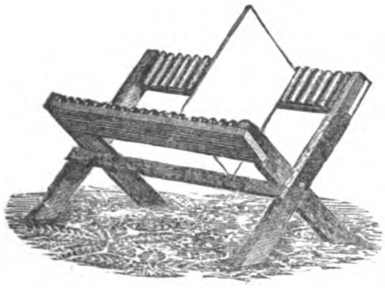
2. (*Photography.*) The cliché or picture in reverse; from it the *positive* is printed.

Neg'a-tive Rack. A frame for holding glass negatives to drip. See Fig. 1813.

Nerve In'stru-ments. (*Dentistry.*) Instruments for broaching, cleaning, filling, etc., the nerve cavity. Fig. 1814.

a. Spring tempered *nerve bristles*, for removing pulp, cleansing pulp-canals, introducing medicaments in the treatment

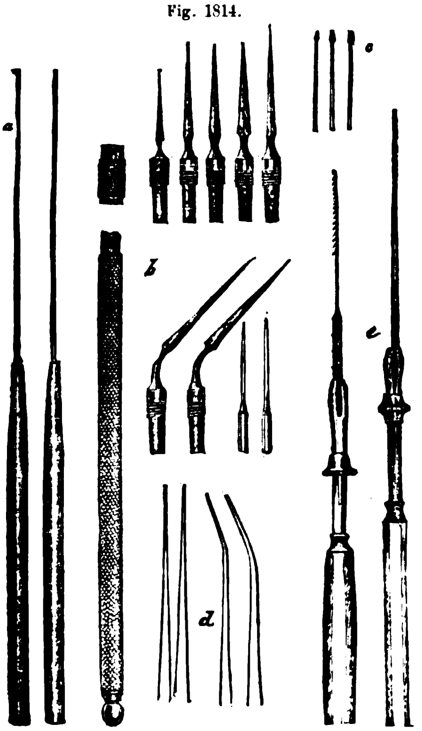
Fig. 1813.



Folding Negative Rack.

of alveolar abscess, etc. Some are roughened, some have minute hooks at the end. There are 10 in a set.

Fig. 1814.



Nerve Instruments.

b. Nerve-canal reamers, for cleansing and preparing nerve canals. A set consists of 14 triangular and 3 4-sided reamers.
c. Bur drills, used in drilling fangs preliminary to filling.
d. Nerve-cavity pluggers.
e. Nerve extractors. Barbed bristles.

Neurotome; excision of dental nerve * "*Sc. Am. Sup.*," 4114.

Nest Spring. A spiral spring of several concentric coils. *s. t.*, Fig. 1143, p. 483, "*Mech. Dict.*"

Net. For list of U. S. Patents, fishing nets, pounds, traps, seines, eel pots, etc., see FISHING NET, p. 342, *supra*.

See also: —

Anchored net.
Bag.
Bag net.
Bait net.
Bar net.
Bar weir.
Bowl.
Bull net.
Casting net.
Cast net.
Collecting seine.
Crab net.
Crib.
Dip net.
Dipping wheel.
Dredge.
Drift net.
Drop net.
Eel pot.
Float.
Folding net.
Fyke net.
Gill net.
Handle net.
Haul seine.
Heart.
Heart net.
Heart seine.
Hook.
Hook net.
Jerk net.
Landing net.
Leader.
Line.
Lint.
Meshing net.
Meter.
Pocket net.
Pot.
Pound.
Pound net.
Purse net.
Purse seine.
Scoop net.
Seaming.
Seine.
Seine windlass.
Sheave block.
Skim net.
Stake net.
Tilting net.
Towing net.
Trailing net.
Trammel net.
Trap.
Trap net.
Trawl net.
Tunnel.
Weir.
Wing.
Wing net.

Also: —

Garden net, over fruit trees.
Fly net.
Horse net.
Poultry netting, to limit their range. A sort of fence.
Spring net; one closed by trigger and spring; used in catching rabbits.
Banner netting, for painting signs or banners, to be suspended across a street, and avoid carrying away by the wind.
Clap net; one having hinged sections; used in bird-catching.
Hammock net; open-work netted hammock.
Vat net, for a strainer.
Quail or partridge net, for catching those birds.
Lawn-tennis net; used in the game.

Net'ma-ker's Knife. (*Fishing.*) A blade (2″) without a handle, and the heel of the blade curved so as to fit the finger like a ring.

Net'tle. (*Nautical.*) A small cord used for seizing or grafting, as the *nettles* (*knittles*) of a hammock.

Net'tle Stuff. (*Nautical.*) Small line used for seizings, worming, etc.

New Pro'cess Mil'ling. See CYLINDER MILL; ROLLER MILL; HIGH MILLING; MIDDLINGS PURIFIER, etc., and "*American Miller*," vi. 2.

Ni-au'det Bat'te-ry. (*Electricity.*) Otherwise known as the *chloride of lime battery*. The positive electrode is a plate of zinc in a solution of chloride of sodium; the negative element is a plate of coke surrounded by coke fragments and chloride of lime in a vessel of biscuit ware or parchment paper.

Nic'ol's Prism. (*Optics.*) A prism of Iceland spar so constructed as to transmit but one of the two rays into which light is divided in passing through this substance — polarizing the same.

Used in connection with the polariscope for the microscope. See POLARISCOPE.

Nick'el. See data on p. 1525, "*Mech. Dict.*"

The alloys of nickel are of considerable importance. It unites readily with iron, cobalt, copper, antimony, zinc, tin, etc.

The alloys of nickel with copper and zinc form German silver or albata (Eng.), *Argentan* (Fr.) *Packfong* (Ch). See list, p. 63, "*Mech. Dict.*"

Britannia metal is principally copper, tin, and antimony.

French recipes: —

	Copper.	Nickel.	Zinc.
1. Common *argentan*	16	4	7
2. White *argentan*	16	6	7
3. Electrum	16	8	7
4. Electrum	16	12	7
5. Tutenag	16	6	11

Solder for *argentan*; argentan (No. 1), 5 parts; zinc 4 parts.

Nickel	"*Scientific American*," xxxv. 149.
And cobalt at Centennial. *Wharton*	"*Eng. & Min. Jour.*," xxiii. 13.
Battery, *Slater* . . .	* "*Scientific American Sup.*," 3341.
Bronze	"*Manuf. & Builder*," xii. 197.
Furnaces	"*Eng. & Min. Jour.*," xxv. 326, 346, 424 : * xxvi. 24.
Plating, *Stolba* . . .	"*Sc. American*," xxxvi. 295.
Plating, *Wharton* . .	"*Iron Age*," xxv., April 8, p. 9.
Litigation	"*Iron Age*," xxv., April 29, p. 9.

At Krageroe, Norway, magnetic pyrites, holding on an average 1.25 per cent. of nickel, are worked by the following process: "The raw ore is smelted with slag from refining in a 13-foot 3-tuyere shaft furnace, the slag made being thrown over the dump while the raw matte, holding 3.5 per cent. of nickel, is roasted in stalls. This roasted matte is smelted in a low furnace with one tuyere, 4′ high. The slag, holding 1 to 1.5 per cent. of cobalt, goes to the ore smelting. The matte made contains 30 per cent. of nickel and 15 per cent. of copper, and is returned to the same furnace, which concentrates it to 60 per cent of nickel and 30 per cent. of copper. The sulphur is only 10 per cent. This matte is ground and roasted completely in a small reverberatory furnace, and the oxides are reduced with charcoal powder in graphite crucibles, yielding 68 per cent. of nickel and 30 per cent. of copper. By the addition of copper this product is smelted into an alloy of one of copper and one of nickel, which is marketable." — *Friedr. Bode in "Dingler's Polytechnic Journal."*

In Plazanet's nickel-plating process a bath is used of 87.5 grams of sulphate of nickel, 20 sulphate of ammonia, 17.5 citric acid, and two liters of water. A bath much used in France is formed of a solution of 4 parts of nitrate of nickel in 4 of liquid ammonia, and 150 water, in which 50 parts of sulphate of soda have been dissolved. Using a moderately weak current, the operation is at an end in a few minutes. There is no need to interrupt it by taking the objects out and brushing them. When the film of nickel is of sufficient thickness, the objects are withdrawn from the bath and dried with sawdust.

A new nickel-plating solution, said to yield beautiful results, is prepared by mixing the liquid obtained by evaporating a solution of $\frac{1}{2}$ oz. nickel in aqua regia to a pasty mass and dissolving it in 1 lb. aqua ammonia, with that obtained by treating the same quantity of nickel with a solution of 2 ozs. cyanide of potassium in 1 lb. of water. More cyanide renders the deposit whiter, and more ammonia renders it grayer.

Nick'el Bat'te-ry. (*Electricity.*) *Slater.* One form consists of a vessel with two interior porous concentric cells. In the central one is placed the plate of nickel with its excitant, dilute sulphuric or other acid; in the middle space is a solution of sesqui-carbonate of ammonia; in the outer space is a solution of sulphate of nickel, or the double sulphate of nickel and ammonia, together with suspended prisms or plates of carbon. The deposited salts are of commercial value.

Slater . .	"*Scientific American Supplement*," * 3341, 3790.
Wenzel .	"*Scientific American*," * xxxix. 150.

Nick'el Bronze. An alloy named from M. Jules Garnier, the inventor. The *garnierite*, an ore of nickel found in great quantity in New Caledonia, is worked in Nouméa, and the regulus shipped to Septemes, near Marseilles.

Here the pure metal is mixed with various proportions of copper, zinc, and tin, forming nickel bronze. Twenty per cent. of nickel suffices to give the desired tint, and to secure inoxidizability. All articles now made of brass or copper, nickel plated, can be produced in solid bronze by the same processes and with the same plant, and at practically the same cost. So made they are 20 per cent. stronger, and may generally be much lighter. Its great strength and the property of non-oxidization make this alloy eminently suitable for mathematical and musical instruments. It is used for:

Builders' fittings.	Harness trimmings.
Chains.	Arms.
Scientific instruments.	Clocks.
Art-metal work.	Bells.
Journal bearings.	Propeller journals.

See: "*Iron Age*"	xxiii., Jan. 16, p. 13; xxiv., Nov. 27, p. 13; xxv., May 20, p. 19.
"*Eng. and Min. Journ.*" . .	xxv. 26; xxvii. 76; xxix. 389.
"*Am. Manuf. and Iron World*"	xxvi., May 28, p. 7.
"*Scientific American*" . . .	xlii. 288.
"*Manufact. and Builder*" . .	xii. 144, 197.
Guillemin "*Technologiste*," .	xl. 364.

Nick'el-ine. The term given by Guillemin to nickel bronze. "*Technologiste*," xl. 364.

Nick'el Plat'ing. Nickel galvanoplasty for electrotypes and reproductions of works of art, has been much advanced by Boudreaux (*père et fils*), of Paris. The great difficulty attending the deposit in any considerable thickness, is owing to the tendency to exfoliate and curl, which is ascertained to be due to the absorption of hydrogen.

"This mode of accounting for the phenomenon will be readily accepted, if it be borne in mind that in this case the nickel crystallizes; that it is very porous as compared with ordinary cast nickel; and that in 12 hours it condenses 160 times its own weight of hydrogen, when it is attached to the negative pole of a rather powerful galvanic battery, in the electrolysis of water." — "*Electrician*," Feb., 1882, p. 24.

The advantage of nickel for type plates and art reproductions is evident from the fact that with about the same density (Cu., 8.90; Ni., 8.57) the resistance of nickel to mechanical pressure is about 3 times that of copper. Nickel is also much less affected by colored inks.

Prof. Stolba's Process: To a dilute solution of chloride of zinc (5 to 10 per cent.) enough nickel sulphate is to be added to impart a decidedly green color to it, and the solution is then to be heated to boiling in a porcelain vessel. The clouding of the liquid from a separation of a basic zinc salt need not be heeded, as it will not interfere with the effectiveness of the bath. The articles to be nickel-coated — first carefully cleaned of oxide or grease — are to be suspended in the solution from 30 to 60 minutes, the bath being kept at a boiling temperature. When articles are observed to be uniformly coated, they may be removed, washed in water in which a little chalk is suspended, dried and finally polished with chalk or other suitable material. By the substitution of a cobalt salt in place of the nickel, objects may be similarly coated with cobalt.

U. S. Patents since list pp. 1525, 1526, "*Mech. Dict.*": —

121,883	. . . .	*Keith*	1871
125,868	. . . .	*Whitman & Neal* . . .	1872
128,166	. . . .	*Parmalee*	1872
129,881	. . . .	*Beardslee*	1872
130,362	. . . .	*de Lobstein*	1872
136,634	. . . .	*Adams*	1872
154,435	. . . .	*Adams*	Aug. 25, 1874
155,884	. . . .	*Normandeau*	1874
6,313	(Reissue)	*Adams*	Mar. 2, 1875
6,402	(Reissue)	*Adams*	Ap. 27, 1875
172,862	. . . .	*Adams*	Feb. 1, 1876
228,390	. . . .	*Pomeroy* . .	June 1, 1880
228,921	. . . .	*Perry*	June 15, 1880

See also "*Elements d'Électro Chimic*," Paris, 1864, p 325.

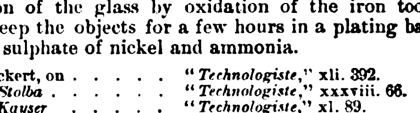
(*Glass.*) Recommended by M. Clémendot, a French glass manufacturer, to nickel-plate all pontys and molds for glass-making, to prevent coloration of the glass by oxidation of the iron tools. Steep the objects for a few hours in a plating bath of sulphate of nickel and ammonia.

Lockert, on	"*Technologiste*," xli. 392.
Stolba	"*Technologiste*," xxxviii. 66.
Kayser	"*Technologiste*," xl. 89.
	"*Scientific Amer.*," xxxvi. 408; xxxviii. 209.
Stolba	"*Scientific Amer.*," xxxvi. 295.
Wharton	"*Iron Age*," xxv., April 8, p 9.
Litigation	*Ibid.*, xxv., April 29, p 9.

Nick'el Steel. An alloy of cemented iron and nickel. — *Boussingault.*

Nick'ing Saw. A small circular saw, used in nicking screw-heads, etc.

Fig. 1815.



Nicking Saw.

Ni-el'lo. (*Fine Art Metal-working.*) Formerly, a metallic plate was engraved and the lines run full of an alloy which became black by heat. The surface being scraped down, the effect was of a drawing in black on the gold or silver plate.

On a larger scale, brass monumental plates were similarly ornamented, and the alloy formerly used, which was of copper, silver, lead, etc., was substituted by enamel, and then by black wax.

The latter style lives in the shop and door-plates of our streets.

Artistic work is yet produced in this line, black enamel and red copper being used, the latter deposited in the electro-bath.

See also p. 1526, "*Mech. Dict.*"

One beautiful form of niello is a sort of enameling upon silver; with a paste consisting chiefly of the sulphide of the metal itself. The process is as follows: —

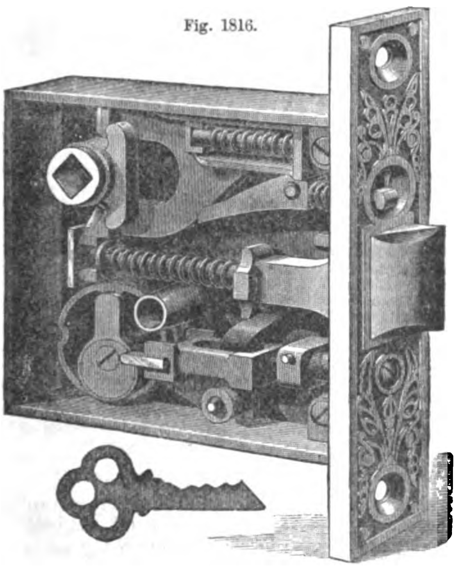
Take 4 drachms of silver, 2 oz. and 4 drachms each of copper and sal-ammoniac, 3 oz. and 4 drachms of lead, and 12 oz. of flowers of sulphur. Make a paste of the flowers of sulphur and water; put it into a crucible; afterwards melt the metals, and pour them into the crucible which contains the paste; re-cover this vessel in order that the sulphur may not take fire, then calcine over the fire until all the superfluous sulphur is driven off; afterwards finely pulverize the mass, and make, with the addition of a solution of sal-ammoniac, a paste, which introduce by means of rubbing, into the parts intended to be enameled; then clean the article, and place it in a furnace, where it is sufficiently heated to melt the paste which fills the engraved parts and makes it adhere to the metal. That done, moisten the article with a solution of sal-ammoniac, and heat it in a muffle to redness; after which you may rub and polish the article when it has become cold without fear either of altering or of detaching the enamel; it remains always of a very fine black color. — *Dr. Percy.*

Ni-el'lo Sil'ver. The composition of the Russian tula, or Niello silver, long kept secret, has been announced to be as follows: —

It consists of 9 parts silver, 1 part copper, 1 part lead, and 1 part bismuth, which are melted together and saturated with sulphur. This mixture produces the gorgeous blue which has often been erroneously spoken of as steel blue. — "*Berliner Tagblatt.*"

Night Latch. A lock operatable by key only from the outside, by handle from the inside; but capable of being fastened by a catch so that the bolt becomes immovable.

Fig. 1816.



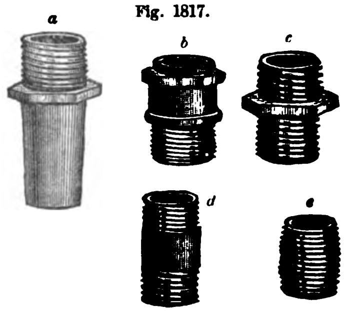
Night Latch.

The illustration shows a mortise lock, adjustable to right or left-hand doors.

Nip'pers. (*Nautical.*) An elastic hank made of strong yarns, laid parallel and marled from end to end. It is used for binding the messenger to the cable.

Nip'ple. A pipe coupling of reduced size, frequently threaded on the outside to allow the wire binding to compress the attached hose into the depressions of the thread.

Fig. 1817.



Nipples.

a. One end screw, the other solder.
b. Screw, and screw socket ends respectively.
c. Double screw.
d. Shoulder.
e. Close.

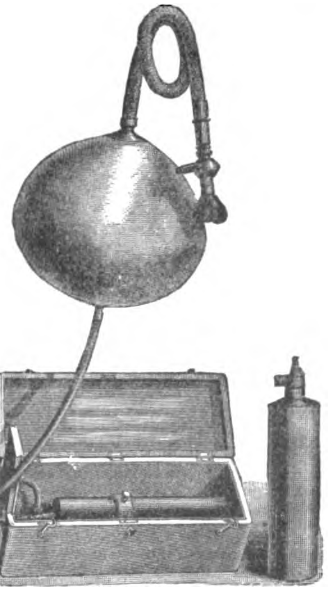
Ni'tro-gel'a-tine. An explosive agent invented by Nobel; formed by dissolving gun-cotton in nitro-glycerine, with camphor added in varying proportions, nominally 4 per cent. See BLASTING GELATINE, p. 105, *supra.*

Ni'tro-gly'cer-ine. The subject is discussed and numerous references given on pp. 1529, 1530, "*Mech. Dict.*"

See also "*Scientific American,*" xxxiv. 341; xxxviii. 58; "*Scientific American Supplement,*" 3874.

Ni'trous Ox'ide Ap'pa-ra'tus. This comprises a strong cylinder containing 100 gallons of gas compressed to a pressure of 80 lbs. to the square inch at 60° Fah. The case is provided with an iron ring and set screw, by which the iron cylinder is held in place during use, and its valve protected from injury; also, a rubber bag with rubber

Fig. 1818.



Surgeon's Case.

tube at one end for admission of gas; and a tube, terminating in an inhaler, at its opposite end.

See also Figs. 3331, 3332, p. 1530, "*Mech. Dict.*"

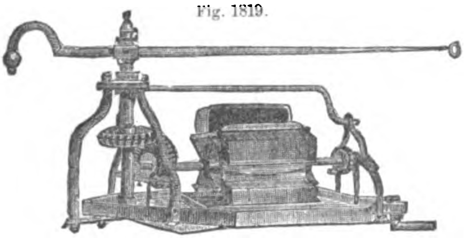
Nitrogen gas apparatus, *Blair,* * "*Sc. American,*" xxxix. 21.

Non′-con-duct′or. (*Electricity.*) Anything that does not freely transmit the electrical current, such as glass, hard rubber, dry wood, etc.

No′ri-a. (Arabic, *Na' Ura.*) A water-raising device consisting of a chain of pots or buckets. A very ancient device, still very crude in Syria and Egypt. See Figs., p. 1533, "*Mech. Dict.*"

Fig. 1819 shows a modern French form in which the main features of the ancient contrivance are preserved, but with

Fig. 1819.

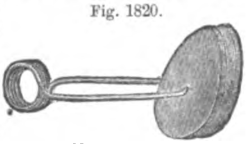


Modern Noria.

the aid of improved construction and materials. The animal, an ox usually, travels in the accustomed route; the interposition of a single pair of gears transposes the motion from the vertical to the horizontal, and upon the shaft are iron chains and buckets, the substitutes for the ropes and pots.

Nose Com′press. Pinchers for the nose, when administering gas from a *mouth*-piece, and not from a face-piece.

Fig. 1820.



Nose Compress.

Nose Glass. (*Optics.*) A *pince-nez*, or folding eye-glass, supported by grasping the nose instead of the temples.

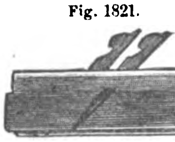
No′sing. The keeper of a lock, into which the latch or bolt engages.

No′sing Mo′tion. Refers to appliances for the perfect winding of yarn on the noses of the spindles, by an accelerating motion, to secure tightness of the yarn on the reduced diameter of the upper end of the mule spindle.

See article by Mr. Eli Spencer, of Oldham, in "*Engineering*," xxx. 510, Figs. 8 to 12.

No′sing Plane. A plane with hollow-rounded sole, for dressing the front edges of wooden treads of stairs.

Fig. 1821.



Nosing Plane.

Notch′ing Ma-chine′. 1. (*Sheet-metal Working.*) A machine for cutting the corners and notches for square boxes, hinges, etc. It has adjustable gages, works with a foot-treadle, and will cut several thicknesses at once: 12,000 notches in 10 hours.

2. A machine for cutting notches in blanks for paper boxes or envelopes. See Fig. 693, p. 222, *supra.*

Noz′zle. A discharge-pipe or ventage.

The nozzles of the placer mines in California are shown in Fig. 2616, p. 1149, "*Mech. Dict.*," and the subject also considered under Hydraulicking, p. 481, *supra.*

With the introduction of iron pipe, the nozzles were gradually enlarged, and the "Little Giant," a large cast-iron nozzle working on a swivel joint, was introduced.

Craig discovered that by rifling the Little Giant, the jet, instead of whirling and expanding, shot out straight, retaining its full force. Then Hoskins invented the second joint to the "Little Giant," which enables the raising or lowering of the nozzle, and under several inventions a nozzle has been perfected, the largest of which can be moved in any direction by a child; one of eight inches, with 200 feet head, capable of moving 3,000 cubic yards per day, being operated by one hand with ease. Thus one man, with perfect ease moves as much gravel in a day as 1,000 men could with shovels and cars.

Controlling nozzle, *Clemens*, * Fig. 685, p. 219, *supra.*

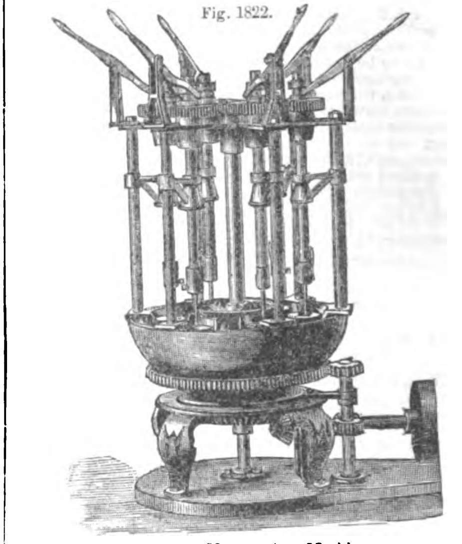
Nut Lock. A device to keep a nut from turning on the bolt. See Fig. 3350, p. 1538, where 46 illustrations are given.

	* "*Scientific Amer.*," xxxviii. 244
Conical, *Atwood* . . .	* "*Railroad Gazette*," viii. 34.
Grubb	* "*Scientific American*," xli. 86.
Fish-plates, *Skinner*, Br.	* "*Engineer*," xlvi. 146.
Atwood	* "*Scientific American*," xliii. 386.
Whitmarsh	* "*Scientific American*," xxxix. 230.

Nut-tap′ping Ma-chine′. A machine for cutting threads in punched nut blanks.

The machine shown in Fig. 1822 consists of a solid cast-iron platform, upon which rests a bowl which is kept nearly full of water; on the top of this bowl is a solid six-armed plate upon which rest six nut chucks; above this plate there

Fig. 1822.



Cleveland Nut-tapping Machine.

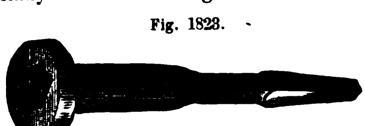
is a top plate supported by iron columns, in the center of which there is a vertical driving shaft, on the head of which there is a cog-wheel. Around this cog-wheel at regular distances apart are six spindles. The tap goes in at the lower end of the spindle, each spindle being over a nut-chuck on the bottom plate. The top and bottom plates being securely bolted together, have a rotary motion, and at the same time the gearing is so constructed that the six vertical spindles, being propelled by cog gear at the top, perform the work of tapping nuts as they pass around. One person can manage the machine. The water in the bowl comes up to the surface of the nut chuck or seat, and about a quarter inch of oil floats upon the water, coming over the nut (one quart of oil being sufficient for the tapping of a ton of nuts).

Each tap will hold from 8 to 12 nuts, which, fast as they are cut, rise to give place to the next one. When the tap is full, the attendant releases it, removes the nuts, and replaces the tap, which is ready to operate as before.

See: Cold punching . .	* "*Iron Age*," xxii., Aug. 15, p. 1.
Forg. mach., *Horsfall* .	* "*Scientific American Sup.*," 1491.
Horsfall, Br. . . .	* "*Engineer*," xliv. 148.
Boring, tapping, facing, & slotting, *Hartnell*, Br.	* "*Engineering*," xxi. 364.

Nut Wrench. A tool to be used in an ordinary brace, for the screwing on or off of bolt-nuts. Especially useful in carriage work.

Fig. 1823.



Nut Wrench.

Nut and washer gage, Fig. 7048, p. 2727, "*Mech. Dict.*"

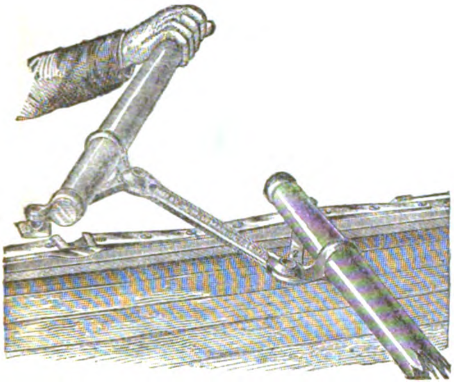
O.

Oar. The early notices of, and terms employed in, the handling of oars, are given on p. 1541, "*Mech. Dict.*"

The *Lyman* oar is a compound lever arrangement by which the oars are manipulated by a rower facing forward. Fig. 1824.

See also Rowing Gear.

Fig. 1824.



Lyman Facing Rowing Gear.

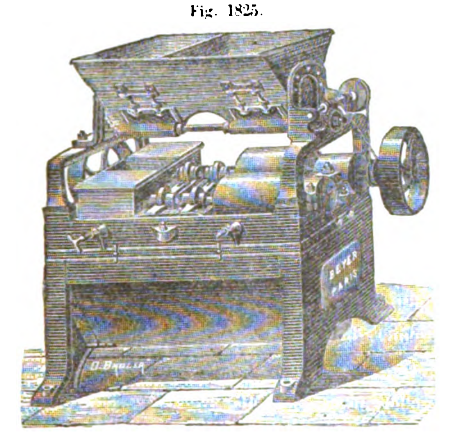
Oat Mill. A machine for coarse-grinding oats.

The machines are of two characters : —

1. For grinding horse-feed ; these are known as feed-mills or kibbling mills in England, and as *concasseurs d'avoine*, or *aplatisseurs*, in France. Their action is usually rather a crushing than a grinding operation.

2. Machines for the grinding of oats for gruel or porridge. The proper plan is to hull the oats, and then to pass them

Fig. 1825.



Oat Mill. (French.)

through a pointing machine which removes the fuzz on the point of the berry. This fuzz is said to produce an irritation of the skin which Byron mockingly calls "Sawney's violin."

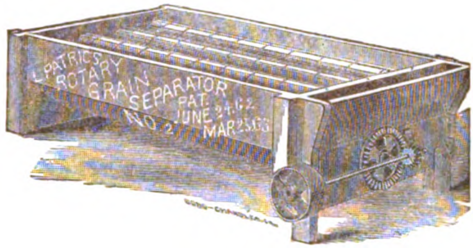
The French oatmeal machines (Beyer, Paris) proceed, however, directly upon the oats, by a double operation. The oats are passed between cylinders which simply flatten the grain without discharging any of the farina, and this product is then passed through the mill, which grinds it and discharges it into the sieves beneath, which sort it into qualities. See also • "*Scientific American*," xlii. 261.

A British form of oat-mill, *Biddell's*, is also double, but its duplicate parts are for simultaneous operation upon two grains for feed, — say oats and beans.

Oat Sep'a-ra'tor. A machine for removing from wheat the oats which are so frequently present in merchantable grain.

The grain is poured on to the slanting rollers which continually rotate and keep the berries in line ; the thinner oats escape in the intervals between the rollers.

Fig. 1826



Rotary Oat Separator.

See also Grain Cleaner, Plate XX., opp. p. 416, *supra*, where a number of devices for this purpose are shown.

Ob'e-lisk. The obelisk, to be erected to Gen. John E. Wool, near Troy, N. Y., is to be 59′ height, 5.5′ square at base, 3′ square at top. To be erected on a pedestal 15.5′ high, on a foundation of 16′. Total 90′.

The following may be referred to for data on obelisks : —

Alexandria & N. Y. .	"*Scientific Amer. Sup.*," xii. 322
Paper on Egyptian. *Cooper*	"*Scientific American Sup.*," 1887.
Paper by *Donaldson* . .	"*Scientific American Sup.*," 2002.
Elevating	• "*Scientific Amer.*," xxxvii. 328.
Launch of Cleopatra's needle	• "*Scientific Amer.*, xxxvii. 255.
Launch of the	"*Scientific American Sup.*," 1521.
Abandonment at sea .	• "*Scientific Amer.*," xxxvii. 354.
Lowering of Alexandrian	"*Iron Age*," xxv., Jan. 15, p. 13.
Cleopatra needle vessel.	• "*Scientific Amer.*," xxxviii. 199.
Inscriptions on obelisk .	• "*Scientific Amer.*," xxxviii. 199.
Taking down Cleopatra's needle	"*Scientific American*," xlii. 48.
Machinery	• "*Engineer*," xliv. 256.
Machinery for moving and raising	• "*Engineering*," xxvi. 409.
Placing on Thames embankment	• "*Scientific American*," xxxix. 55.
	• "*Harper's Weekly*," Oct. 26, 1878.
Cleopatra's needle (varnishing)	"*Scientific American*," xli. 26.
Vessel, Br.	• "*Engineering*," xxiii. 211.
Purpose, proportions, etc. "*Builder*," *Donaldson*	"*Van Nostr. Mag.*," xviii. 538.
Cleopatra's needle, Lond.	• "*Scientific American Sup.*," 2379.
	• "*Scientific American*," xxx. 215 ; xxxviii. 23.
	• "*Scientific American Sup.*," 1089.

See also Monolith, "*Mech. Dict.*" *et supra*.

A list of the remaining famous monolithic pillars of Rome is given under Masonry, p. 586, *supra*.

O-blique' Fire. (*Fire-arms.*) That shape of action in which the plunger lies and strikes the ignition obliquely, that is, not parallel with the axis of the barrel.

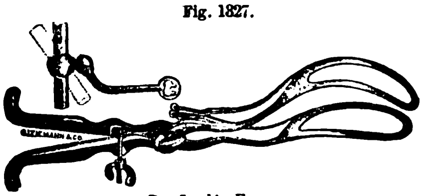
Ob-stet'ric For'ceps. A clasping prehensile instrument for assisting in difficult parturition. See Fig. 3363, p. 1543, "*Mech. Dict.*"

From a Guide Book to Pompeii : —

"*Maison des Grâces ;* ainsi nommée d'une peinture des Grâces, avec Vénus et Adonis. A en juger par les instruments qu'on y a découverts (différentes espèces de forceps) on pense que c'était l'habitation d'un accoucheur."

Fig. 1827 shows *Dr. Lusk's* modification of the *Tarnier* obstetric forceps. The shanks have a peculiar forward

Fig. 1827.



Dr. Lusk's Forceps.

bend; a transverse screw crossing the handles below the lock; two movable traction rods attached to the inner curvature of the blades, and their outer ends inserted into a socket-rod joint belonging to a steel bar with a downward curve, and furnished with a transverse handle which has a universal joint, and by which alone tractions are made. — "*American Journal of Obstetrics*," April, 1880.

Fig. 1828.

Dr. Coles' Forceps.

Fig. 1828 shows *Dr. Coles'* obstetrical forceps.

Ob'tu-ra'tor. (*Add.*) 2. (*Ordnance.*) A gas check in a breech-loading piece; a Broadwell ring, for instance.

See remarks on the application of the obturator in an Austrian rifled cast-iron breech-loading howitzer of 21 cm. "*Ordnance Report*," 1878, Appendix L, p. 97, and Fig. 12.
Broadwell gas check, Fig. 1067, p. 448, "*Mech. Dict.*"

Oc'to-plex Tel'e-graph. (*Electric.*) One capable of sending 8 messages simultaneously over a single wire. An extension of the principle of the duplex, quadruplex, etc.

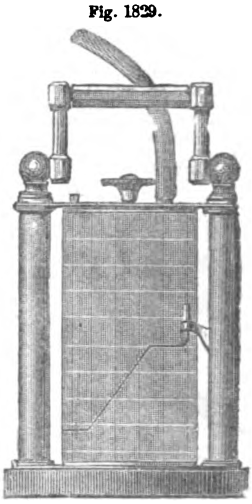
Klinkerfuss . . . . "*Scientific American*," xli. 306.

Oc'u-lists' Chair. One with special adaptations for operations on the eye.

The *seat* is adjustable for height.
The *back* for length, and for inclination.
The *head-rest* for angle.
The *cheeks* for distance, in clamping the head to hold it steady.
The *foot-rest* for length, height, and angle. *McIlroy.*

O'do-graph. An apparatus invented by M. Marey, for measuring the length and rapidity of man's strides in walking.

Fig. 1829.



Marey's Odograph.

It is a small instrument carried by the hand, and consists of a cylinder containing clockwork which causes the cylinder to revolve at the uniform rate of 2.36″ an hour. A pen is so arranged as to trace a line on paper rolled around the cylinder, and the track made by this pen shows the rapidity of the footsteps of the person to whom it is attached. An air valve is placed in the sole of the shoe, and it communicates with the instrument by means of a rubber tube leading up the trowsers' leg. Each time that the foot strikes the ground a slight puff of air is sent through the tube, causing the pen (which would otherwise mark only a horizontal line) to rise a distance equal to 0.004″. Thus a line is traced on the paper from left to right, rising at a greater or less angle with the horizontal according as the rapidity of the step is increased or diminished. If a man stepped exactly 3′ at each step it is evident that in going 3,000′ the pen would rise just 0.4″ but it was found in practice that the distance the pen was raised varied between 0.51 and 0.67″, showing that the average step varied in length from 2¼ to 2′.

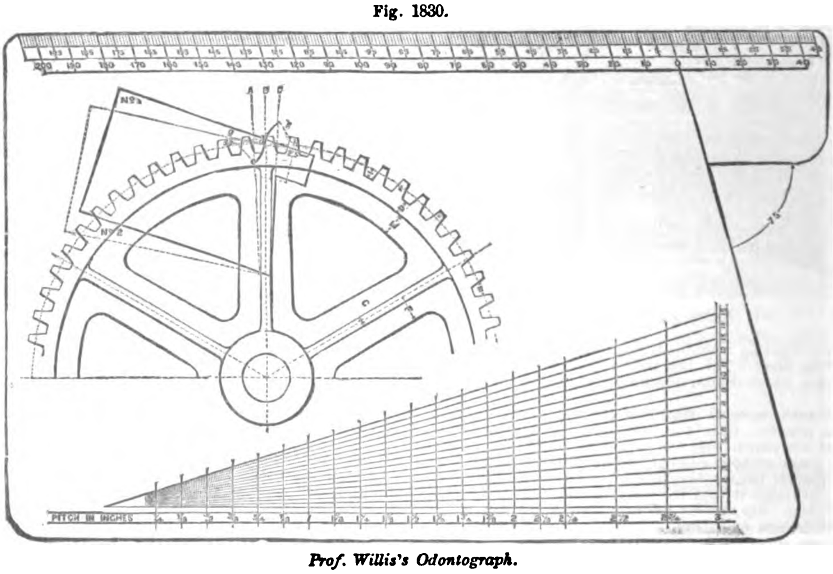
Odometer, *Gurley*, * "*American Man.*," July 25, 1879, p. 12.

O-don'to-graph. An instrument for setting out the forms of teeth of gear wheels.

By the use of Prof. Willis's instrument, shown in Fig. 1830, and tables of the *centers for the roots*, and *centers for the tops or faces*, the circular tops and roots of teeth can be readily drawn, and, considering the shortness of the arc, the shape of the tooth approximates very closely to the true epicycloidal form, and is quite correct enough for all practical purposes.

Fig. 1830 shows how the instrument is used. The wheel

Fig. 1830.



Prof. Willis's Odontograph.

selected as an example has 61 teeth, 3'' pitch. Having found the diameter of the pitch line of the wheel required, and this diameter being described, set out A C = to the pitch of the tooth, and draw the radial dotted lines as shown; bisect these by another radial line, B. For the root of the tooth, place the instrument as indicated in No. 1, and in the Table for the Roots of Teeth, which is the number nearest to that required, and in the column for 3'' pitch, will be found 37. This point must be pricked off at g, and the arc d e described. This gives the proper form for the root of the tooth. The instrument is then moved into the position indicated by the dotted lines No. 2; and 25 being the number given opposite to 60 in the column for 3'' pitch in the Table for Tops of Teeth, this point is pricked off as above described, and from the point h the arc k d is described. This gives the proper form for the top or face of the tooth.

When fixing the points g and h, it must be remembered that they will be found on *opposite* sides of the radial arm of the instrument.

***Internal Gear.* — In setting out internal gear the rule is inverted, the curve for the root becoming that which is given for the top in the foregoing instructions for using the instrument.**

***Rack Gear.* — For setting out racks the pitch line becomes a straight line, and the instrument is applied to perpendiculars drawn on it equal to the pitch.**

The numbers for pitches not given in the Tables may be found by doubling or dividing the numbers of a given pitch. As examples, if 4'' pitch is required, double the number given for 2'' pitch; or if ½'' pitch is required, take half that given for 1'' pitch.

The diagonal scale, at the lower part of the figure, gives the proportions of the various parts of wheels. These proportions give good results for wheels of ordinary dimensions; but modifications are required for very small or very large wheels. — *Appleby*.

CENTERS FOR THE ROOTS OF TEETH.

No. of Teeth.	Pitch in Inches.							
	1	1¼	1½	1¾	2	2¼	2½	3
13	129	160	193	225	257	289	321	386
14	69	87	104	121	139	156	173	208
15	49	62	74	86	99	111	123	148
16	40	50	59	69	79	89	99	191
17	34	42	50	59	67	75	84	101
18	30	37	45	52	59	67	74	89
20	25	31	37	43	49	56	62	74
22	22	27	33	39	43	49	54	65
24	20	25	30	35	40	45	49	59
26	18	23	27	32	37	41	46	55
30	17	21	25	29	33	37	41	49
40	15	18	21	25	28	32	35	42
60	13	15	19	22	25	28	31	37
80	12	15	17	20	23	26	29	35
100	11	14	17	14	22	25	28	34
150	10	13	16	19	21	24	27	32
Rack	10	12	15	17	20	22	25	30

CENTERS FOR TOPS OR FACES OF TEETH.

No. of Teeth.	Pitch in Inches.							
	1	1¼	1½	1¾	2	2¼	2½	3
12	5	6	7	9	10	11	12	15
15	5	7	8	10	11	12	14	17
20	6	8	9	11	12	14	15	18
30	7	9	10	12	14	16	18	21
40	8	9	11	13	15	17	19	23
60	8	10	12	14	16	18	20	25
80	9	11	13	15	17	19	21	26
100	9	11	13	15	18	20	22	26
150	9	11	14	16	19	21	23	27
Rack	10	12	15	17	20	22	25	30

PROPORTIONS OF WHEEL SHOWN IN FIG. 1830.

I = Depth of tooth below pitch line . . = $\frac{6}{15}$ P.
K = Height of tooth above pitch line . . = $\frac{5}{15}$.
L = Breadth of tooth above pitch line . . = $\frac{7}{15}$.
M = Width of space between teeth . . . = $\frac{8}{15}$.
D = Thickness of rim below the teeth . . = $\frac{7}{15}$ P.
E = Depth of rib of rim . . . . = 1 P.
F = Width of arm from feather . . . . = 1 P.
G H = Thickness of metal . . . . = $\frac{7}{16}$.

Robinson . . . . . * "*Min. and Sc. Press*," xxxiv. 105.
"*Scientific American*," xxxv. 181.
Willis . . . . * "*Van Nostrand's Mag.*," xv. 1.

O'dor-less Ex'ca-va'tor. A pump, tank, and consumer of odor, to remove inoffensively the contents of cesspools.

See CESSPOOL PUMP, Fig. 584, p. 187, *supra*.
"*Scientific American Supplement*" . . . . . . 978.

Œ-de'ma Glot'tis Tube. (*Surgical.*) See EDEMA GLOTTIS TUBE.

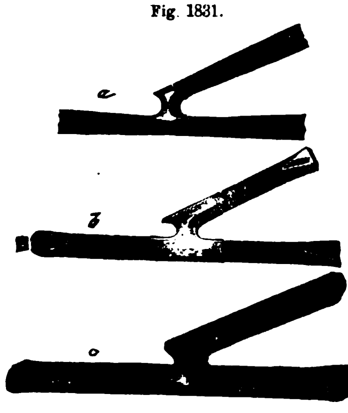
Off'-bear-ing Bar'row. The barrow in a brick yard, plying between the molding bench and the hack. See Fig. 2351, p. 1046, "*Mech. Dict.*"

Of'fice Watch'man. An instrument to keep record of the periodical visits of a watchman in a building or yard.

See WATCH CLOCK, Fig. 7080, p. 2733; WATCHMAN'S TIME DETECTOR, Figs. 7083, 7084, p. 2784, "*Mech. Dict.*"

Off'set. (*Carriage Hardware.*) The fork at the point in the back-stay where the branches separate to reach the hind axle at two points.

Fig. 1831.

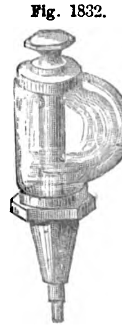


Offsets.

a. Round offset.
b. Point octagon offset.
c. Oval offset.

Off'set Glass. A journal oiler having a glass globe, the bulge of which is on one side in order to allow the glass to stand in a place close up to the side of an object.

Fig. 1832.



Offset Glass.

Off'set Pipe. A pipe to pass an obstacle, bending aside, and then resuming the original direction.

Several examples may be seen in Fig. 295, p. 97, *supra*.

Ohm. (*Electricity.*) A measure of electric force or resistance equal to 1,000,000,000 centimeters per second. Ganot's "*Physics*," p. 832. Named from the electrician Ohm, a German savant. The law governing the relations of current, electromotive force and resistance is known as *Ohm's law*.

The Electrical Congress in Paris, 1881, determined that the *ohm* should be represented by a column of mercury of a square millimeter section at 0° Centigrade. A committee was appointed to ascertain and report the height of such column in millimeters.

Oil Box. (*Railway.*) The journal-box, or axle-box of a car-wheel.

Oil Bush. A socket in which an upright spindle works, and which holds a quantity of oil, so that the spindle runs in oil, as in the Noyes oil-bush spindle for mill-stones.

Oil Cake Break'er. A machine for grinding oil cake as food for stock.

See CAKE BREAKER, Fig. 498, p. 152, *supra;* OIL CAKE BREAKER, Fig. 3369, p. 1547, "*Mech. Dict.*"

Oil Cans, etc. See: —

Cabinet, *Thayer*	* "*Scientific American*," xli. 382.
Can, *Moran*	* "*Scientific American*," xl. 150.
Can nozzle, *Hasenritter*	* "*Scientific American*," xxxiv. 274.
Can, suspended, *Graves*	* "*Scientific American*," xxxvii. 54.
Car	"*Scientific American Sup.*," 737.
Cleansing app., *Koellner*	* "*Scientific American Sup.*," 4108.
Cotton-seed oil	"*Scientific American*," xxxvi. 229.
Cylinder, *Siebert*	* "*Amer. Manuf.*," July 11, 1879, p. 16.
Cup, *High*	* "*Scientific American*," xxxv. 194.
Engine	* "*Manufact. & Builder*," x. 9.
Feeder, "American"	* "*Iron Age*," xix., June 14, p. 5.
Lubricants	"*Scientific American*," xliii. 404.
Oiler, *Eason*	* "*Scientific American*," xl. 85.
	* *Laboulaye's* "*Dict.*," ii., "*Graissage*," Figs. 1001-1007.
Backus	* "*Scientific American*," xxxiv. 291.
Tank protector	* "*Scientific American*," xliii. 308.
Storage, *Shaw*	* "*Manufact. & Builder*," xii. 175.
Testers. See LUBRICANT TESTER, *supra;* OIL TESTER, *infra.*	
Wells, *Baker*	"*Scientific American Sup.*," 107.
Of Burmah, *Robertson*	"*Scientific American Sup.*," 4049.
Process of sinking	"*Scientific American Sup.*," 1969.

Oil Cel'lar. (*Railway.*) A cavity in the lower part of a journal box for collecting the oil and dirt which runs off the axle at the dust-guard. — *Forney.*

Oil Cup. A lubricator placed over a journal or on a cylinder to oil the piston.

Fig. 1833.

Oil Cup.

The forms are various and may be found under: NEEDLE LUBRICATOR; OILER LUBRICATOR; TALLOW CUP, etc., in "*Mech. Dict.*," and herein.

The form shown in Fig. 1833 is a glass cup mounted on brass, provided with a hollow tube, inside of which is placed a loose-acting, solid or hollow wire, which rests upon the journal and acts as a feeder and regulator.

Oil En'gine. A name for the HYDRO-CARBON ENGINE, which see, Fig. 1420, p. 484, *supra.*

Oil'er. A LUBRICATOR. See TALLOW CUP; OIL CUP; OIL GLOBE, etc.

The oiler for wool is attached to the first breaker card.

Oil Gage. An instrument usually of hydrometer form for ascertaining the specific gravity of oils, and thereby obtaining data by which to estimate their purity.

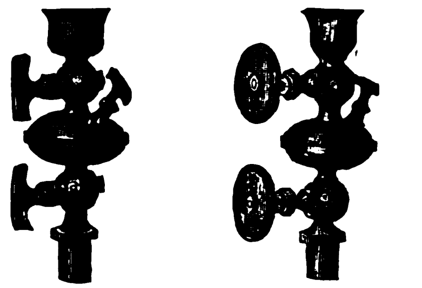
Plunge the instrument in the oil, give it time to acquire the temperature of the oil, and then observe the degree of the thermometer, as well as the degree of the hydrometer. If the thermometer is at x degrees *above* zero, an equal number of degrees must be deducted from the hydrometer degree. If the thermometer is at x degrees *below* zero, an equal number of degrees must be added to the hydrometer degree. The range of the hydrometer scale is from 22 to 50, and the following table shows the degree of certain common oils: —

Purified rape oil	38-39
Common rape oil	37-38
Olive oil	37-38
Dotter oil	32-33
Poppy oil	32-33
South sea train oil	33
Nut oil	32-33
Hempseed oil	30-31
Linseed oil	29-30

Mixtures of oils show a mean density. Oils that have been purified are rendered lighter, and show about 1° more on the instrument.

Oil Globe. A form of oiler having a globular oil chamber. In the instances shown, the devices have three cocks: one between the funnel and the chamber, one between the chamber and the steam cylinder, a third allows air to escape from the chamber when filling.

Fig. 1834.



Oil Globes.

Oil Line Pipe. A pipe laid for conveyance of petroleum. It was first introduced by S. Vansyckle, who laid a 2″ tube, 6 miles in length, in 1865. The United Pump Co. laid a 3″ pipe in 1873.

The following is the total mileage of iron pipe used for conveying oil in the oil regions of Pennsylvania: —

Lines.	Size of Pipe.		Total Miles.
	2-in.	3-in.	
	miles	*miles.*	
Atlantic Pipe Co.	80	10	90
American Transfer Co.	50	22	72
Ant. and Oil City Pipe Co.'s	-	-	186
Brady's Bend Iron Co.	1½	-	1½
Church Run Pipe Co.	6	-	6
Charley Run Pipe Co.	1¼	-	1¼
Cherry Tree Run Pipe Co.	25	-	25
Columbia Conduit Co.	71	51	128
Conewango Pipe Co.	5	-	5
Franklin Pipe Co.	9	1	10
Grant Pipe Co.	120	-	120
Hunter & Cummings Pipe Co.	5	¼	5¼
Karns Pipe Co.	82	-	82
Keystone Pipe Co.	80	-	80
Milton and Sandy Pipe Co.	52	1	53
McKean County Pipe Co.	16¾	-	16¾
New York Pipe Co.	40	-	40
New York and Alleghany Oil Co.	5	-	5
Octave Pipe Co.	20	-	20
Olean Pipe Co.	83	-	83
Pennsylvania Transportation Co.	380	-	380
Prentice, F. & Co.	¾	-	¾
Pacific Pipe Co.	2	-	2
Private Pipe (Foxburg)	2	-	2
Richard Jennings Pipe Co.	3	-	3
Relief Pipe Co.	100	-	100
Rochester and Oleopolis Co.	30	3	40
Sage Run Pipe Co.	5	-	5
Shaffer Run Pipe Co.	1½	-	1½
Smith's F'y & I. Run Co.	5	-	5
Titusville Pipe Co.	40	-	40
Tidioute Oil Pipe Co.	11	2	13
Taft & Payne Pipe Co.	10	-	10
Union Pipe Co.	300	-	300
United Pipe Co.	276	24	300
Total mileage	-	-	2,081½

The following is the mode of collecting the oil by means of the pipe lines and loading it into the cars: The pipe used is of wrought-iron lap welded, usually two inches in diameter, put together with a screw-sleeve joint. The main pumping line or lines are run from the center of production by the most direct route to the railroad station. The pipe is laid along the surface of the ground, except at road crossings or where protection is necessary. At the railroad large iron receiving tanks are erected varying from 5,000 to 20,000 barrels capacity each. These tanks are placed at a sufficient elevation above the railway to permit their contents to be run by gravity through pipes to the loading racks where the cars stand in sidings adjacent. At the necessary intervals along the pipe line, pumping stations are established for the reception and forwarding of the oil. The equipment of the main stations consists of a pump house, with two or more powerful pumps worked by steam: two tanks of from 500 to 2,000 barrels capacity each in a tank house; a telegraph office and a building to accommodate the employée in charge. From each such station, branch connecting lines lead off in every direction to the hundreds of wells that are tributary to it. At each well accurately gaged storage tanks are fixed to which the pipe line branches are attached. Before commencing to draw oil from these tanks their contents are measured and recorded; another measure and record is made after the pipe line ceases taking oil from them, and the difference in inches between the two measures forms a basis of credit to the well owner in the company's books. A memorandum receipt, known as a gager's ticket, is given to the well owner at the time the oil is run into the pipe line, and becomes a negotiable certificate. All petroleum received goes into a common store, from which deliveries are made in accordance with orders received from the owners.

"The average capacity per 24 hours of a single main of two-inch pipe may be considered as about 40,000 gallons. From 1866 to March 31, 1876, the oil passed through the Empire Transportation Company's pipes amounted to 375,810,551 gallons of crude petroleum. The quantity of petroleum held in store in tanks located in the Pennsylvania oil region may be stated as averaging from 80,000,000 to 120,000,000 gallons. In case of the conflagration of an oil tank the loss is shared by the owners, in the ratios of the relative quantities of the oil held for them at the time. From Karns City to the Alleghany Valley Railway the charge made for the use of the pipe line was 30 cents per barrel, an allowance of a little over two per cent. being made for leakage and waste." — *Capt. Galton.*

Pipe lines, statistics of .	"*Eng. & Min. Jour.*," xxii. 299.
	"*Scientific American*," xxxv. 130.
	"*Sc. American Sup.*," 737, 796.
Line pump	* Fig. 5725, p. 2359, "*Mech. Dict.*"

Oil Press. A press for extracting oil from seeds, fruits, fatty matters, etc. See: —

LARD PRESS, Fig. 2811, p. 1255, "*Mech. Dict.*"; HYDROSTATIC PRESS, p. 1156, *Ibid.*
See OLIVE PRESS, *infra.*
See also HOT PRESS (stearine), Fig. 1386, p. 471, *supra*; OIL PRESS, Figs. 3383, 3384, pp. 1534, 1535, "*Mech. Dict.*"; STEARINE PRESS, *infra*; SCREW PRESS; WEDGE PRESS, "*Mech. Dict.*"

Oil Pump. 1. A pump for oil wells, usually very deep.

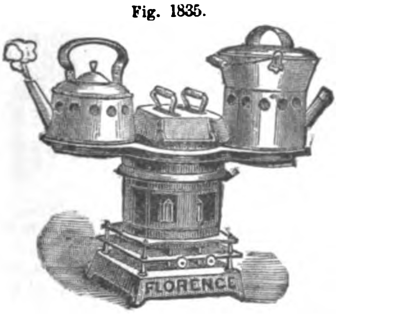
See DEEP WELL PUMP, Fig. 1604, p. 683, "*Mech. Dict.*"; EJECTOR, Figs. 1833–1835, p. 775, *Ibid.*; WELL APPARATUS, Plate LXXIV., p. 2758, *Ibid.*

2. A pump for oil pipe lines. Fig. 5725, p. 2359, *Ibid.*

Oil Stone. A report on whetstones and oil-stone was made by *J. M. Safford*; "*Centennial Exhibition Reports*," Group I., vol. iii., p. 172, *et seq.*

Oil Stove. A stove heated by petroleum.

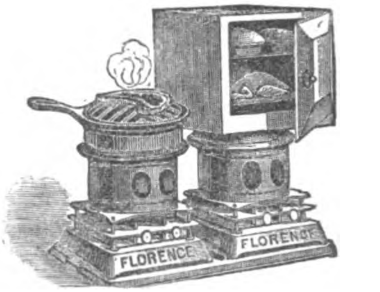
Fig. 1835.



Single Oil Stove.

Figs. 1835, 1836, show two forms, heated by lamps burning kerosene. One has a three-hole top on a single stove, and the other has two stoves on a common base.

Fig. 1836.



Double Oil Stove.

Refer to: —

Adams & Westlake . .	* "*Eng. & Min. J.*," Aug. 2, 1879, p. 10.
Cooking, "Summer comfort"	* "*Iron Age*," xix., April 5, p. 5.
"Faëry Queen" . . .	* "*Iron Age*," xix., June 7, p. 24.
Whitney & Hall . .	* "*Iron Age*," xix., June 28, p. 9.

Oil Test'er. 1. A machine for testing the lubricity of oils. See LUBRICANT TESTER. See also Fig. 6330, p. 2539, "*Mech. Dict.*"

2. Apparatus for testing explosive points of burning oils. See PETROLEUM TESTER. See also Fig. 3666, p. 1676, "*Mech. Dict.*," Figs. 6317, 6318, p. 2536, *Ibid.*, and memorandum on p. 1558, *Ibid.*

A simple test for the presence of free acid in machine oils consists in pouring the oil to be tested over a layer of cuprous oxide contained in a glass. (The ash of the coppersmith answers the purpose, since it contains this oxide.) If the oil contains either free, fatty, or resinous acid, the same will attack the oxide and color the oil green in a very short time. Slightly heating accelerates the action, which manifests itself in less than half an hour. This test is said to be very delicate, and more satisfactory than any hasty test heretofore devised.

Testing mach., *Ashcroft*	* "*Railroad Gazette*," xxii. 511.
Testing for acids . . .	"*Iron Age*," xxi., May 23, p. 15.
App., *Ingram & Stapfer*	* "*Scientific American Sup.*," 1078.
	* "*Engineering*," xxiii. 28, p. 33.
Mead	* "*Scientific Amer.*," xxxiv. 402.
Millspaugh	* "*Scientific Amer.*," xxxiv. 182.
Pease	"*Scientific American*," xlii. 323.
Thurston	* "*Engineering*," xxiii. 176.
	* "*Manufact. & Builder*," ix. 59.
Cleveland, *Withycombe* .	* "*Railroad Gazette*," xxi. 266.

See also LUBRICANT TESTER.

Oil'-well Pump. A pump for deep wells of narrow bore. See references under OIL PUMP, *supra.*

In the *Douglas* pump, Fig. 1837, the stuffing box head has a branch pipe on which to connect the discharge pipe that leads to the tank. Forked metallic connections are screwed on to the short connecting-rod in the stuffer head and to the piston, and are themselves connected by a wooden rod to which they are attached. The piston has a brass ball valve. Threads are cut on the stuffing box head, and the lower cylinder, so as to screw on iron pipes between to lengthen out the pump to suit wells of any depth.

O-i'ron-ware. (*Ceramics.*) See FAÏENCE D'OÏRON; HENRI-DEUX WARE, *supra.*.

O'le-o-jec'tor. A name adopted by the inventor, Mr. Royle, for a new form of cylinder and slide valve lubricator.

The apparatus has an elevated reservoir from which the oil drips, drop by drop, into the cup. A valve closes against internal pressure, and at each recurrence of low pressure a jet of steam drives the oil in a spray into the chamber or cylinder.

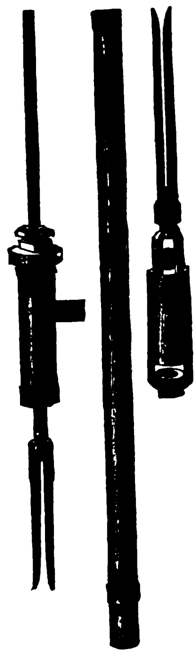
"*Engineering*"	xxx. 294.
"*Engineer*"	l. 281.

O-le-om'e-ter. An instrument on the Gay Lussac hydrometer principle, for testing the relative gravity of oils.

It has a weighted air bulb and graduated stem, and does not differ from other meters of its class, except in proportion and the index of graduations.

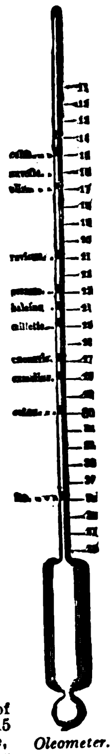
Another test of the purity of oils proceeds by observation of the tints of oils by adding a drop of concentrated sulphuric acid to 10 or 15 drops of the given oil on a glass plate, covering with white paper, and observing the tints produced: the method of M. Heydenreich, of Strasburg. The results obtained are affected, however, by the age of the oil; in some degree by the mode of its extraction; some oils give the same indications, and mixtures give curious combined results difficult to read.

Fig. 1837.



Oil-well Pump.

Fig. 1838.



Oleometer.

Lefebvre's Table of Densities of Oils, freshly prepared, Temperature, + 15° C.

Oils.	Density, Water, 10,000.	Weight. Per Hecto-liter.	Per Liter.
		Kilos.	*Grams.*
Sperm	8.840	88.40	884.
Oleic acid	9.003	90.03	900.3
Winter colza	9.150	91.50	915.
Winter turnip seed	9 154	91.54	915.4
Summer turnip seed	9.157	91.57	915.7
Neats' foot	9.160	91.60	916.
Summer colza	9.167	91.67	916.7
Earth nut	9.170	91.70	917.
Olive	9 170	91.70	917.
Sweet almond	9.180	91.80	918.
Beech nut	9.207	92.07	920.7
Grape seed	9.210	92.10	921.
Sesame	9.235	92 35	923.5
Whale	9.240	92 40	924.
Poppy seed	9.253	92.53	925.3
Hemp seed	9.270	92 70	927.
Cod liver.	9.270	92.70	927.
Skate liver	9.270	92 70	927.
Cameline	9.282	92.82	928.2
Cotton seed	9.306	93.06	930.6
Flax seed	9.350	93.50	935.

See also tables and lists, pp. 1551-1553, "*Mech. Dict.*"

The instrument of Lefebvre, of Amiens, Fig. 1838, has a relatively large cylindrical air-chamber and a long stem. The latter is graduated for densities comprised between 9,000 and 9,400, which includes the principal oils of commerce. The figuration on the scale comprises actually only the two middle figures, the units and thousands not being shown.

For example: colza oil shows "15" on the scale. It is necessary to read 9(15)0 for the density; or 91.50 kilos for the weight per hectoliter: or 915 grams per liter.

On the left of the line of the graduations are the names of the oils. Thermometrical corrections are made by table. Adulterations give indications between the two oils so combined, according to their relative densities, and proportional quantities. The test is much complicated by the settling of the heavier oil to the bottom as the mixtures are unstable. Poppy-seed oil, mixed with olive oil, will form a lower stratum in 8 days of repose.

Earth-nut and olive oil have the same weight: hemp seed and cod-liver oil are also equal.

The oleometer of Laurot, of Paris, is for testing by means of ascertaining the density at the boiling point of water in a bath of which the vessel of oil is placed. At the temperature 100° C., the oils differ more in relative densities The instrument of Gobley, *Elaiometre*, is designed simply to test the presence and quantity of poppy-seed oil in olive and almond oils.

See *Laboulaye's "Dictionnaire des Arts et Manufactures,"* iii., "*Oléomètre.*"

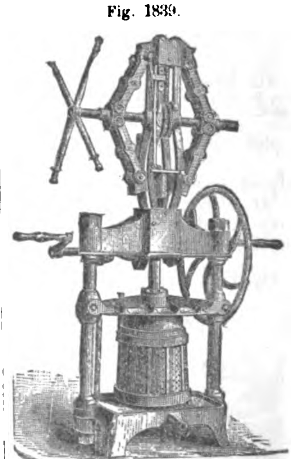
Ol'ive Press. A toggle-press for olive pressing was exhibited at the Paris Exposition, in 1878, by Samain, of Blois, France, and is shown in Fig. 1839.

It is capable of being worked by hand or steam, though the pulley is not shown in the cut. It is an eminently compact arrangement, even in that land of fruit and presses.

For the lower power the machine is worked by the crank, but when the higher power is required the upper handles are used to extend the arms of the toggle-levers. This flexor and extensor movement is found in some of our own presses, and is both powerful and compact.

A sheet-iron barrel is shown in the press, and the tampon is of a corresponding shape. Fig. 1840, however, shows a cast-iron square box or caisson for containing the olives; the wooden plug or tampon which enters the box and expresses the oil towards the side as well as downward; also the sheet-iron barrel with perforated sides.

Fig. 1839.



Toggle Press for Olives. (Samain of Blois.)

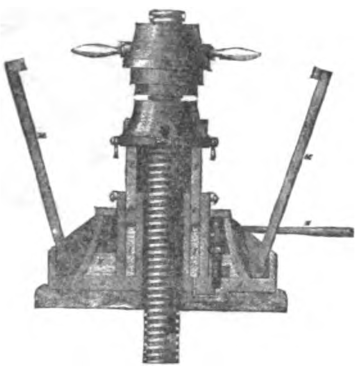
Fig. 1840.

Samain's Caisson, Tampon, and Barrel for Oil Press.

A very compact combination of the screw and hydraulic press is made by Cassan Fils, of Jallieu, near Bourgoin (*Isère*), the hydraulic mechanism being in the sole of the pressure-block beneath the nut on the screw of the press.

The vertical fixed screw has two nuts, *L* and *J*. When high pressure is to be applied, the tank *H* is filled with wa-

Fig. 1841.

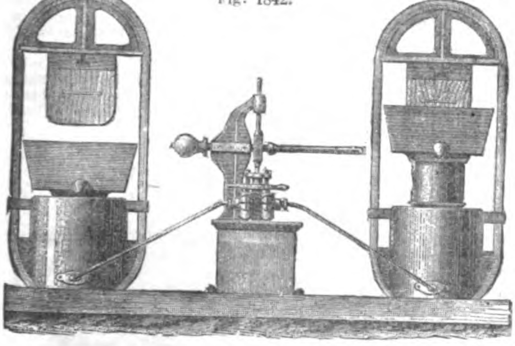


Combined Screw and Hydrostatic Press. (*Cassan, fils, Jallieu.*)

ter, the valve of egress closed, and the lever *E* of the pump worked. The sole *B* descends as the water from the cistern *H* is driven by the pump *D* into the cylinder *I* beneath the piston *C*. As soon as the circular mark *O O* appears, the course of the piston is complete.

To sustain the pressure, the props *M M* are brought beneath the nut *L*, which is adjusted in height to suit the occasion The exit-valve of the cylinder is opened, and the water returns into the tank *H*. The nut *J* and the piston *C* then descend until the latter is at the bottom of the cylinder. The valve is then closed, the pump worked, and the sole *B* driven down again as before.

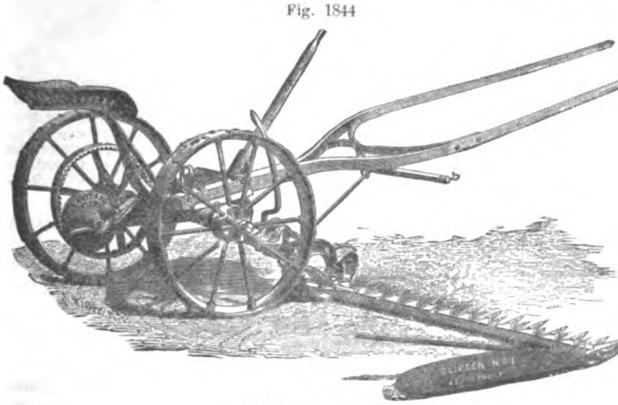
Fig. 1842.



Hydraulic Oil Press. (*Mannequin, Troyes.*)

Fig. 1842 shows a compact hydraulic press by Mannequin, of Troyes, France. It is intended for nut oil, colza, rape, and turnip seed.

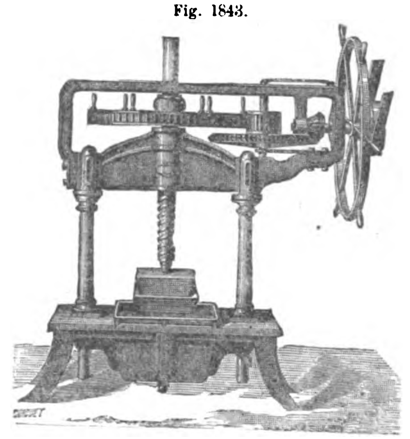
Fig. 1844



"*Clipper*" *Mower.*

The follower enters the basin, which is on the summit of the piston of the hydraulic press. The pistons are worked alternately by a single pump. The press is adapted for wine, for the extraction of the oils of seeds, nuts, olives, and fish, and also for use in sucreries, paper, and soap factories. Its power varies according to the purpose for which it is constructed, from 1,000 to 200,000 kilos.

Fig. 1843.



Press with Gearing. (*Mabille, Frères.*)

Fig. 1843 is a press operated by gearing, either by hand or power.

The press has two speeds: First by levers in the pins of the master wheel, and secondly, by the hand-wheel and system of gearing. The capacity is stated as yielding from 15 to 20 liters each filling, requiring 20 minutes for perfect extraction; 30 trips per day at 20 liters = 600 liters per 12 hours without reheating the cakes.

Olives . . . . . . "*Scientific American Sup.*," 1912.

One′-horse Mow′er. A mower of relatively small size, adapted to be drawn by one horse. That shown in Fig. 1844 has driving wheels 30″ high, and cuts a swath 3.5′.

One′-legged Rail′way. A railway supported on a single row of posts, adapted to be traversed by a saddle-shaped car.

Used in the Bradford oil region.

One form was shown in operation in Fairmount Park, at the Centennial. See also Figs. 1856, 1857, pp. 792, 793, "*Mech. Dict.*," "*Scientific American*," xxxviii. 22. See also ONE-RAIL RAILWAY; UNO-RAIL RAILWAY, *infra*.

One′-light Reg′u-la′tor. (*Electricity.*) An order of regulators for voltaic arc lights, adapted to a single light; as distinguished from a *many-light*, or *polyphote* regulator. Usually called a *monophote* regulator.

One′-rail Rail′way. One in which the car travels saddle-fashion upon a single rail. Instances are given in Fig. 1856, p. 792, "*Mech. Dict.*" See also ONE-LEGGED RAILWAY.

A one-rail railway in the oil regions of Pennsylvania is 6 miles long.

The car is not unlike an ordinary passenger car in appearance. It is 28′ long, 8′ 2″ wide, with seats running lengthwise of the car, as in street cars. Underneath the car, and running its entire length, are two sections or boxes, flush with the outer sides of the car, with sufficient space between them for the wheels and the rail they travel on. The sections serve to balance the car upon the rail, and also for the carriage of baggage. Transversely, below the floor at each end of the car are the axles of the 34″ double-flanged wheels, the upper portions of the latter being boxed in, while the lower rest on the rail. The rail is laid upon piles about 4′ high. Along the piles, on each side, about a foot below the running rail, are flat guide-rails. The inner sides of the two sections that come below the rail have friction rollers that run snugly on the guide rails. There are several points of similarity between this and the instances given on p. * 792, "*Mech. Dict.*"

See also Fig. 6872, p. 2683, *Ibid.*

O'nyx Glass. A revival of the art to which we are indebted for the Portland Vase, which is formed of a dark glass for the body and a white opal glass for the raised figures overlying it, but all in one piece.

To produce such vases it is necessary to first envelop the whole surface of the vase with a thick coating of white or opal glass, and then to cut away, down to the groundwork or body of darker glass, all that is not required to form the raised figures. These figures are sculptured and engraved in minute detail by steel points used as gravers, as stone cameos are wrought out of the solid onyx. The effects are the same.

Pieces of onyx glass were shown in the Paris Exposition (British section) in 1878.

See *Prof. Blake's* Report, "*Paris Exp.* (1878) *Reports*," iii. 286.

O'pal Glass. (*Glass.*) Calcined bones are added to the batch in the glass pot.

A Philadelphia company made a sort of opal glass under the name of *Hot-cast Porcelain*. It consisted of

Cryolite	10
White sand	20
Oxide of zinc	20

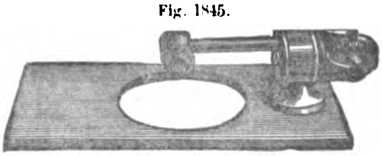
The dark discolored oxide answers the purpose very well. Fluor spar has also been used in making opal glass.

O'pal Glass Slip. (*Microscopy.*) An attachment placed on the stage of the microscope, under the object, to modify or diffuse the light passing through the latter.

O-paque' Disk Re-vol'ver. (*Optics.*) *Beck's.* A means for holding an object under a microscope so that five sides of a cube can be examined seriatim while under investigation.

The object being attached by gum to the surface of a small blackened metallic disk, this is fitted by a short stem pro-

Fig. 1845.



Opaque Disk Revolver.

jecting from its under surface into a cylindrical holder; the holder carrying the disk can be made to rotate round a vertical axis by turning the milled head on the right, which acts on it by means of a small chain that works through the horizontal tubular stem, whilst it can be made to incline to one side or to the other until its plane becomes vertical by turning the whole movement on the horizontal axis of its cylindrical socket.

The supporting plate being perforated by a large aperture, the object may be illuminated by a lieberkuhn if desired.

The disks are inserted into the holder, or removed from it with a pair of forceps constructed for the purpose.

O-paque' Il-lu'mi-na'tor. (*Optics.*) *Beck's.* See Vertical Illuminator.

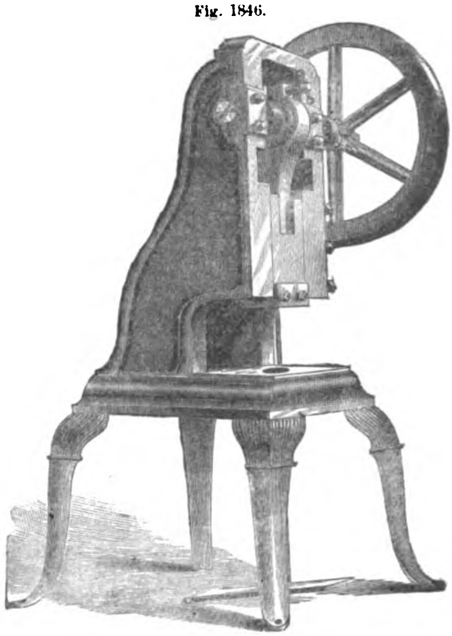
O-pei'do-scope. A phonoscope. An instrument for making sound visible. A mirror on a membrane vibrated by the voice throws a ray upon a screen. "*Scientific American*," xxiv. 5.

O'pen Back Press. One with standards set apart so that work can be put in or withdrawn, forward or rearward, and objects placed beneath the plunger, their length extending through the opening.

O'pen Bead Sight. (*Rifle.*) Also known as *aperture* sight. See Bead Sight.

O'pen Die Ma-chine'. A screw-threading machine with open die on the traveling head.

Fig. 1846.

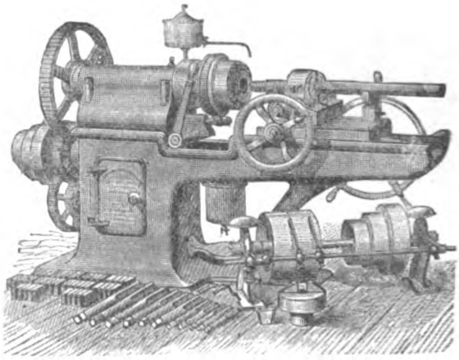


Open Back Press.

When the bolt or tube is threaded, the halves of the die are unclamped and the object removed.

The die head is constructed to receive finished blocks or cases, with inserted chasers, forming the dies, thus doing away with the labor of fitting each die or chaser to the head.

Fig. 1847.



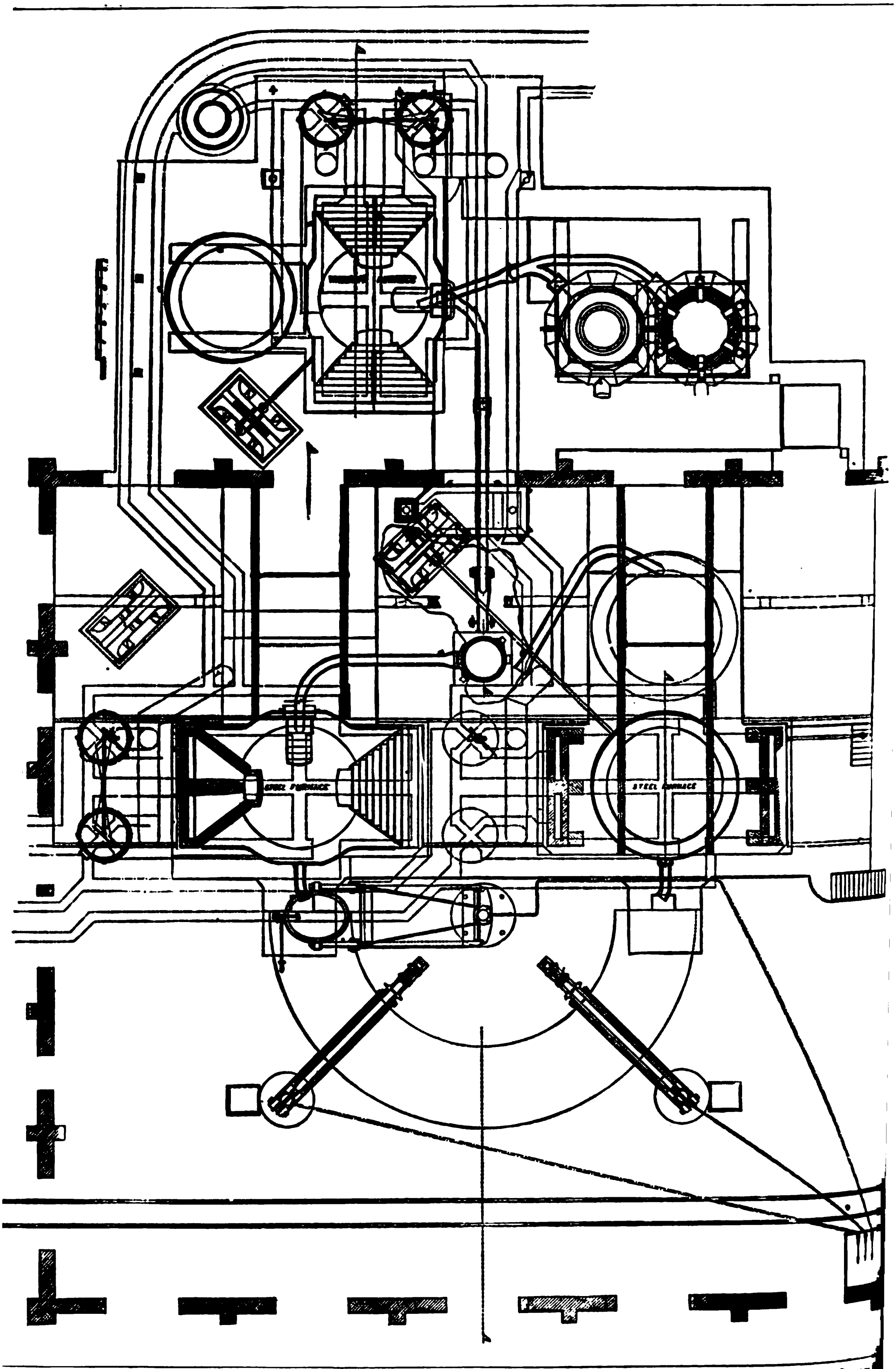
Open Die Machine.

The machine can be quickly converted into a nut tapper by removing the case dies and putting in their place a steel block to which is secured a universal chuck for holding taps. The locking device is positive and requires but one movement of the lever, by hand, or automatically, for unlocking and opening the dies, when the desired length of thread has been cut, or closing and locking. The hollow spindle allows a piece to be threaded any distance desired.

O'pen-er Lap'per. A machine for taking bale cotton, picking it, extracting dirt, and bringing it into a relatively clean and fleecy condition in a continuous lap, fit for feeding to the carding machine. See Lapper.

O'pen Hearth Fur'nace. (*Metallurgy.*) 1. A form of furnace for obtaining iron by direct process from the ore. See Blomary; Hearth.

2. A form of furnace of the nature of a puddling furnace; in the improved practice it has a remova-



XXXI. THE "PERNOT" OPEN HEARTH FURNACE, SPRINGFIELD IRON WORKS, SPRINGFIELD, ILLINOIS. See page

(General plan of open hearth plant.)

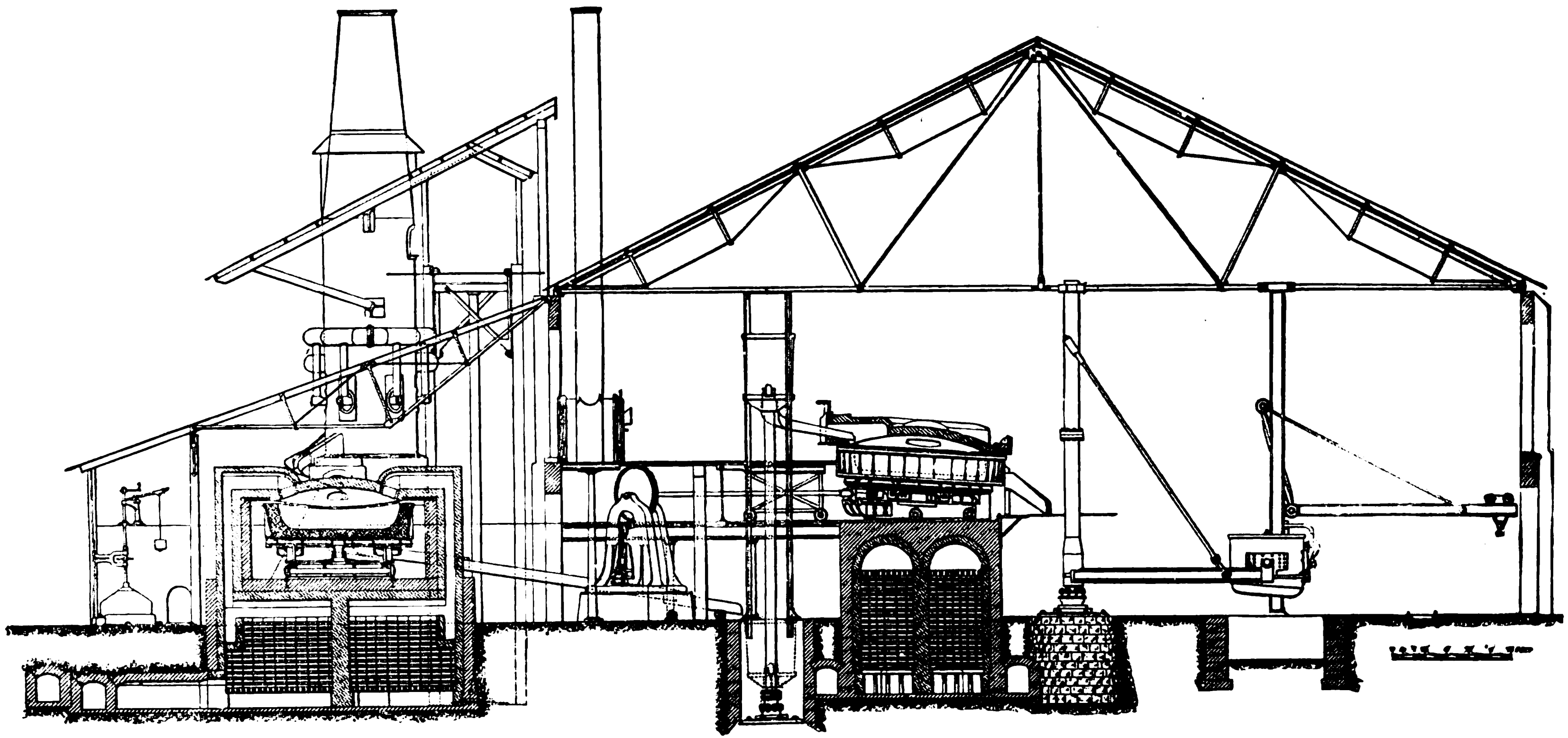


PLATE XXXII — THE "PERNOT" OPEN-HEARTH FURNACES, SPRINGFIELD IRON WORKS, SPRINGFIELD, ILL. — See page 645.

Vertical section on lines A A A, Plate XXXI.

ble hearth and is worked by the Siemens' regenerative furnace.

This regenerative furnace is shown in Figs. 1159, 1160, p. 386, *supra*; and the Ponsard regenerator in Figs. 1161, 1162, p. 387, *Ibid*.

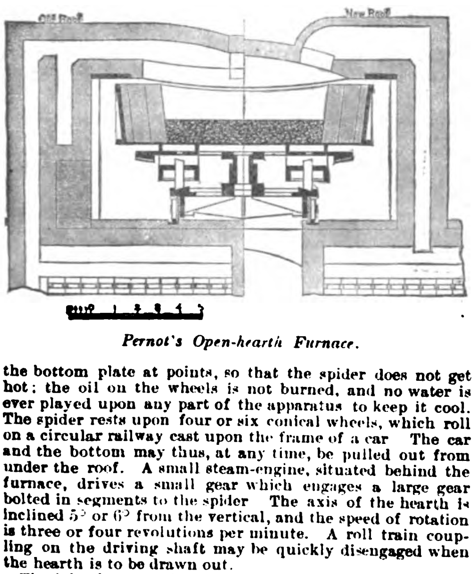
The materials employed are various: melted or unmelted pig with ore, and with or without scrap; pig iron purified from silicon and phosphorus, with or without scrap; pig iron and scrap, remelted together in a cupola, or charged hot or cold, together or separately, into the steel furnace; a pig-iron bath, and hot or cold steel or iron scrap, direct sponge or Catalan or puddled blooms charged into the bath.

The operation is, to a greater or less extent, according to the nature of the materials used, a desiliconization and decarburization of the pig iron and its dilution by already purified materials. Manganese is employed at the end of the operation to remove oxide of iron and silica, a regulated amount of manganese remaining in the product.

The Pernot hearth is shown in the engraving with its old form of roof on the left, and its new form on the right. The new roof is a flat dome, resting upon a continuous skew back, which is supported by the circular iron frame.

The hearth has a plate-iron bottom, the sides being cast-iron staves secured by an upper ring, and easily replaced. The hearth stands on a cast-iron spider, which only touches

Fig. 1848



Pernot's Open-hearth Furnace.

the bottom plate at points, so that the spider does not get hot; the oil on the wheels is not burned, and no water is ever played upon any part of the apparatus to keep it cool. The spider rests upon four or six conical wheels, which roll on a circular railway cast upon the frame of a car. The car and the bottom may thus, at any time, be pulled out from under the roof. A small steam-engine, situated behind the furnace, drives a small gear which engages a large gear bolted in segments to the spider. The axis of the hearth is inclined 5° or 6° from the vertical, and the speed of rotation is three or four revolutions per minute. A roll train coupling on the driving shaft may be quickly disengaged when the hearth is to be drawn out.

The joint between the revolving hearth and the stationary roof is simply a 3″ space filled with fire-sand, excepting a mere slit at the top, which forms a perfectly efficient packing.

The roofs and the sides of the hearth are made of silica brick. The bottom of the hearth is of fire-sand, rammed hard while the hearth is out. It is more durable and more easily set than the stationary bottom.

Each 8-ton furnace has four producers of the ordinary Siemens pattern and size.

The Pernot open-hearth of the Springfield Iron Company, of Springfield, Ill., is shown in Plates XXXI., XXXII.

This company, as Mr. A. L. Holley observed, was the first in the United States to adopt the Krupp process of washing phosphorus out of pig iron, and the second to introduce the Pernot revolving and movable hearth. The full plant of the open-hearth furnaces is shown in the plates, which are respectively a plan and vertical section.

The pig is melted down in the cupolas shown on the upper left hand, Plate XXXII., and run through a gutter to the revolving Krupp washing furnace near it. After being purified, the metal is tapped and transferred to the Pernot steel furnace. In this it is converted into steel, which is tapped into the ladle shown in position over the pit. The steel is finally cast into ingots.

The following description is by Mr. Holley: "The furnaces stand high enough to give a roomy and well ventilated floor all around them on a general level, and also a conveniently shallow casting pit. The upper part of the regenerators, and also the reversing valves, stand accessibly above ground. The charging floor and appurtenances are on the opposite side from the casting department.

"Casting is done by means of an ingot crane of large radius, rather than by the less convenient and less easily moved ingot car. There is a platform in front of the furnace for dressing the tap hole. The arrangement is such that the ladle may be moved over the ingot molds; or steel may be running into the ladle, and at the same time out of the ladle into a group of molds.

"The furnaces stand in a single line, and not in a double line, which gives a concentrated stock-yard and a producer-house (reached by the same elevated railway system) on one side, and a cool casting house and an ample ingot yard on the other side.

"The chief advantage of the revolving hearth is mechanical agitation, which facilitates the chemical reactions. The obvious and important advantage of the removable hearth is convenience and economy of repairs. The ordinary repairs do not, as in the case of the stationary hearth, interfere with the continuous production of steel.

"The sustaining and revolving gear of the hearth are not materially changed from M. Pernot's designs, except that a water-cooled center pintle has been provided to resist the lateral thrust of the hearth. The hearth must necessarily be run out for repairs, not only on the charging side, but through the charging floor. In order to avoid the trouble of taking up the charging floor when the hearth is run out, that part of the floor behind the hearth is placed on a carriage that rests on the same railway that sustains the hearth.

"The arrangement of the pig melting and washing apparatus is intended to promote the least handling of materials, and also good ventilation. It is not only economical, but it is humane, to arrange a plant so that men can comfortably perform the best work there is in them.

"The cupola furnaces are set 12′ from the open-hearth house, and their *débris* (drop bottoms) and slag discharge are directed away from other furnaces and operations. One hydraulic hoist raises materials with equal convenience to the charging floors of the cupola, the washing furnace, and the steel furnaces. The flow of fluid metal from the cupolas to the washing furnace, from the washing furnace to the ladle, and from the ladle to the steel furnaces, is short and direct.

"There is no lateral transference of melted metal in ladles; the washed-metal ladle stands permanently on a lift, and is once raised vertically. The system avoids the expenditure of time and labor attendant upon swinging, turning and drawing about heavy ladles on cranes, turn-tables, and cars.

"The hearths at Springfield prove large enough to convert 20-ton charges with facility. With cold pig (30 per cent.) and cold scrap, 24,000-pound heats have been made in 4 hours, and 40,000-pound heats in 8 hours. The regenerators prove abundantly large, and the burning gas plunges down upon and flows over the whole surface of the bath in such a manner as to heat it with the greatest efficiency. The importance of the removable hearth has been strikingly demonstrated; the hearth has been run out (by means of a chain from an ingot crane), its lining entirely replaced, and again run under the roof, in 17 hours from the tapping out of a charge. Meanwhile a part of the roof was renewed. It is now confidently expected that one of these furnaces will produce 100 tons of ingots per 24 hours from Krupp-washed material." — *Holley*.

See Report of A. L. Holley in Group I., "*Centennial Reports*," vol. iii., p. 37, and also report read before the Baltimore meeting of the American Institute of Mining Engineers.

Reported in	* "*Iron Age*," xxiii., March 6, p. 1; March 13, p. 3.
Puddling	* Fig. 3995, p. 1817, "*Mech. Dict.*"
Process, *Heath* (1845) .	"*Iron Age*," xxiii., Feb. 13, p. 15.
Full plant	* "*Iron Age*," xxv., June 24, pp. 1, 3.
	* "*Engineering*," May 14, 1880.
	"*Scientific American Sup.*," 1121.

O'pen-hearth Steel. (*Metallurgy*.) Steel made by open-hearth process, as contradistinguished from blister, puddled, Bessemer, cast, etc.

O'pen-ing Ma-chine'. See OPENER.

The *wolf* (Fr. *loup*, the action being known as *louvetage*), or French *opening machine*, is shown in Figs. 1322, 1323, article "*Laines*," *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," ii., edition 1877.

O'pen Plate Wheel. (*Railway*.) A cast-iron single-plate wheel for street-cars, with openings cast in the plate between the ribs.

Fig. 1849.

Open Plate Wheel.

O'pen Re-turn' Bend. A **U**-shaped pipe-coupling having the branches open or distinct as in the letter **U**, and not close, or united by a fin.

O'pen Sheave. One having spokes, or mortised openings; in contradistinction to one turned solid, or with perfect web.

O'pen Sight. A sight, *through* which the object is viewed. See list under SIGHT, where many examples may be found, as also pin, fin, and globe sights which are not *open*.

Op'e-ra Flan'nel. A name given to a light flannel more highly finished than the ordinary article, piece-dyed uniformly in many fancy colors, and not pressed.

Oph-thal'mo-scope. 1. An instrument for the examination of the interior of the eye. The invention of Dr. Helmholtz; denoted on p. 1562, "*Mech. Dict.*" Dr. Knapp's auto-ophthalmoscope is Fig. 3403, p. 1563, *Ibid.*

2. An instrument for testing the form of the eye.

The metrical system of numbering the glasses has been adopted in preference to the statement by length of focus.

The dioptric unit, proposed by Prof. Donders at the congress of oculists in 1876, is a lens of 1 meter focal distance; and the following derivation: —

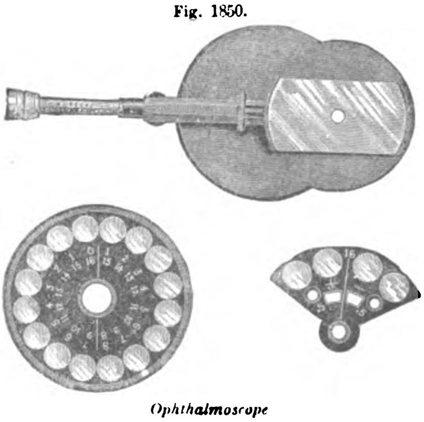
2 *d* (dioptric)	= 0.5 meter focal length.
1 *d*	= 1 meter focal length.
0.5 *d*	= 2 meters focal length.

The lens 2 *d* bears its relation to 1 *d* as having *double* the refracting power of the latter, and a lens of 5 *d* has one fifth the length of focus, or 5 times the refracting power of the lens 1 *d*, and so on.

The oculist's instrument for testing the focus of vision is a convenient arrangement of a series of lenses in a disk with numbers attached, so that after diagnosis the reading can be observed and the prescription for the optician readily given.

Dr. Loring's ophthalmoscope is shown in Fig. 1850. The single disk contains 16 glasses on the metric system, the plus being numbered in white, and the minus in red. The first row of numbers, or that just beneath the glass, shows the real value of the glass; the second or inner row shows the result of the combinations when the quadrant is in position. The quadrant rotates immediately over the disk and around the same center, and contains four glasses, — 5, — 16. and + 5, + 16 When it is not used the quadrant is beneath its cover The instrument then represents a simple ophthalmoscope with 16 perforations, the series running with an interval of 1 *d*, and extending from 1 to 7 plus, and from 1 to 8 minus. This is ample for all ordinary work, as the interval of 1 *d* is as close as even an expert usually desires, and can, with a little experience, be used for even very minute discrepancies For if in a given case the fundus is seen distinctly with 1 *d*, and a little to spare, while 2 *d* blurs the picture, we know at once that the refraction must be between the two, or 1.5 *d*. If, however, for any reason we wish to prove this conclusion, we can bring up 0 5 *d* From this glass we get successive half-dioptric from 1 to 8 plus, and from 1 to 9 minus. If the higher numbers are desired these are obtained by combinations with those of the quadrant These progress regularly up to 16 *d*, every dioptric being marked upon the disk; above this, up to + 23 *d*, and — 24 *d*, we have to simply add the glass which comes beneath the 16 *d*, turning always in the same direction.

Fig. 1850.



Ophthalmoscope

The mirror shown in the drawing is the *tilting* form.

See also OPTOMETER, *infra*, and AMETROMETER, Fig 48, p. 29 *supra*.

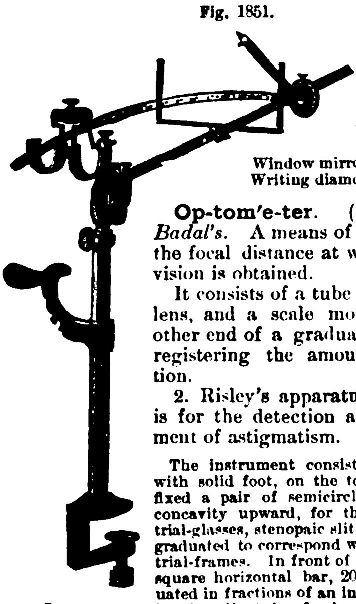
Op'ti-cal Glass. (*Glass.*) A flint glass of great density, owing to the quantity of lead it contains. See also STRASS.

Op'ti-cal In'stru-ments, etc. Subjects concerning optical apparatus are considered under the following heads: —

Achromatic condenser.
Achromatic right angle prism.
Adapter.
Adjusting cone.
Air pump.
Ametrometer.
Amici prism.
Amplifier.
Analyzer.
Anamorphoscope.
Aplanatic searcher.
Astrolabe
Astronomical mirror.
Aurora tube.
Binocular body.
Binocular telescope.
Bioscope.
Bull's eye condenser
Burette.
Camera.
Camera lucida.
Camera obscura
Camera stand.
Cane telescope.
Capillary bottle.
Celestial indicator.
Cell.
Cell cutter
Chromostroboscope.
Circle cutter.
Claude Lorraine.
Coddington lens.
Collecting bottle.
Compound spectacles.
Compressor.
Concave mirror.
Condenser.
Condensing lens.
Cosmorama lens.
Current slide.
Cylindrical glass
Dancing flame.
Dark tent.
Dark well.
Demonstration lens.
Diaphragm.
Diatom prism.
Dichroiscope.
Disk cutter.
Dissecting hook.
Dissecting knife.
Dissecting scissors.
Double image prism.
Double nose piece.
Draw tube.
Dropping tube.
Drying case.
Elbow scissors.
Engraver's glass.
Entomological pin.
Equatorial.
Equilateral prism.
Erecting glass.
Eye glass.
Eye piece.
Eye piece indicator.
Eye piece micrometer.
Eye protector
Eye shade.
Field camera.
Field glass
Finder
Fishing tube.
Flat mirror.
Flower microscope
Focussing glass.
Forceps.
Frameless spectacles
Franklin spectacles.
Frog plate.
Glass ring.
Glass slip
Glass stage.
Glass trough.
Glazier's diamond.
Goggles.
Goniometer.
Graphoscope.
Graphostereoscope.
Growing cell.
Hand magnifier
Heliostat.
Heliotellus.
Heliotrope.
Illuminator.
Immersion objective.
Indicator, eye-piece.
Injecting syringe.
Insect pin.
Iris diaphragm.
Kaleidoscope.
Knife.
Lamp.
Landscape mirror.
Lens.
Lens grinding.
Lever compressor.
Lieberkuhn.
Life slide.
Light moderator.
Linen prover.
Live box.
Live trap.
Lorgnon.
Louchettes.
Loupe.
Lunatellus.
Maltwood finder.
Mechanical finger.
Megascope.

Melanoscope.
Meridian circle.
Meridian instrument.
Micrometer-microscope.
Micrometer.
Microscope.
Microscope lamp.
Microscope table.
Microtome.
Micro-spectroscope.
Mineral holder.
Mirror.
Mounting instrument.
Mounting stand.
Mural circle.
Mydriasis spectacles.
Nachet's prism.
Necessaire.
Needle, dissecting.
Needle holder.
Nichol's prism.
Nobert's plates.
Nose glass.
Nose piece.
Object glass.
Objective.
Observatory.
Opal glass slip.
Opaque disk revolver.
Opaque illuminator.
Ophthalmoscope.
Optometer.
Orrery.
Orthoscopic eye-piece.
Pankratic microscope.
Parabolic illuminator.
Parabolic reflector.
Parallel compressor.
Photodrome.
Picture lens.
Pipette.
Plane table.
Planisphere.
Pocket microscope.
Polariscope.
Polarizer.
Polarizing apparatus.
Polymicroscope
Polyzonal lens.
Prism.
Prismatic glass.
Projector.
Pulpit spectacles.
Quadrant.
Quadruple nose-piece.
Range finder.
Reading glass.
Reflector.
Repeating circle.
Resonator.
Reversible compressor.
Revolving diaphragm.
Right-angle prism.
Sciopticon.
Scissors.
Screw live box.
Section cutter.
Section knife.
Seed microscope.
Selenite.
Selenite stage.
Shade.
Shell piece.
Side condenser.
Side reflector.
Siderostat.
Siphon slide.
Siren.
Solar camera.
Solar microscope.
Spectroscope.
Spectroscopic eye-piece.
Spectrum scale.
Spot lens.
Spring compressor.
Stage.
Stage forceps.
Stage micrometer.
Stand.
Stereopticon.
Stereoscope
Strabismus spectacles.
Student's lamp.
Sun spot instrument.
Syringe.
Table.
Telemeter.
Telescope.
Telescope clamp.
Tellurian.
Temples.
Test plate.
Test tube.
Theodolite.
Tightening key.
Time globe.
Tourmaline.
Transit instrument.
Trial sight.
Trial spectacle frame.
Trinopticon.
Triple nose piece.
Triplet.
Tripod stand.
Trough.
Turn-table.
Valentine's knife.
Vertical illuminator.
Water lens.
White cloud illuminator.
Window mirror.
Writing diamond.

Fig. 1851.



Optometer.

Op-tom'e-ter. (*Optics.*) 1. *Badal's.* A means of ascertaining the focal distance at which perfect vision is obtained.

It consists of a tube containing a lens, and a scale movable at the other end of a graduated tube for registering the amount of variation.

2. Risley's apparatus, Fig. 1851, is for the detection and measurement of astigmatism.

The instrument consists of a stand, with solid foot, on the top of which is fixed a pair of semicircles, with their concavity upward, for the reception of trial-glasses, stenopaic slit, etc. They are graduated to correspond with the Nachet trial-frames. In front of the holders is a square horizontal bar, 20″ long, graduated in fractions of an inch. Upon this bar is adjusted a freely-moving carrier, designed to bear a series of cards containing test-types, and test-figures for astigmatism, including the system of radiating lines of Dr. Green, of St. Louis. The whole set is intended for use at 12″ instead of 20″. Some of the tests are cut in thin brass disks, and are to be used over an illuminated background, which is furnished by a plate of ground glass. A plate fitting the carrier has a central opening designed to receive these disks, and to permit their free rotation over a graduated scale corresponding to that upon the holders. One of this series of test-objects is a wire *optometer*, consisting of a brass rim, with two groups, each containing five wires, stretched one millimeter apart, the two groups crossing the center at right angles.

There is also an adjustable *perimeter*, which can be removed when not in use.

See also OPHTHALMOSCOPE, Fig. 1850 p. 646; AMETROMETER, Fig. 48, p. 29; ASTIGMATISM APPARATUS, Fig. 124, p. 53, *supra*.

O'pus Con-su'tum. Cut cloth-work or *appliqué*.

O'ral In'stru-ments. (*Surgical.*) See EAR INSTRUMENTS.

Or-ches'tri-on. (*Music.*) An instrument constructed on the principle of an organ, except that the tubes are caused to *speak* by means of a mechanical arrangement similar to that used in a *musical box*, instead of being operated by means of a key-board or manual. They frequently contain, in addition to the reed stops, metal pipes, bells, drums, etc., etc.; in fact, anything that will give forth a sound when you strike or blow it; but no strings.

See p. 108, Class XVI., vol. ii., Official Catalogue British Exhibition, 1862.

Ore Car. (*Railway.*) A small, narrow-gage car, with four wheels, used on tracks in mines for transporting minerals to daylight.

Ore Dry'er. A machine in which a vibrating screen furnishes the sand and metallic particles to the hopper, from which it is discharged in a regular stream, under the influence of the rotary agitators, into the drying cylinder below, that is kept heated by a furnace in the basement of the machine.

As the sand dries and becomes less cohesive, the rotary heated cylinder discharges it through its spout into a receptacle beneath.

Ore Ma-chin'er-y. See the following references: —

Breaker, *Blake* . . .	* *Laboulaye's* "*Dict.*," ii. (ed. 1877), Art. "*Métallurgie*," Fig. 1770.
Tin ore	* *Ibid.*, Fig. 1771.
Lead ore	* *Ibid.*, Fig. 1772.
Classifier	* "*Engineering*," xxii. 329.
	* "*Min. & Sc. Press*," xxxiv. 78.
Wengler & Lowe . .	* "*Eng. & Min. Jour.*," xxii. 189.
Concentrating-table . .	* "*Min. & Sc. Press*," xxxiv. 161.
Concentration, *Krom* .	* "*Eng. & Min. Jour.*," xxii. 284.
Crusher, *Alden* . . .	"*Sc. American*," xxxviii. 54.
	* "*Eng. & Min. Jour.*," xxiv. 419.
	* "*Am. R. R. Jour.*," li. 287.
	* "*Man. & Builder*," x. 241.
Baugh	* "*Eng. & Min. Jour.*," xxii. 296.
Sectional crush., *Blake* .	* "*Scientific American*," xli. 306.
Blake	* "*Eng. & Min. Jour.*," xxii. 311; xxviii. 393.
Brown	* "*Scientific American*," xl. 194.
	* "*Eng. & Min. Jour.*," xxvi. 184.
Phelps	* "*Eng. & Min. Jour.*," xxviii. 58.
Dressing app., *Allouez*, Lake Superior . . .	* "*Eng. & Min. Jour.*," xxiii. 294.
Dressing works, *Clausthal*	* "*Eng. & Min. Jour.*," xxviii. 134.
	* "*Engineering*," xxi. 35, 64, 102, 106, 167, 209, 249, 298, 303.

Dressing: "Report on Mechanical Dressing of Minerals," by *E. F. Althans*; "*Centennial Exhibition Reports*," Group I., vol. iii., p. 207.

Von Sparre Laboratory ore dresser . . .	* p. 228
Blake's Ore crusher	* p. 238
Marsden's Ore crusher	* p. 239
Krom's Roller crusher	* p. 242
Coxe Bros. & Co.'s Anthracite breaker . .	* p. 246
Dingey, Horizontal mill	* p. 248
Althan's Stamp cams	* p. 251
Ball's Steam stamp	* p. 258
Ball's Stamp mill	* p. 261

Sievers & Co. Sorting drum		* p. 269
Coal dressers		p. 273
Concentrators		p. 279
Blei-scharley, Silesia Fine grain jig		* p. 288
Kasalovsky's Double jig		* p. 289
Lake Superior, Copper jig		* p. 290
Evrard's Decanteur		* p. 297
Evrard's Hydraulic classificator		* p. 299
Krom's Dry ore concentrator		* p. 303
Settling apparatus		p. 307
Sluice tables		p. 306
Electro magnetic concentrators		p. 313
Evrard's Rotary picker and sorter		p. 322

Feeder, *Hendy*	* "*Min. & Sc. Press*," xxxiv. 271.
Tulloch	* "*Min. & Sc. Press*," xxxiv. 319.
Stevenson	"*Min. & Sc. Press*," xxx. 323.
Tulloch	* "*Min. & Sc. Press*," xxxv. 401.
Furnace, revol., *Bruckner*	* "*Iron Age*," xvii., Jan. 13, p. 1.
Eames	* "*Scientific American Sup.*," 714.
Mill, *Paul*	"*Scientific American Sup.*," 596.
Process, ammonia.	
Clarke & Smith, Br.	"*Van Nostrand's Mag.*," xv. 108.
Holloway	"*Iron Age*," xxiv., July 24, p. 3.
Monnier	* "*Scientific American Sup.*," 771.
Stewart	"*Min. & Sc. Press*," xxxiv. 266.
Davis	* "*Min. & Sc. Press*," xxxviii. 137.
Roasting furnace, *Fryer*	* "*Scientific American Sup.*," 172.
Shaft, *Ramage*	* "*Iron Age*," xxii., Nov. 28, p. 5.
Separator, magnetic.	
Babcock & Ewell	* "*Scientific American*," xliii. 291.
Magnetic, *Edison*	"*Scientific American*," xlii. 388.
	* "*Scientific American*," xliii. 36.
	* "*Engineer*," l. 6, 91.
Sifter	* *Laboulaye's* "*Dict.*," ii., ed. 1877.
Lalande	* *Ibid.*, Fig. 1776, "*Métallurgie*," Fig. 1773.
Stamp, *Ball*	* "*Iron Age*," xxi., May 9, p. 1.
Direct act., pneumatic	
Sholl, Br.	* "*Engineer*," xliii. 95.
Washing mach., *Curson Iron Works*, Fr.	* "*Engineering*," xxvi. 80.
	* *Laboulaye's* "*Dict.*," ii. ed. 1877, Art. "*Métallurgie*," Figs. 1765–1769.
French	* "*Scientific American Sup.*," 2227.
Taylor	* "*Scientific American Sup.*," 1322.
Works, *Clausthal*	* "*Eng. & Minnig Jour.*," xxi. 247, 295, 303, 319, 345, 415, 439.

Or'gan. See the following references : —

History of the organ in report of *H. K. Oliver* on group XXV. in vol. vii., "*Centennial Exhibition Reports*," p. 35. Parlor organs, *Ibid.*, p. 45.

Blower	* Figs. 3426, 3427, p. 1576, "*Mech. Dict.*"
Backus	* Fig. 7120, p. 2743, *Ibid.*
	* Hydr. Blower, Fig. 1401, p. 475, *supra.*
Electricity, applied to	* "*Telegraphic Journal*," iv. 84.
	* "*Manuf. & Builder*," viii. 64.
	"*Scientific American Sup.*," 724.
Electric & pneum. appli.	* "*Scientific Amer.*," xxxiv. 117.
Cincinnati Music Hall compared with others	"*Sc. American*," xxxviii. 324.
Pipes	* *Laboulaye's* "*Dict.*," "*Orgues*," ed. 1877.
Reeds, manufacture of	"*Scientific American*," xl. 110.
Garden City Cathedral	"*Scientific American*," xli. 385.

Or'gan, Au'to-mat'ic. See AUTOPHONE, p. 57, *supra.*

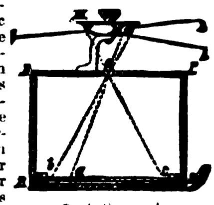
Or'o-graph. (ὄρος, a mountain.) An instrument for mapping undulating or mountainous surfaces.

As constructed by M. Schrader, the instrument consists of a circular paper-covered plate with central vertical axis carrying a sleeve which can turn round freely. On the top of the sleeve is a telescope on a frame, the movements of which in altitude are communicated to a pencil, and transformed by gearing into to-and-fro movements. If the telescope revolves in azimuth, the style describes a circle on the plate; a motion in azimuth compounded with one in altitude, gives an oblique line, an outward or inward curve; the trace produced being farther from or nearer to the central axis, as the movement in altitude increases or diminishes. A spirit-level is fixed to the telescope, and graduated scales give the value in height of any point on the tracing.

Or'o-he'li-o-graph. An instrument invented by M. Noë, and described in a memoir to the Photographic Society of France.

It consists of a camera, the sensitive plate forming the inner horizontal floor, and the lens looking up perpendicularly to the sky. Over the lens is placed a silvered mirror, half globe-shaped, completely circular on its plan and parabolic through its vertical section. The result is that an image of all surrounding objects reflected from this half-ball-shaped mirror is received by the lens, and transmitted thereby to the sensitive plate underneath, with its surface forming a right angle with the axis of the lens and circular mirror. By this means a circular panoramic view of the horizon is obtained, as seen from the station the oroheliograph occupies.

Fig. 1852.



Oroheliograph.

This instrument is described in "*Scientific American*," xxxviii., 40, * 116. See also PHOTOGRAPHOMETER, *infra.*

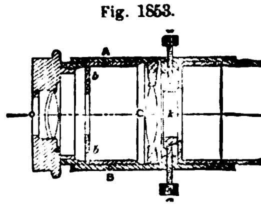
Or'tho-pe'dic Ap-pli'an-ces. Apparatus for talipes, eversion of the feet, etc.

See Report by *Dr. J. H. Thompson*, of Group XXIV.* in vol. ii., "*Centennial Exhibition Reports.*" *Darrach's* raw-hide appliances, *.
Dr. Stillman's "*Contributions to Orthopædic Surgery*," * "*Medical Record*," August 30, 1879.
See also CLUB-FOOT APPLIANCES AND SPLINTS, pp. 203. 204; CURVATURE APPARATUS, p. 236, *supra.*

Or'tho-scopic Eye'piece. A combination of lenses used in an eye-piece, giving a very large field of view.

Kellner's orthoscopic eye-piece is achromatic, and has the advantage of an actually flat field and a straight, flat image of any object, correct in perspective, distinct in its whole extent. It consists of three lenses, the bi-convex collective lens *C*, the flatter curve of which is toward the object-glass, and the achromatic lens *O*, which is composed of two lenses, similar to the achromatic object glass. *b b* is a diaphragm.

Fig. 1853.



Orthoscopic Eye-piece.

O-ru'go. From Latin *Aurūgo*, the jaundice, referring to the yellow color induced by oxidation. The peculiar oxidation seen on ancient bronzes, and which gives character to the antique medals and statuary in that alloy.

See PATINA.

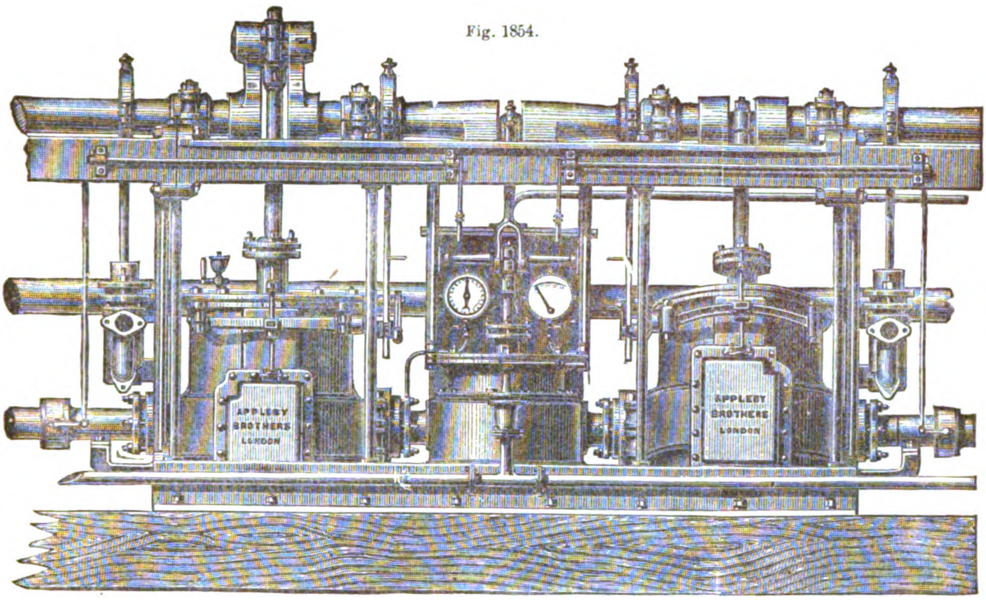
Os'cil-la'ting En'gine. Engines with oscillating cylinders are shown in Figs. 3430–3433, pp. 1578, 1579, "*Mech. Dict.*"; Screw Propeller Engines, * p. 2073, *Ibid.* See also MARINE ENGINE, *supra.*

The type of paddle engine, shown in Figs. 1854, 1855, has been more used in Great Britain than any other on account of the large power which can be provided in a very limited space; the piston rods working direct on to the crank pins, there is little loss by friction except that due to the friction of the trunnions. The steam enters the cylinders through the outer trunnions, and, when it has done its work, passes through the inner trunnions to the condenser. The air-pump is driven from a crank central between the two cylinders, and the two feed-pumps are driven by eccentrics on the paddle shaft. The bearings for the paddle shaft are carried on a strong entablature, which is supported on wrought iron stays or columns from a massive base plate.

Such engines are employed on the English channel and river steamers, and the form of the framing is such that, while light, it has strength to resist the strain caused by the work being suddenly thrown on one paddle, while the next moment the deep immersion is sufficient to greatly retard the normal speed of the engine.

Oscillating cylinder eng.,	
"Lord of the Isles"	* "*Scientific American Sup.*," 1458.
Penn	*Laboulaye's* "*Dict.*," "*Bateau à Vapeau*," IV., Figs. 3415, 3416.
Oscillating steam engine.	
Roberts	* "*Man. & Builder*," x. 145.
For light draft steamers.	
Wilson, Br.	* "*Engineering*," xxiii. 341.
Wheel, feathering.	
Williams	* "*Scientific American*," xxxvi. 374.

Fig. 1854.



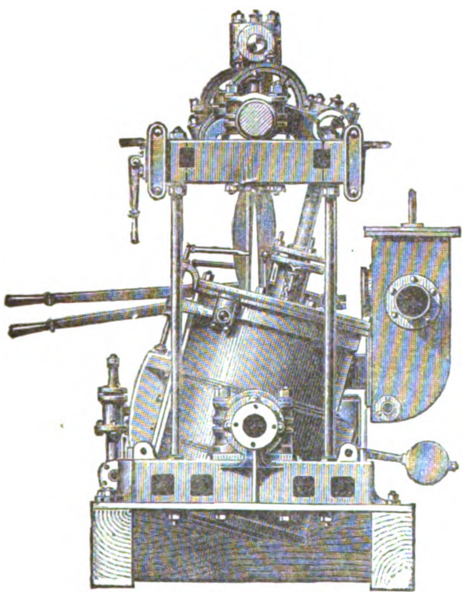
Oscillating Paddle Engine.

Os′cil-la′tor. A machine, the principal or an important functional portion of which vibrates in a curved track; *e. g.*, the oscillating-cylinder steam-engine, the oscillating-shuttle sewing machine.

Os′cil-lom′e-ter. An instrument for measuring the angle through which a ship rolls at sea.

Clark. . . . . * "*Engineering*," xxvii. 406.

Fig 1855



Oscillating Paddle Engine. (*Side Elevation.*)

Os′mo-gène. An osmotic apparatus of M. Dubrunfaut, adapted to the refining or fabrication of sugar. Described in *Laboulaye's "Dictionnaire des Arts et Manufactures*," tome iii., article "*Sucre*," Figs. 78, 79, "*Osmose*."

Os′te-o-phor. (*Surgical.*) A powerful bone forceps with long serrated jaws. *Hamilton.* Fig. 53 *c*, p. 12, Part I., *Tiemann's "Armam. Chirurg."*

Os′te-ot′o-my In′stru-ments. (*Surgical.*) See Bone Instruments, p. 119, *supra*.

Os′te-o-trite. (*Surgical.*) A conoidal-shaped bone-drill. *Marshall.* Fig. 78 *c*, p. 22, Part I., *Tiemann's "Armamentarium Chirurgicum."*

Os U′te-ri Di-la′tor. See Cervix Uteri Dilator, "*Mech. Dict.*" *et supra*.

O-the′o-scope. A form of radiometer devised by Mr. Crookes, which revolves, even though destitute of a glass envelope.

"The first form of otheoscope described by M. Crookes consists of a four-armed fly, each carrying a vane of thin clear mica. At one side of the glass bulb which incloses the apparatus there is a vertical plate of mica blackened on one face, and so placed that each vane closely approaches it as the mill rotates. If light be allowed to fall only upon the clear vanes, no motion is produced; but if the light shine upon the black plate the vanes instantly begin to rotate, as though repelled by a molecular wind blowing from this surface. The movement is therefore produced by pressure generated on a fixed part of the apparatus, by which the movable portion is propelled. As this driving-surface is stationary, it is not restricted in weight, size, or shape; and hence the modifications of which the otheoscope admits are well-nigh endless." — "*Chemical News*," May 4, 1877.

Out′crop. (*Mining.*) That portion of a vein appearing at the surface.

Out′er-hung Brake. (*Railway.*) One in which the brake shoes and beams are attached outside of the wheels.

Out′rig-ger Hoist. A hoisting apparatus rigged out from an outer wall; as distinct from the hatchway hoist. — * "*Scientific Amer.*," xxxviii. 223.

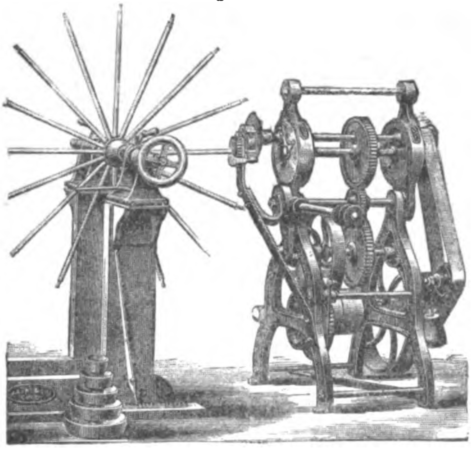
Out′side Mold′ing Ma-chine′. That form of wood-planing machines in which the cutter is on an overhung spindle; in contradistinction to the *inside* molding machines, in which the cutter is between the bearings of the spindle. See Fig. 3198, p. 1467, "*Mech. Dict.*"

Out′sole Tack′ing Ma-chine′. One which drives a headed nail with a clinching point, which buries itself in the insole, to secure the outsole to the insole for future sewing or pegging.

O'val Ten'o-ning Ma-chine'. A machine for making oval tenons, on the ends of spokes where they enter the felly. The diameter of the tenon is longer with the grain of the wood in the felly than across it. This form of tenon reduces the risk of splitting the rim in driving it on the tenon, and dispenses with wedging.

The wheel is held between the chucks, which receive the ends of the hubs, and the chucks are supported on a sliding frame, which can be adjusted to cut the spokes to the desired length. The spoke being operated on is held between

Fig. 1856



Oval Tenoning Machine.

two geared clamps, which open and close simultaneously, bringing the center of the spoke to the center of the revolving disks.

The upper part of the machine in which the disks revolve has a vibrating motion given to it by the weighted hand lever. By depressing this lever the cutter-head is brought forward, the saw cutting off the end of the spoke and bringing the cutter-head up to the spoke, cutting the oval, which may be varied in size to suit the work required.

Oval lathe . . . . *Heckendon's patent*, No. 222,901.

O-va'ri-ot'o-my In'stru-ments. (*Surgical.*) Instruments for the extirpation of ovarian tumors.

The list includes : —

Ligator.	Tissue and sac forceps.
Ecraseurs.	Tenaculum forceps.
Clamps.	Pedicle forceps.
Vulsellum forceps.	Polypus forceps.
Vulsellum hook.	Uterine fixator.
Tenaculi.	Polyptome.
Blunt hook.	

Pages 92-99, *Tiemann's "Armamentarium Chirurgicum."*

O'ver-flow' Gage. (*Gas.*) An attachment to a station gas-meter. It performs a double purpose : (1.) it maintains a true measuring water line on the inside of the drum, insuring accurate registration ; and (2) it produces a constant change of the water contained in the meter to keep it free from impurities, especially ammonia. See STATION METER.

O'ver-hand Knot. (*Nautical.*) A form of knot shown at 1, Fig. 2777, p. 1240, *"Mech. Dict."*

O'ver-head' Trav'el-ing Crane. These are of five descriptions : —

1. Those with the engine and boiler moving with the load.
2. Travelers having the engine and boiler fixed at one end of the beams.
3. Travelers driven by a line of shafting.
4. Travelers driven by a high-speed cord.
5. Travelers driven by a slow-speed wire rope.

See Fig. 3451, p. 1585 ; Fig. 5652, p. 2335 ; Figs. 6623, 6624, pp. 2618, 2619, *"Mech. Dict."*

Traveling crane, 50 ton	
Alcock, Br. . . .	* *"Engineering,"* xxv. 85.
Woolwich, Br. . .	*"Scientific American Sup.,"* 838. *Laboulaye's "Dict.,"* iv., *"Échafaudage,"* Fig. 21.

O'ver-head' Work. Countershafting and gearing, when overhead.

O'ver-hung' Door. One supported from above, as the sliding door of barns and cars.

O'ver-hung' Head. A cutter on a spindle outside of the bearing, as in outside molding machines. Fig. 3198, p. 1467, *"Mech. Dict."*

O'ver-pick' Loom. One with a *picking* or shuttle driving arrangement above; in contradistinction to *under* or *side picking* motion.

O'ver-pres'sure Valve. A valve which opens when a predetermined pressure in a boiler has been reached. A SAFETY VALVE, which see. A special form by Hopkinson at Paris Exposition, 1878. * *"Scientific American Supplement,"* 2192.

O'ver-shot' Sep'a-ra'tor. (*Agric.*) One in which the sheaf grain is fed into the threshing machine *above* the cylinder.

O'ver-wind'ing Check. A device to cast loose a cage from the hoist when a certain height is attained, to avoid accident by carrying the cage over the drum.

In the device shown in Fig. 1857 a bar connects the cable with the chain attached to the cage in such a manner that

Fig. 1857.

Overwinding Check.

as the straight bar is drawn over the pulley or sheave, in case the cage is hoisted too high, this bar will separate and the cage be held in place by the safety clutches, while the rope or cable may pass over the sheave without taking the cage with it. This bar is formed in two pieces, having at one end a hook and at the other a socket into which the hook engages. Light rivets are driven through both hook and socket. As long as the cage is held by the cable the bar will remain as one piece ; but as soon as the cage is raised too high and the bar is drawn partly over the sheave, the bending action of the straight bar passing over the circular sheave breaks the rivets and throws the hook out of the socket.

In *Lane's* apparatus the hand of the dial does all the work of stopping the cage. When it moves round to the point which indicates that the cage is nearing the mouth of the shaft, the hand comes in contact with the end of a lever, which moves a second lever attached to the end of a rod which reaches to the engine, and there moves a third lever that gradually shuts off the steam and stops the machinery.

In the overwinder check at the Justice mine on the Comstock, at the depth of 100 feet below the top of the shaft, the cage moves a lever and half the steam is shut off at the engine. The cage then ascends at a moderate speed, passes the proper stopping-place, and moves on upward toward the sheaves. Just before it reaches the point of danger, however, the cage presses another lever, a powerful brake is ap-

PLATE XXXIII. FRENCH OYSTER IMPLEMENTS. See page 651

plied to the hoisting reel, and the cage, with its load, is instantly stopped.
See Detaching Hook, Fig. 802, p. 253, *supra*.

For mine cages . "*Min. & Sc. Press*," xxxvii. 369; xxxvi., 326.
"*Iron Age*," xxii., August 1, p. 19.

Laboulaye's "*Dictionnaire des Arts et Manufactures*," iv., ed. 1877, article "*Parachute*," treating of safety apparatus for cages in mines, etc.

Ox'i-dized Sil'ver. "The color of so-called oxidized silver depends on sulphurization. The silver goods are dipped into a boiling-hot solution of calcium sulphide or hyposulphite of soda, or into ammonium sulphide, until they have taken the proper color. 'Old silver' is a coloration produced by laying on a mixture of graphite and oil of turpentine, or some fatty matter, and cleaning off with blotting paper until no more color comes away. Copper acquires a handsome look if treated in the same manner. If it is desired to varnish oxidized silver, take 18 parts alcohol, 3 red arsenic, and 1 castor oil, and a non-transparent varnish can be made, which may be diluted with its own volume of alcohol, if a particularly thin coating is wished." — "*Engineering and Mining Journal.*"

Oys'ter Cul'ture.

LIST OF UNITED STATES PATENTS.

125,470	Oyster basket of galvanized metal strips.
127,903	Oyster nursery.
130,631	Hoisting bucket, bottom of angle iron and bars.
149,921	Sunken net to keep off star-fish.
212,389	Tank for fattening oysters; may be lowered into the water.
217,558	Oyster float to keep oysters submerged.
221,326	Oyster feeder; two tanks with inclined bottoms.

Oys'ter Dredge.

LIST OF UNITED STATES PATENTS.

25,680	Dredge rope runs over a pulley; landed over roller. Reissued February 4, 1868.
27,213	Rake runs on sled runners.
35,324	Guards or fenders on dredge head.
38,436	Conical wheels to roller on gunwale.
45,904	Fenders rods to aid getting dredge over roller.
55,228	Flange on roller to aid in getting dredge aboard.
59,812	Davit on gunwale to raise dredge.
65,442	Screw roller on gunwale.
74,857	Aids in getting dredge aboard.
78,509	Construction of dredge head.
81,304	Adjustable rake, and clevis.
85,936	Guides for dredge rope to roller.
89,323	Guide bars on dredge head.
97,420	Wire basket behind dredge rake.
109,104	Winding apparatus for dredge rope.
120,463	Adjustable rake. Float to keep it vertical in sinking.
121,227	Open-arched cage to dredge.
121,249	Windlass.
122,423	Construction of dredge.
125,964	Automatic adjustment of rake.
132,668	Automatic adjustment of rake.
138,164	Construction of rake.
141,489	Bottom opens to discharge oysters.
144,169	A dredging scoop, with angular blade and prongs.
178,498	Windlass.
197,341	Windlass.
217,031	Hoisting drum and shaft.
220,827	Dredge winder.

Steam dredge, *Graves*. . "*Scientific American Sup.*," 3947.

Oys'ter Im'ple-ments. These are of various kinds, and the practices of countries and districts differ materially. See under the heads: Oyster Tongs, Rakes, etc.

Plate XXXIII. is a collection of the implements used in France, in the parks of St. Brieuc, Arcachon, and the Island of Ré on the coast of Bretagne: —

1. *a*, Wooden rake for cleaning oyster park.
   b, Rake for moving oysters.
   c, Rake for cleaning oyster parks.
2. Wooden rake for removing oysters from the parks.
3. *a*, Shovel for lifting oysters from the mud.
   b, Shovel for use in the parks.
   c, Wooden shovel for washing collectors after removal from the parks.
   d, Wooden rake for cleaning parks and basins.
   e, Iron shovel for lifting oysters from the mud.
4. Fork for hunting and destroying eels.
5. Shovel for throwing water on oysters after they have been taken from the beds.
6. Wooden rake for removing oysters from the parks.
7. Two-pronged hook for raising oyster basket.
8. Shovel to select oysters in boxes, taking only the large ones.
9. Knives for breaking up bunches of grown oysters.
10. Sifter for separating different sizes of oysters.
11. Trap for taking crabs.
12. Shovel for raking oyster beds.
13. Double hook for raising bunches of oysters.
14. Knife for breaking up bunches of grown oysters.
15. Tool for boring holes in tiles.
16. Tool for boring holes in tiles.
17. Knife for breaking up bunches of grown oysters.
18. Lock for letting water in and out of the parks.
19. Knife for breaking up bunches of grown oysters.
20. Caisson for raising oysters.
21. Caisson for breaking oysters after being taken from the tiles.
22. Iron rake for raking oyster beds.
23. Drag net with rake. (Prohibited in France.)
24. Galvanized wire basket for washing oysters.
25. Drag-net, used only under surveillance of the maritime guard.
26. Stationary nippers for separating the oyster from the tiles by breaking the tiles.
27. Hand-barrow for carrying oysters.
28. Crab-trap made of wood and galvanized wire.
29. Machine for separating oysters of different sizes.
30. Rotary rake for removing clay and slime from oyster beds.
31. Crab or lobster trap made of galvanized wire.
32. Sifter for separating oysters.
33. Machine for separating oysters and scraping them from the slates.

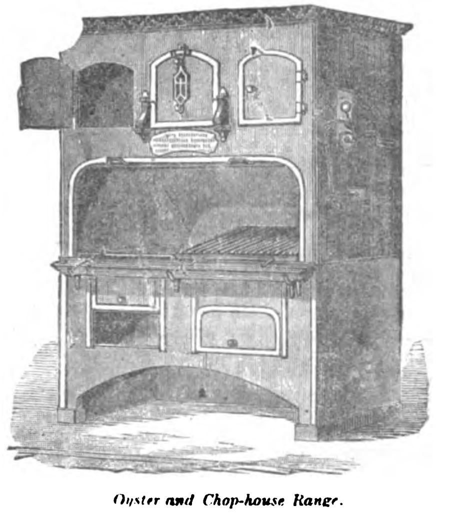
Oys'ter Rakes and Tongs.

LIST OF UNITED STATES PATENTS.

19,516	Grapnel jaws, with locking catch.
44,634	Barrel used as a drum in hoisting rakes.
58,426	Pair of rakes, with handles and lever catch.
75,550	Pair of rakes, with lazy tongs.
76,697	Hinged rake-heads.
105,495	Grapple tongs.
107,740	Grapple tongs.
135,167	Construction of rake.
201,559	Construction of tongs.

Oys'ter Range. A cooking arrangement, with the various appurtenances for stewing, broil-

Fig. 1858.

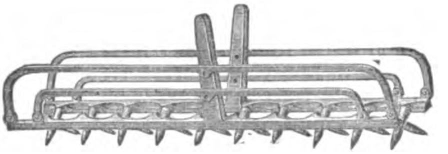


Oyster and Chop-house Range.

ing, roasting, frying, baking of oysters. To cite the possibilities would be to copy a page of a possible bill of fare.

Oys'ter Tongs. A pair of hinged claws which are approached to gather the oysters, and then form a tray in which they are contained while being lifted on board.

Fig. 1859.



Oyster Tongs.

O'zo-ke'rite. A fossil gum, found in Africa.

Cire fossil, Weil . "*Technologiste*," xxxviii. 308.
Refined . . . . "*Technologiste*," xlii. 430.

O'zone Ap'pa-ra'tus. In M. Bertholet's apparatus for the thermic formation of ozone, the gas is produced by means of the silent electric discharge.

It consists of a glass tube to which are connected two smaller tubes. A fourth tube is placed in the large tube. The apparatus is filled with a conducting liquid, water acidulated with sulphuric acid, and inserted in a test tube filled with the same. The electrodes communicate with the liquid in the interior tube, and with that in the test glass. The silent discharge takes place in the annular space between the tubes and acts on the oxygen which enters at one of the smaller tubes and escapes at the other. The gas is thus transformed into ozone through the influence of the current.

Ozone Machine, *Bartlett* * "*Scientific American*," xxxv. 83.
Apparatus . . . . . * "*Scientific American Sup.*," 727.
Leeds . . . . . . * "*Scientific American Sup.*," 2453.
Ozonizer . . . . . . * "*Man. & Builder*," xii. 133.
Generator, *Leeds* . . . "*Scientific American*," xl. 242.
Ozonoscope . . . . . "*Scientific American Sup.*," 2474.

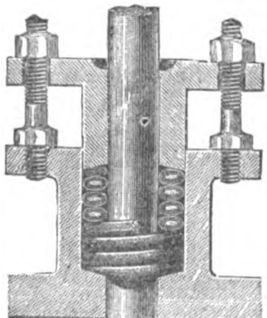
P.

Pa-chym'e-ter. A Viennese instrument which determines the thickness of paper to the 1-1000th of an inch. The micrometer caliper (which see) has much more delicate adjustment.

Pack'ing. A stuffing around a part to prevent leakage of a fluid.

Various materials and applications are given under PACKING, p. 1590; and PISTON PACKING (45 citations), pp. 1717, 1718, "*Mech. Dict.*"

Fig. 1860.



Steam Packing.

The packing shown is that of Ottenson, Hamburg. It is a wick-twisted hose stuffed with mineral and animal grease, and wound around the piston rod in a continuous coil. The gland being screwed down upon the packing expresses sufficient of the lubricant.

Cf. Gun-metal, *Fault* . * "*Engineer*," xlix. 439.
Metallic . . . . . . "*Scientific American Sup.*," 2739.
Jackson . . . . . * "*Scientific American Sup.*," 1827.
Katzenstein . . . . * "*Iron Age*," xxv., April 29, p. 7.
Steam, *Phillips* . . . * "*Scientific American*," xlii. 150.
Hemp and Soapstone . * "*Iron Age*," xx., Nov. 29, p. 9.
Wire cloth & caoutchouc.
Beardmore . . . . * "*Iron Age*," xxv., April 29, p. 9.

Pack'ing Ex-pand'er. A spring to spread the packing of a piston or valve against the surface upon which it traverses. See numerous examples in Fig. 3759, p. 1716, "*Mech. Dict.*"

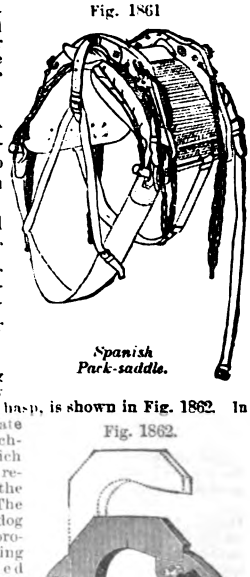
Pack'ing Gland. An annular piece, the cover of a stuffing box, which is screwed or otherwise forced into the stuffing box to expand the packing against the piston. See PACKING, *supra*.

Pack'ing Leath'er. A leathern ring on a piston or plunger, traversing against the cylinder or barrel to make a tight joint therewith.

Pack Sad'dle. The Spanish military pack saddle is shown in Fig. 1861.

The saddle has an adjustment of the sides relatively so as to fit the width of shoulders of the pack mule. The pommel and cantle afford points of attachment for the breast, buttock, and belly bands, and also for the chains by which the load is fastened on to the saddle. The body is sheet iron, with a covering of leather sewed with wire. The lining is of thicknesses of hair felt secured by clasps to the saddle and capable of being removed and opened so as to take out or add thicknesses to adjust the saddle to the shape of the mule's back.

Fig. 1861



Spanish Pack-saddle.

Pad Brack'et. A stable-wall bracket having a shape adapted to receive the saddle which rests thereon.

Pad'lock. Several forms of padlocks are shown on page 1575, "*Mech. Dict.*," and others may be found by titles in the list under LOCK, p. 1342, *Ibid.*

The *Miller* self-fastening lock, which operates by thrusting in the tang of the hasp, is shown in Fig. 1862. In the upper figure the outer plate is removed to exhibit the mechanism. *A* is the dog, which is so pivoted as to fit into a recess of the hasp *B*, when the latter is pushed down. The end of the lower arm of the dog is formed with an angular projection *C*, which, engaging against a properly shaped shoulder at the bottom of the recess, holds the hasp in the position mentioned in opposition to the upward tending force of one arm of the spring *D*. At *E* are the tumblers, either six or seven in number, according to the size of lock, all of which are pivoted on a single pin, and each provided with a bent wire spring, as shown. The upper portion *F* of one of these springs, instead of resting, as do the others, against the projecting part in the shell, is brought forward and under the straight arm of the dog, so as to force the lower arm of the latter against the tumblers, and causes the projection *C* to enter notches in the tumblers, when the same are brought into proper position.

Fig. 1862.

Self-locking Padlock

Owing to the angle of the

notches in the tumblers, and to the dog being in a solid piece, it is only when all the notches coincide that the projection can enter them. By means of varying the positions of the notches on the tumblers, a special key is required to operate each, in order to render all the notches coincident. The key having peculiarly formed projections and recesses at its extremity, acts on all the tumblers simultaneously, and lifts each the exact distance required.

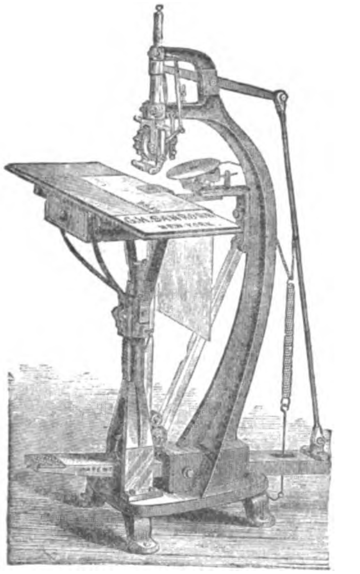
The key is merely pushed in the proper aperture, freeing the dog as above described, and allowing the hasp to be acted upon by the spring *D*, and so lifted upward into the position indicated by the dotted lines, in Fig. 1362. Motion in this direction is then limited by the catch *H*.

Lock, *Miller*. . . . * "*Iron Age*," xxi., April 4, p. 1.

Pa'ging and Num'ber-ing Ma-chine'. The principle of the change of numbers in paging machines is described under that head, p. 1596, "*Mech. Dict.*"

Sutcliff's paging and numbering machine is shown in Fig. 1863. It is adapted for paging blank books, for numbering bonds, checks, drafts, policies, tickets, etc.

Fig. 1863



Paging and Numbering Machine.

The cut represents the machine ready for numbering, with the table up, and the smut-band removed. For paging books, as large figures are used, it is necessary to change the head, and replace the smut-band to prevent smutting the pages. This machine is compact, has two inking rollers, both of which ink the figures, an adjustable gage, and an endless smut-band. With a four-disk head it will number or page to 10,000; with six disks will number to 1,000,000.

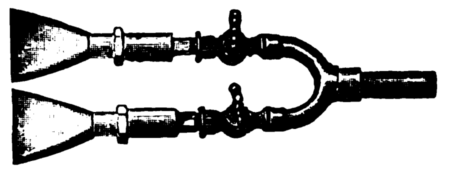
Pail and Tub Ma-chin'er-y. See Fig. 3484, p. 1596, "*Mech. Dict.*"

In Whitney's pail and tub machinery the wood is sawn into planks the breadth of the staves, then cut into pieces of the proper length; these are again sliced into staves by a stout cylindrical saw with the teeth formed upon its extremity; the staves are now baked in an oven, then have the edges planed by a suitable machine to the required form, the pail is set up with a temporary hoop and slipped upon a conical chuck, there held by an end-washer, plate, and bolt, and the hoop removed. A slide-rest tool is then passed along the exterior surface, the temporary hoop is again applied, and then pushed into a box chuck, another slide-rest tool is passed down the interior and finishes at one move. When at the bottom, the workman with the left hand in an instant moves another chisel to form the groove for receiving the chine of the pail-bottom and chamfers the upper edge. The boards for the bottom are planed on both sides in an ordinary machine, then sawn into squares; the squares are gripped between revolving plates and cut to the proper diameter by a parting tool, when a second tool bevels the edge to fit the pail.

Paint Burn'er. An instrument for softening paint by heat or gas, in order that it may be removed. Fig. 3188, p. 1597, "*Mech. Dict.*"

Reed's atmospheric paint burner, for softening paint with gas, is shown in Fig. 1864. The two burners are flattened out so as to present a wide sheet of flame.

Fig. 1864.



Paint Burner.

Acid proof paint	. .	"*Scientific American*," xxxv. 278.
Copper paint	. . . .	"*Scientific American*," xxxv. 18.
Paint in construction, *Grimshaw*	. . . .	"*Scientific American Sup.*," 1998.
Cleaning oil paintings	.	"*Scientific American Sup.*," 1994.

Paint'ing Ma-chine'. A machine for painting of laths or strips of wood, or iron, evenly and thoroughly on both sides and on the edges. — *Roberts*, Br.

There are two feed rollers, the lower of which is grooved spirally, and has at each end a paddle-wheel with floats so arranged as to dip into a tank of thin paint, and, carrying up the liquid, throw it on the rollers and on the strips which may be fed between them. The strip or lath is thus washed with paint on both sides, and it next passes between two long brushes which distribute the color evenly, and remove and return to the tank below any excess of paint.

The speed of the small machine, which takes in a lath 3″ wide and ¼″ thick, is estimated at 6,000 running feet, say 600 laths per hour, on both sides and both edges; requiring the attention of one man and two boys. The rollers and the brushes have a vertical adjustment by means of screws.

Paint Mix'er. A can with shaft and paddles, resembling an upright churn. Used to mix paint with the necessary oil, turpentine, varnish, or what not. The shaft is driven by hand-crank and gearing, and the outlet is by faucet with a gate.

Pa-lam'poor. (*Fabric.*) A bed cover. A highly decorated printed cotton goods of India. See PALLAMPOOR, p. 1599, "*Mech. Dict.*" Also p. 427, *Ibid.*

Pal'a-tor'rha-phy In'stru-ments. (*Surgical.*) For sewing up a cleft palate, synonymous with staphylorraphy. See Fig. 5563, p. 2309, "*Mech. Dict.*"

Pa'le-o-phone'. A writing telephone. *Cross.* "*Technologiste*," xl. 48.

Pa'li-er Glis'sant. A bearing where the journal runs on a film of lubricant or water.

See Fig. 3496, p. 1599, "*Mech. Dict.*" See also HYDRAULIC PIVOT; WATER BEARING, *Ibid.*; and JOURNAL BEARING, Fig. 1499, p. 516, *supra*.

Palier graisseur, *Béthouart et al.*	. . . . .	* "*Technologiste*," xl. 397.
Palier graisseur, *Delerm*		* "*Technologiste*," xxxix. 278.
Pivot hydraulique, *Girard*	. . . .	* "*Technologiste*," xxxix. 73.

Pa-lis'sy Ware. (*Ceramics.*) A faïence with stanniferous glaze and raised decorations made by Bernard Palissy, of Saintes, France, about 1555.

His work was principally representations of aquatic objects: fish, shells, lizards, etc., in relief.

Fig. 1865.

Palm.

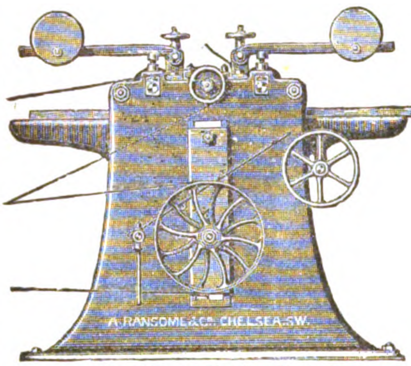
Palm. The sailor's thimble: made of leather, with a hole for the thumb and an abutment over the palm of the hand for the needle.

Pan'el Pla'ner. 1. A planing machine for working on thin stuff for panels, dressing the surface, and feathering the edges to enter the grooves in the stiles.

2. A machine for rabbeting down the edges of panels in order to leave a raised central portion. A PANEL RAISER, Fig. 3502, p. 1602, "*Mech. Dict.*"

The boards are fed through the machine by two pairs of rollers, all of which are driven so as not, by slipping, to mark the surface. The cutters are secured to a wrought-iron adze block, and the pressure bars hold the board firmly on either side of the cutter head.

Fig. 1866.



Panel Board Molding Machine.

S. A. Woods & Co. . .	* "*Manuf. & Builder*," viii. 193.
Rowley & Hermance .	* "*Scientific American*," xliii. 164.

See also MOLDING MACHINE, Figs. 3200, 3201, p. 1468, "*Mech. Dict.*"; SHAPER, Fig. 4916, p. 2133, *Ibid.*

Pan'krat-ic Mi'cro-scope. The microscope of Oberhauser & Ploessl. It has a sliding tube containing the eye-piece, by which its distance from the object glass may be changed, and various degrees of enlargement of the image obtained without change of glasses.

* "*Manufacturer & Builder*" . . . . . xi. 85.

Pan'ning Ma-chine'. A cracker or biscuit machine which rolls and dusts the dough, cuts into crackers, biscuits, cakes, or snaps, separates the same from the scraps, and places the work on pans ready for the oven. See CRACKER MACHINE, Fig. 715, p. 228, *supra*.

Pan-tel'e-graph. One for reproducing at the receiving end a message in the handwriting of the sender.

See FAC-SIMILE TELEGRAPH, p. 324, *supra;* AUTOGRAPHIC TELEGRAPH, p. 56, *supra ;* ELECTRIC WRITING APPARATUS, * p. 304, *supra*, and references *passim*.

Sawyer	"*Iron Age*," xviii., July 20, p. 3.
	* "*Scientific American Sup.*," 302.
d'Arlincourt	"*Jour. Soc. Tel. Eng.*," vii. 15.
	* "*Teleg. Jour.*," vi. 495 ; vii. 28.
Caselli	"*Mech. Dict.*," p. 191.
Meyer	* *Supra*, p. 56.
Cowper	* *Supra*, p. 304.
Bonelli	"*Mech. Dict.*," p. 784.

Pan-tel'e-phone. A microphonic transmitter, so named by its inventor, *Prof. Leon de Locht*, Liège.

It is sensitive to sonorous vibrations emanating at a great distance. It is capable of transmitting words spoken at 45′ from the apparatus to a distance of several miles through the medium of receiving telephones. It is composed essentially of a movable plate carrying a carbon contact, which presses against a disk of carbon or metal, silver or platinum.

* "*Scientific American*" . . . . xliii. 162.

Pan'to-graph. Statement and illustration, p. 1603, "*Mech. Dict.*"

Fenby, Br.	* "*Engineering*," xxx. 8.
	* "*Scientific American Sup.*," 3848.
	* "*Scientific American Sup.*," 2506.
	* "*Scientific American*," xli. 66.
Polar, *Napoli*, Fr. . .	* "*Engineering*," xxvi. 427.

Pan'to-graph En-gra'ving Ma-chine'. A system of etching calico rolls by means of a pantographic apparatus.

A copy of the pattern to be engraved is enlarged by camera to any required size ; this copy is then laid on a table forming a part of the machine ; and over the lines of this copy the operator guides a stylus or tracing point, which, by being connected with suitable mechanism, causes a number of gravers or diamond points to come in contact with the roller, each point duplicating on its surface the exact copy, in miniature, of the original design. The roller is covered with a coating of varnish, and upon this coating the figures are etched. After this, the roller is immersed in nitric acid, where it remains till the metal has been eaten away to the required depth excepting where the varnish preserves the surface from the action of the acid.

Pan-to-graph'ic Cut'ter Form'ing En'gine. A milling machine for forming cutters for gear cutting.

An arrangement by which from a templet of the correct size, any required reduction may be made in the size of the cutter. preserving the correctness of shape. The gear cutter is turned nearly to the required form ; the notches are cut in it, and the duty of the pantographic engine is merely to give the finishing touch to each cutting edge and give it the correct outline. — *Pratt & Whitney.*

Pan-tom'e-ter. (*Surveying.*) An instrument by Fouquier, for obtaining angular measurements. It is composed of two vertical cylindrical drums of the same diameter, one superposed on the other axially.

The lower has a socket beneath which rests on a staff, and the upper one turns on the axis and has two planes diametrically perpendicular acting as alidades. An object is viewed through one and the angle determined by aid of an opening and wire in the lower drum, then bring on the other object the opening and wire in the upper drum. The angle sought is then equal to that of the diametric planes of the two drums, and is read directly by aid of the divisions with which they are furnished.

Pan-top'ol-lite. A German dynamite containing a small proportion of naphthaline dissolved in the nitro-glycerine. Intended to prevent the formation of disagreeable nitrous vapors during explosion.

Pa'per. The statement, adopted from Pliny, and given on p. 1604, "*Mech. Dict.*," as to the mode of making paper from the *papyrus* reed, requires correction.

Pliny said a great many things from knowledge and still more from information, and in this case is not correct. He describes the cutting of the reed stalks into lengths and separating " by splitting the successive folds of the stalk with a needle."

A critical examination of the papyrus stalk shows that it does not have successive folds, but its triangular stalks have a single envelope and the pith on the inside must have been divided into slices by a knife, either in strips of such width as the side of the prism admitted, or else shaved round and round (like the operation of cork making) making a long spiral slice, as practiced from time immemorial in China and Formosa in making what is popularly called, by us, " rice paper," which has no rice in its composition but is a spiral shaving, made as just described (of the papyrus), from the pith of the *Aralia papyrifera*, which grows wild in Formosa. See p. 1938, "'*Mech. Dict.*"

Materials for paper, shown or cited at the Centennial Exhibition, 1876 : —

Common and Botanical Names.	Exhibited from.
Maguey, *Agava Americana*	Mexico, etc.
Maguey, *Agava Mexicana*	Mexico.
Spanish broom (*Esparto*), *Macrochola tenacissima* .	Spain.
Banana leaves, *Musa*	Egypt.
Halfa, *Ligeum Spartium*	N. Africa.
China grass (Rhea), *Bæhmeria nivea*	Victoria.
New Zealand flax, *Phormium tenax*	New Zealand.

Agave, ***Fourcroya gigantea***	Tropical America.
Cow-itch tree, ***Lagunaria Pattersoni***	Norfolk Island.
Spanish bayonet, ***Yucca aloifolia***	Victoria.
Spanish bayonet, ***Yucca filamentosa***	Victoria.
Adam's needle, ***Yucca gloriosa***	Victoria.
Adam's needle, ***Sparmannia Africana***	Africa.
Adam's needle, ***Hibiscus heterophyllus***	Queensland.
Queensland hemp, ***Sida retusa***	Queensland.
Victorian hemp, ***Sida pulchella***	Victoria.
Queensland grass cloth, ***Pipturus propinquus***	Queensland.
Flame tree, ***Brachychiton acerifolium***	Queensland.
Bottle tree, ***Sterculia rupestris***	Queensland.
Tree nettle, ***Laportia gigas***	Queensland.
Mulberry (***Kuwa***)	Japan.
Wild cherry (***Hi-no-ki***)	Japan.
Sisal hemp, ***Agave sisilana***	Yucatan.
Pineapple, ***Ananassa sativa***	Jamaica.
Pineapple, ***Bromelia sylvestris***	Mexico.
Pineapple, ***Bromelia penguin***	Jamaica.
Mohant tree, ***Hibiscus arboreus***	Tropical America.
Okra, ***Malva***	Jamaica.
Yercum, ***Calatropis gigantea***	Jamaica.
Bow-string hemp, ***Sanseviera Zeylanica***	Jamaica.
Ife tree, ***Sanseviera Angolensis***	Angola.
Fig tree, ***Ficus speciosa***	Brazil.
Milk weed, ***Asclepias***	Brazil.
Diss, ***Cyperus dives***	Egypt.
Cat-tail, ***Typha latifolia***	Egypt.
Neilgherry nettle, ***Urtica heterophylla***	India.
Puyba (puya flax), ***Bœhmeria puoya***	India.
Kangra hemp, ***Cannabis sativa***	India.
Barriala, ***Sida rhomboida***	India.
Brown hemp, ***Hibiscus cannabinus***	Bombay.
Roselle, ***Hibiscus sabdariffa***	India.
Indian mallow, ***Abutilon Indicum***	India.
Sun hemp, ***Crotalaria juncea***	India.
Jubbulpore hemp, ***Crotalaria tenuifolia***	India.
Jute, ***Corchorus olitorius***	India.
Nettle, ***Urtica incisa***	Queensland.
Paper mulberry, ***Broussonetia papyrifera***	Queensland.
Hollyhock tree, ***Hibiscus splendens***	New South Wales.
Hollyhock tree, ***Abutilon venosum***	S. America.
Hollyhock tree, ***Abutilon mollis***	S. America.
Hollyhock tree, ***Abutilon Bedfordianum***	S. America.
Hollyhock tree, ***Abutilon striatum***	S. America.
Ribbon tree (lace bark), ***Plagianthus betulinus***	N. Zealand.
Club rush, ***Scirpus fluviatilis***	Australia.
Sedge grass, ***Carex appressa***	Australia.
Gallingall rush, ***Cyperus lucidus***	Australia.
Gallingall rush, ***Carex pseudo-cyperus***	Australia.
Sword grass, ***Gahnia psittacorum***	Australia.
Sword grass, ***Cyperus vaginatus***	Australia.
Sword grass, ***Lepidosperma elatius***	Australia.
Coast sword grass, ***Lepidosperma gladiatum***	Australia.
Slender sword grass (mat grass), ***Lepidosperma flexuosa***	Australia.
Black reed (cutting grass), ***Cladium radula***	Australia.
Stringy bark, ***Eucalyptus obliqua***	Australia.
Messmate, ***Eucalyptus fissilis***	Australia.
Swamp tea-tree, ***Melaleuca ericifolia***	Australia.
Swamp tea-tree, ***Melaleuca genistifolia***	Australia.
Swamp tea-tree, ***Melaleuca squarosa***	Australia.
Flame tree, ***Sterculia acerifolia***	New South Wales.
Bottle tree, ***Sterculia diversifolia***	Victoria.
Bottle tree, ***Sterculia lucida***	Victoria.
Bottle tree, ***Sterculia fœtida***	Malaysia.
Lye plant, ***Commersonia Fraseri***	Queensland.
Lye plant, ***Dombeya Natalensis***	Natal.
Wire grass, ***Ehrhasta tenacissima***	Australia.
Wire grass, ***Poa Australis***	Australia.
Plume grass, ***Arunda conspicua***	New Zealand.
River rush, ***Isolepus nodosa***	Australia.
Sea-coast rush, ***Juncus maritimus***	Australia.
Sea-coast rush, ***Juncus vaginatus***	Australia.
Sea-coast rush, ***Dianella latifolia***	Australia.
Sea-coast rush, ***Dianella longifolia***	Australia.
Dragon tree, ***Dracœna Draco***	Teneriffe.
Spear lily, ***Doryanthes excelsa***	Eastern Australia.
Bulrush, ***Typha angustifolia***	Australia.
Jaggery palm, ***Caryota urens***	Queensland.
Screw pine, ***Pandanus utilis***	Australia.
Common rush, ***Juncus pauciflorus***	Australia.
Tussock grass, ***Xerotes longifolia***	Australia.
Currijong, ***Pimelia axiflora***	Queensland.
Currijong, ***Dais cotinifolia***	Natal.
Currijong, ***Pittosporum crassifolium***	Natal.
Manila hemp (abaca), ***Musa textilis***	Philippines.
Baobab, ***Adamsonia digitata***	Tropical Africa.
Baobab, ***Strelitzia regina***	South Africa.
Baobab, ***Heliconia gigantea***	Tropical America.
Urania (*Ravenala*), ***Madagascariensis***	Madagascar.
Urania, ***Pterospermum acerifolium***	Mauritius.
Urania, ***Guazuma ulmifolia***	Mauritius.
Urania, ***Melochia liliacefolia***	South Africa.
Sago palm, ***Sagus ruffia***	Mauritius.
Sago palm, ***Sagus saccherifera***	Mauritius.
Sago palm, ***Livistona mauritiana***	Mauritius.
Sago palm, ***Sanseviera zebrina***	Mauritius.
Sago palm, ***Sanseviera latifolia***	Mauritius.
Sago palm, ***Sanseviera cylindrica***	Mauritius.
Sago palm, ***Colocasia antiquorum***	India.
Mulberry, ***Morus tartarica***	Tartary.
Mulberry, ***Alpinia magnifica***	Tropical Africa.
Mulberry, ***Cordia myxa***	Egypt.
Mulberry, ***Ixora corylifolia***	
Panama hat-straw, ***Carludovica palmata***	Ecuador.
Bamboo, ***Bambusa vulgaris***	Asia.

The Victoria collection at the Philadelphia Exposition embraced samples of paper made from plants growing in Victoria, Australia, were as follows: —

Paper made from Bark of

Paper mulberry tree, ***Broussonetia papyrifera.***
Salvia Canariensis.
Dais continifolia.
Stringybark, ***Eucalyptus obliqua.***
Messmate, ***Eucalyptus fissilis.***
Soft-leaved abutilon, ***Abutilon mollis.***
Veined lantern flower, ***Abutilon venosum.***
Currijong, ***Pimelia axiflora.***
Lye plant, ***Commersonia Fraseri***, **Queensland.**
Thick-leaved pittosporum, ***Pittosporum crassifolium.***
Queensland grasscloth plant, ***Pipturus propinquus.***
Common tea tree, ***Melaleuca ericifolia.***
Broom-leaved tea tree, ***Melaleuca genistifolia.***
Victorian bottle tree, ***Sterculia diversifolia.***
Flame tree, ***Sterculia acerifolia.***
Chinese grasscloth plant, ***Bœhmeria nivea.***
Victorian hemp, ***Sida pulchella.***
Queensland hemp, ***Sida retusa.***
Victorian yellow-wood, ***Melaleuca squarrosa.***

Paper made from Stems of

Victorian nettle, ***Urtica incisa.***
Ehrharta tenacissima.
Carex appressa.
Carex pseudo-cyperus.
Isolepis nodosa.
Few-flowered rush, ***Juncus pauciflorus.***

Paper made from Stems and Leaves of

Gahnia psittacorum, var. erythrocarpum.
Tall sword rush, ***Lepidosperma elatius.***
Tall palm lily, ***Cordyline indivisa.***
New Zealand flax, ***Phormium tenax.***
Pampas grass, ***Gynerium argenteum.***
Plume grass, ***Arundo conspicua.***
Giant lily, ***Fourcroya gigantea.***
Cyperus sp.
Coast rush, ***Juncus maritimus.***
Small sheathed rush, ***Juncus vaginatus.***
Large sheathed rush, ***Juncus vaginatus.***
Coast sword rush, ***Lepidosperma gladiatum.***
Native bulrush, ***Typha angustifolia.***
Scirpus fluviatilis.
Marica Northiana.
Native tussock grass, ***Xerotes longifolia.***
Screw pine, ***Pandanus utilis.***
Cyperus lucidus.
Swamp moss, ***Conferva sp.***
Dianella latifolia.
Jaggery palm, ***Caryota urens.***

De Naeyer & Co., of Willebroeck, Belgium, showed at the Paris Exposition of 1878, paper manufactured from the following materials, and furnished the statement of percentage of fiber yielded: —

Woods.

Common and Botanical Names.	Yield per cent.
Heath, ***Erica vulgaris***	27.14
Filbert trees, ***Corylus avellana***	31.50
Alder, ***Alnus glutinosa***	34.30
Bamboo, ***Bambusa thonarsu***	34.82
White pine, ***Abies pectinata***	34.60
Horse chestnut, ***Æsculus hippocastanus***	38.26
Oak, ***Quercus robur***	29.16
White poplar, ***Populus alba***	35.81
Red pine, ***Pinus sylvestris rubra***	32.28
Elm, ***Ulmus campestris***	31.81
Ash, ***Fraxinus excelsior***	32.28
Black alder, ***Rhamnus frangula***	37.82
Fir, ***Pinus sylvestris***	35.17
Osier, ***Salix alba***	29.50
Canadian poplar, ***Populus Canadensis***	36.88
Beech, ***Fagus sylvatica***	30.90
Pitch pine, ***Pinus Australis***	31.08

Walnut, *Juglans regia*	26.52
Willow, *Salix alba*	37.82
Birch, *Betula alba*	33.80
Italian poplar, *Populus Italica*	36.12
Acacia, *Robina pseudoacacia*	34.10
Lime tree, *Tillia Europea*	38.16
Rattan, *Calamus verus*	29.19
Aspen tree, *Populus tremula*	35.00

HERBACEOUS PLANTS, ETC.

Camelina, *Camelina sativa*	29.16
Bent grass, *Agrostis spica venti*	45.82
Buckwheat, *Fagopyrum esculentum*	30.60
Marsh rush, *Scirpus palustris*	41.70
Banana, *Musa ensete*	31.81
Mateva, *Hyphæne Thebaica*	26.08
Oats, *Avena sativa*	35.08
New Zealand flax, *Phormium tenax*	32.71
Asparagus stalks, *Asparagus officinalis*	32.56
Marsh grass, *Glyceria aquatica*	38.80
Maize, *Zea maïs*	40.24
Reed, *Phragmites vulgaris*	41.57
Canna, *Canna*	20.29
Rye, *Secale cereale*	44.12
Giant nettle, *Urtica dioica*	21.66
Sugar cane, *Saccharum officinarum*	29.15
Barley, *Hordeum vulgare*	36.21
Sedge, *Carex*	33.86
Wheat, *Triticum sativum*	43.14
Fromenteau, *Baldengera Arundinacia*	46.17
Blue flag, *Enodium cæruleum*	40.07
Hop, *Humulus lupulus*	34.84
Canary grass, *Phalari Canariensis*	44.16
Wild broom, *Spartium scoparium*	32.43
Dog's grass, *Triticum repens*	28.38

An *astronomical tower* 29′ in diameter was constructed of paper at the Polytechnic Institute, Troy, N. Y.

A *paper church* near Berlin has a capacity for nearly 1,000 persons. It is circular within, octagonal without. The reliefs outside and statues within, the roof, ceiling, the Corinthian capitals, are all papier mache, rendered water-proof by saturating in vitriol, lime water, whey, and white of eggs.

Bricks are made of paper pulp from rough materials in Wisconsin.

Barrels of paper are made in numerous factories in the United States.

Paper chimney-pots are made in Breslau, and are light and durable. Before the paper pulp is molded and compressed into the required shape, it is treated with chemicals which render it non-inflammable.

See also — asparagus	"*Scientific Amer.*," xxxvii 313.
Asparagus	"*Scientific Amer.*," xxxvii. 52.
Bagasse	"*Scientific American,*" xlii 50.
Bamboo	"*Scientific Am.*," xxxiv. 49, 88.
	"*Scientific American Sup.*," 288.
	"*Eng. & Min. Jour.*," xxviii. 128.
Banana fiber	"*Scientific American*," xliii. 66
Esparto grass	"*Scientific American*," xl. 170.
Grass	"*Scientific American*," xli. 311.
Palmetto fibre	"*Scientific American*," xli. 35.
Hop plant	"*Scientific American*," xli. 87.
Palm fiber	"*Man. & Builder*," xii. 247.
Photolithographic	"*Scientific American Sup.*," 1323.
Poke-weed, Phytolacca	"*Scientific Amer.*," xxxix. 134.
Rice paper of China	"*Scientific American Sup.*," 2408.
Woods & plants yielding paper, list	"*Scientific Amer.*," xxxix. 212.
Yucca	"*Min. & Sc. Press*," xxxv. 289.

Proteaux's "Practical Guide for the Manufacture of Paper and Boards."

Arrowsmith's "Paper Hanger's Companion."

Pa'per, Print'ing, Books. See under the following: —

Agave.
Albumenized paper.
Asbestos paper.
Backing pan.
Bank note paper.
Bank note press.
Blank work folder.
Blotting paper.
Board cutter.
Book backing machine.
Book backing vise.
Bookbinder's plow.
Bookbinder's press.
Book sawing machine.
Book sewing machine.
Book stabbing machine.
Book stitching machine.
Book trimmer.
Bottom plate.
Calendering machine.
Calender rolls.
Cameo press.
Card and ticket cutter.
Cardboard cutter.
Cardboard machine.
Chromo-lithographic mach.
Color printing.
Composing machine.
Coupon ticket machine
Cutcher.
Damping apparatus.
Distributing table.
Electrotype.
Electrotype molding machine.
Electrotyping battery.
Embossing machine.
Envelope machine.
Envelope printing press.
Facsimile printing press.
Fiber-faced paper.
File holder.
Finishing stand.
Fire-proof paper.
Folding and perforating m.
Folding machine.
Gage table shears.
Gilding press.
Gold paper.
Grounding machine.
Inking pad.
Lace paper.
Lettering stamp.
Lithographic press.
Lithographic stone dresser.
Lithographic stone polish. m.
Mailing table.
Matrix-rolling machine.
Mechanical printer.
Mechanical quoin.
Message copying press.
Motor printer.
Multicolor printing press.
Music printing.
Numbering chase.
Pantographic engraving m.
Paper.
Paper articles.
Paper-bag machine.
Paper barrel.
Paper building.
Paper calendering machine.
Paper clipping machine.
Paper collar machine.
Paper coloring machine.
Paper cutting machine.
Paper cutting and winding m.
Paper enamel.
Paper glazing machine.
Paper knife grinder.
Paper making.
Paper press.
Paper pulp engine.
Paper rolling machine.
Pasteboard cutter.
Perfecting press.
Perforated board.
Perforating machine.
Photolithographic paper.
Postage stamp.
Printing machine
Printing press.
Proof press.
Pulp boiler.
Punching press.
Rag boiler.
Rag knife.
Rag washer.
Roller bar.
Rounding machine.
Ruling-pen holder.
Safety paper.
Sheet calender.
Shoot board.
Snatching rollers.
Steel pen.
Stereotype.
Stereotype beveling machine.
Stereotype dressing table.
Stereotype melting furnace.
Stop-cylinder printing mach.
Striker.
Taking-off apparatus.
Technograph.
Ticket printing.
Tissue paper.
Transparent paper.
Two-revolution press.
Type.
Type composing machine.
Type machine.
Type-making and setting m.
Type writer.
Typographic machine.
Wall paper.
Wall paper machine.
Wall paper polishing mach.
Wall paper sticking machine.
Washer.
Water proof paper.
Wet printing press.
Wet broke.
Wood paper.
Wood-paper-stock assorter.
Wood pulp.
Wood rasping machine.
Wood stock boiler.

Pa'per Bar'rel. Barrels are made from molded pulp, formed in sections, and then united; or of paper in layers.

The process of preparing the paper consists in subjecting three layers of paper (called straw-board), cemented together, to a hydraulic pressure of more than 100 tons. This produces a compact, solid substance of great resisting power. These sheets are run through machinery which dovetails the ends, making them ready for joining, and turns the edges. It is passed through another machine, which gives the cylindrical shape. This saves 25 per cent. in packing space over the usual barrel. The outside of the barrel, after being ornamented and rendered perfectly air and water proof, is ready to put together. One operator can easily manufacture 150 per day, while from 15 to 20 have been considered a good day's work in making wooden barrels. Either wooden or paper heads can be used. The former are turned, and the latter are pressed out and stamped in dies. The hoops are strongly united bands of paper Each part of the barrel, hoop, head, and cylinder, is made complete. Empty barrels can be packed the one within another, and put together as required. The weight of a paper barrel is about one-half that of a wooden one. — *Thompson.*

By another method straw pulp is run into a mold made in the shape of a half-barrel, cut vertically. The ends are of paper, but are protected by wood. The staves are three-eighths of an inch thick.

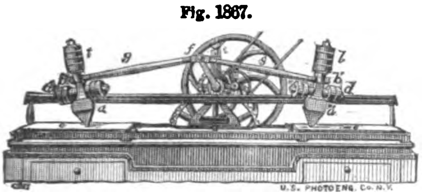
See also "*Manufacturer & Builder,*" xii. 149.

Pa'per Bur'nish-ing Machine'. A machine for putting a polish on paper. The action is more energetic than that of the calender, which depends upon mere pressure.

See CALENDERING MACHINE, Figs. 499, 500, pp. 152, 153, *supra.*

The substitution of glazed rolls for the burnishing of marbled and colored papers with polished agates, etc., has not equaled the previous result. Fig. 1867 is a machine by M. Alauzet, of Paris, for manipulating the burnishing stone, and thus economizing the cost without impairing the beauty of the imparted surface. This machine, which may be used for dyed and undyed paper, is double acting; the sheets of paper are represented by *e*, while *a* shows the burnishing stone guided and moved by the bar *b d t* and the rod *g*, which is

Fig. 1867.



Paper Burnishing Machine.

connected with the crank *f*. The weights *t* and *l* may be increased or diminished according to requirements.

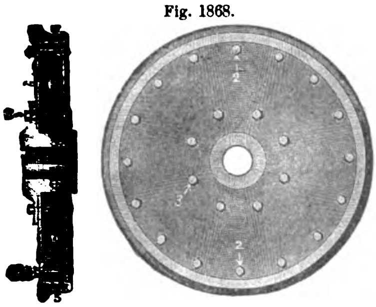
See also PAPER GLAZING MACHINE and PHOTOGRAPH BURNISHER.

Pa'per Cal'en-der-ing Ma-chine'.
Poole's super-calender rollers, Fig. 499, p. 152, *supra*.

Pierron & Dehaîtres French calendering machine, Fig. 500, page 153, *supra*.

See also PLATER ; SUPER CALENDER, *infra*.
See also PAPER GLAZING MACHINE, *infra*.

Fig. 1868.



Paper Car Wheel.

2. Tire-bolt. 5. Tire.
3. Hub-bolt. 6. Compressed paper.

Pa'per Car'bon Lamp. A form of incandescent electric lamp in which a slip of paper reduced to carbon is used as the illuminated agent in a glass globe with an atmosphere of nitrogen. The carbonized strip of paper is the substitute for other forms of carbon, such as rattan or bamboo bark, or the metal platinum. The mode of disposing the carbon arc and its connections is shown in Fig. 938, Plate XIV., opp. p. 300, *supra*.

Pa'per Car'pet.

Paper is rendered hard and tenacious by subjecting the pulp to the action of chloride of zinc. After it has been treated with the chloride, it is submitted to a strong pressure, thereafter becoming as hard as wood and as tough as leather.

"A paper carpet is now made in England, and designed to imitate parquet flooring, the paper being printed in patterns to imitate different woods from photographs, so that the resemblance is perfect. The floor is first prepared by being made perfectly level, and the crevices filled up with plaster-of paris ; over the surface, as thus prepared, *hession* (paper treated with chloride of zinc), is stretched, and on this first lining paper, and then the patterned paper, is pasted, the whole being finished with a coating of a peculiar hard and wear-resisting varnish." — "*Furniture Trade Journal*," Br.

See also LEATHER, ARTIFICIAL, *supra*, and references there cited.

The imitation of Japanese paper, for decorative purposes, is made by the Pavey Co., of London.

It is made of hemp and jute, with a small percentage of animal matter. It is used for lambrequins, window and bed curtains, tapestry, blinds, valances, upholstery, etc. It is made and printed in imitation of silk, woolen, cotton stuffs, the brocades of Lyons, reps, woolen and silk damasks of Paris and Bordeaux, and the cretonnes of Mulhouse, while it retains the peculiar Japanese characteristics.

The paper is first formed into an endless roll, and is perfectly white in color. Afterward it is taken to an embossing machine, which impresses it slightly, and then the design is printed from electrotype plates, first cast from the wood and formed upon a roller, as in wall-paper printing.

Pa'per Car'-wheel. (*Railway.*) A car wheel with steel tire and a web of compressed paper between plates which are bolted to the hub and tire. It is shown by section, and also by elevation, in Fig. 1868.

The central portion of the wheel is entirely of thicknesses of paper, united by paste and compressed by hydraulic machinery to the consistence of wood, but without the liability to split, which wood has more or less ; the hub and the tires are of steel. One of these wheels, used under a Pullman car, has run for eight years, and for a distance of 302,900 miles.

Pa'per Clip'ping Ma-chine'. A machine for trimming the edges of books, or of paper in piles. See PAPER CUTTER.

Pa'per Col'lar Ma-chine'. See p. 1619, "*Mech. Dict.*"

The Lockwood machine works from an endless web of paper, or of cloth and paper, the width of the web being slightly greater than the length of the collar required. The web passes over rollers, and then beneath an intermitting descending platen, which has two sets of dies by which the collars are cut, creased, button-holed, stitch-marked, and embossed with the name and number at the rate of 30,000 per day. The material is fed intermittingly and receives the button-holes, stitch marking, and embossed number by one set of dies, then is advanced beneath the cutting-out dies, both sets of dies descending at once, but operating consecutively upon the paper.

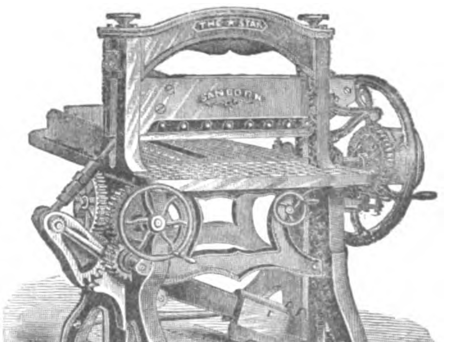
When paper only is used for the collar, three strips of gummed cloth are fed from spools, so as to be exactly over the places for the three button-holes. The patches are cut from these and automatically damped, deposited upon and fastened to the web in the places where the holes are to be cut.

A *forming machine* then bends the paper collar at the crease, taking them in endwise, and discharges them at the rate of 50,000 per day.

Pa'per Cut'ter. A machine for cutting paper in pile. In the Sanford cutter, Fig. 1869, the knife is brought down obliquely upon the pile and returns by a quick upward stroke. The table has rules and lines for cutting to measure. The paper clamp is moved independently.

Another form of paper cutter is that for scoring and cutting paper boards for boxes, notching the corners, and scoring the joints. — *Sanborn.*

Fig. 1869.



Paper Cutter.

* "*Manufacturer and Builder*" . . . . xi. 193.
* "*Scientific American*" . . . . xl. 310.

See Figs. 3524, 3525, pp. 1620, 1621, "*Mech. Dict.*"

See also BOOK TRIMMER, *Semple*, Fig. 384, p. 121 ; BOARD CUTTER, Fig. 354, p. 113 ; CARD CUTTER, Figs. 539–541, p. 166, *supra*.

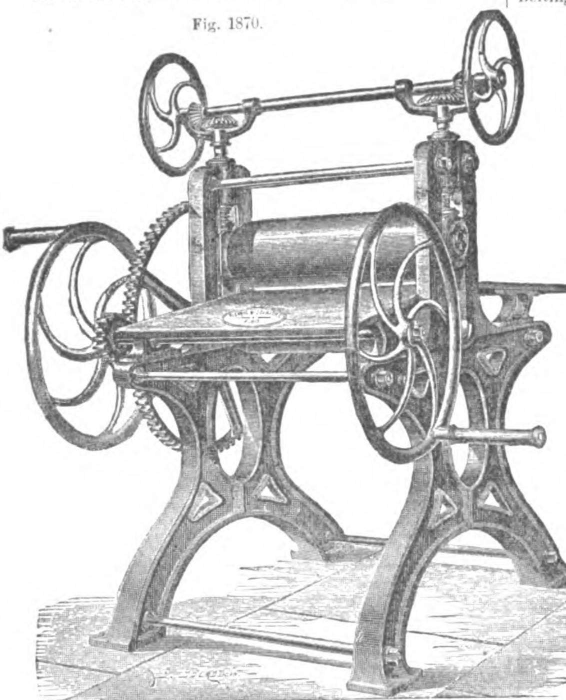
Pa'per E-nam'el. Enamel for paper cards and papeterie.

For white, and for all pale and delicate shades, take 24 parts by weight of paraffine, add thereto 100 parts of pure kaolin (China clay), very dry, and reduced to a fine powder. Before mixing with the kaolin the paraffine must be heated to fusing point. Let the mixture cool, and it will form a homogeneous mass, which is to be reduced to powder and worked into a paste in a paint mill with warm water. The enamel is then ready for application. It can be tinted to any desired color.

Pa'per Gla'zing Rol'ler. A machine through which paper or card is passed to give to it a burnished surface.

The machine shown in Fig. 1870 is that of Pierrin et Dehaître, of Paris. The paper is passed between two rollers, the lower one of which is driven, and the resistance of the upper one gives a sliding pressure which compacts the surface of the paper in the manner of a burnisher.

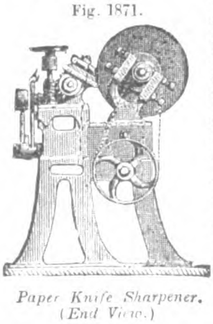
Fig. 1870.



French Paper-glazing Machine.

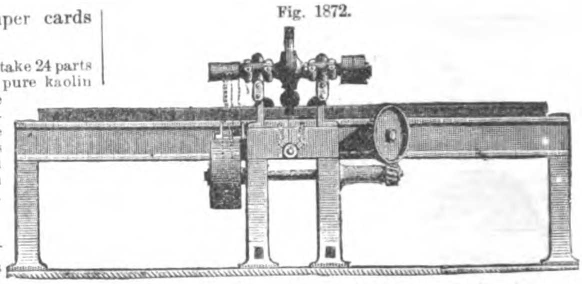
Pa'per Knife Sharp'en-er. The machine of Bell, of Lucerne (Switz.), is shown in Figs. 1871, 1872; it is adapted for knives up to 1.5 meter in length. The emery wheel is in fixed bearings, and the knife, secured to a slide rest, traverses in front of it. The wheel is .45 to .5 m. in diameter and makes 600 turns per minute. The knife is advanced to the emery wheel by hand wheel and screw. The motion of the grinding wheel is communicated to the slide rest which passes the knife to and fro by an alternate movement. See GRINDING MACHINE.

Fig. 1871.



Paper Knife Sharpener. (End View.)

Fig. 1872.



Paper Knife Sharpener. (Side Elevation.)

Pa'per Ma-chin'e-ry, etc.

Articles of, machinery for making	"Sc. Amer.," xxxvi. 339.
Barrel	"Man. & Build.," xii. 149.
Belting, *Crane*	Cooper's "Belting," 198.
Box	Laboulaye's "Dict.," iv., ed. 1877, article "Sac."
Carbon lamp, *Edison*	"Van Nostrand's Mag.," xxiii. 1.
Carbon paper apparatus. *Liebert*, Fr.	* "Sc. Amer. Sup.," 2438.
Coloring machine	"Sc. Amer.," xxxv. 354.
Cutting machine. *Brown & Carver*	* "Engineering," xxi. 525.
Feister	* "Sc. Amer.," xliii. 178.
Cutter, "Diamond."	* "Sc. Amer.," xxxix. 386; xl. 310.
Schlenker	* "Man. & Builder," xi. 193.
Dome, observatory	"Van Nostrand's Mag.," xx. 448.
Fire-proof	"Sc. Amer. Sup.," 2511.
Folding mach., *Forsaith*	* "Man. & Builder," viii. 1.
Hardening	"Sc. Amer.," xxxiv. 310.
Japanese, on, *Munroe*	* "Engineer," xli. 415.
Japanese, Ogi	* "Engineer," xli. 353.
Leather	"Sc. Amer.," xlii. 274.
Making, Albion Paper Mills	* "Sc. Amer.," xlii. 207.
Making, technology of. *Arnot*	"Sc. Amer. Sup.," 1733, 1750, 1845, 1862, 1879, 1956.
Machinery	"Sc. Amer.," xxxvi. 339.
Japanese	"Sc. Amer.," xxxiv. 339; xxxv. 100.
Mill, Japanese, Ogi	"Engineering," xxi. 399, 422.
Maché molds	"Man. & Builder," ix. 144.
Negatives, pap. by *Abney*	"Sc. Amer. Sup.," 1891.
Papyroxyline	"Sc. Amer. Sup.," 1752. See also GUN COTTON.
Preservative, mildew, etc.	"Sc. American," xli. 36.
Press	* "Sc. American," xli. 82.
Press, *Jones*	* "Sc. American," xli. 22.
Toggle motion. *Boomer & Borchrt*	* "Sc. Amer.," xlii. 242.
Pulleys & pulley covers	Cooper's "Belting," xv.
Pulp, black, recipes	"Sc. Amer. Sup.," 3971.
Pulp boiler, *Roeckner*	* "Sc. Amer. Sup.," 698.
Pulp boxes	"Iron Age," xvii., April 13, 23.
Pulp engine	"Sc. Amer.," xxxvi. 403.
Pulp mach., *Lebrousse*	"Sc. Amer. Sup.," 2704.
Sheathing for vessels	"Iron Age," xxiv., Sept. 18, p. 1.
Splitting	"Sc. American," xl. 6.
Tester	* "Sc. Amer.," xxxviii. 69.
Testing machine, *Chauvin & Marin-Darbel*, Fr.	* "Engineering," xxvi. 185.

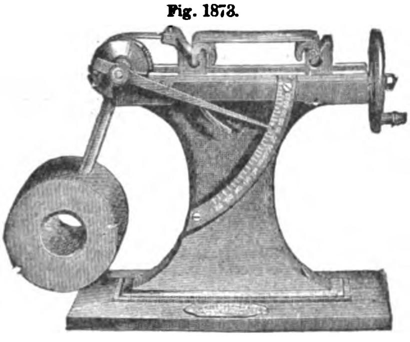
Pa'per Rol'ling Ma-chine'. See PAPER GLAZING ROLLER, Fig. 1870, *supra*; PLATES, *infra*; CALENDERING MACHINE, Figs. 499, 500, pp. 152, 153, *supra*.

Pa'per Test'er. A machine in which the tensile strength of a strip of paper of a given width is ascertained.

In Fig. 1873 the paper is tested by the direct action of a weight, avoiding the variations which arise in the use of springs.

The strip of paper is secured by cam clamps in the two holders. By rotation of the hand wheel the clamps are separated, and the strain is indicated by the finger against the graduated arc.

Fig. 1873.



Paper Tester.

Chavin & Marin-Darbel. . . * "*Sc. American*," xxxviii. 69.
* "*Sc. American*," xxxix. 211.

Pa'per Weight. (*Glass.*) Ornamental blocks or globes made in various ways. See CAMEO INCRUSTATION; FILIGREE; VITRO DE TRINO; MILLEFIORI; and list on pp. 975, 976, "*Mech. Dict.*"

Pa'per Wet'ting Ma-chine'. The bundle of paper is placed on the bank, and fed in quires, either open or folded, to guides on the feed table. At the proper time the table advances and enters the paper between two cylinders covered with felt, the lower one of which runs in a trough of water. As the paper issues from these cylinders, it passes between a top and bottom sprinkler, by which additional water can be put on, and the quantity can be regulated at pleasure. The paper is then conveyed by cords to a sheet-flyer, which lays it on a table suspended on springs. These springs are adjusted to suit the weight of the paper, so that the table falls as the weight increases, and thus keeps the top of the pile always at the same height. — *Hoe.*

Pa-pyr'o-graph. Known also by other names. See HECTOGRAPH; COPYGRAPH; MANIFOLD, etc. See also GELATINE COPYING PROCESS, and references *passim.*

Par-a-bol'ic Il-lu'min-a'tor. (*Optics.*) Beck's. A means of illuminating opaque objects under the microscope.

It consists of one half of the upper portion of a parabola made of polished silver, and slides by means of a fitting, up and down upon the outside tube of the object glass. All parallel rays falling upon the silver surface will be reflected to the focus of the parabola which is of necessity in the optic axis of the microscope, at the point where the object under examination is situated. See Fig. 3545, p. 1629, "*Mech. Dict.*"

Par'a-cen-te'sis In'stru-ments. (*Surgical.*) Instruments for tapping a cavity.

For Paracentesis abdominis: —

Drainage tubes.	Drainage canula.
Trocars.	Hollow trocar.
Aspirators.	Clamp forceps.
Aspirator needles.	

For Paracentesis corneæ: —

Trocars.	Needles.

For Paracentesis thoracis: —

Dieulafoy's Aspirator, Fig. 6665, p. 2629, "*Mech. Dict.*"

Par'a-chute Light. A device invented by General Boxer and used in the British military service as a means of revealing the enemy's position and movements at night.

It forms, when closed, a large shell, expanding into a huge umbrella, 15' high, when opened, the cup of composition which is suspended being designed to burn $4\frac{1}{2}$ minutes.

The star shell, which has been designed as a substitute, is much smaller and more portable, and of comparatively trifling cost. It can be fired into the air from a mortar at the required angle to show the enemy's works, and burns with a brilliant light for about half a minute, long enough to take an observation and lay a gun, but not long enough to allow an adverse wind to bring the light back over the firing point, and so turn the advantage in favor of the enemy.

Par'af-fine. The mode of manufacture of paraffine and some of its uses are referred to on pp. 1629, 1630, "*Mech. Dict.*"

Its use depends upon several qualities: It is inodorous, white, clean, tasteless, non-oxidizable, water repellant, a non-conductor of electricity, inflammable, plastic.

It is used as a water-proofing material for fabrics and paper.
Lining wooden and metallic vessels.
Saturating paper as a water repellant, and to preserve contents from becoming rancid, — butter, for instance.
Trays and tanks for acids and voltaic batteries.
Insulator (electric).
For covering splints and other paraphernalia subject to septic influences.
As a polisher under the iron in fine laundry work.
As a vehicle of the fulminate in matches.
As a covering for cartridges.
Paper saturated with paraffine is used to inclose saccharine or saponaceous materials, etc.
Matthews lines with paraffine the enameled metal reservoirs of his soda fountain.
Hoe lines glass electrotype baths with paraffine.
Staunton preserves fruit and vegetables by films of paraffine.
Makes boxes, cans, or vessels air-tight by lining with paraffine; for holding meat, vegetables, fruit, butter, spices, etc.
Tucker has a lard package made of paper soaked in paraffine.
W. B. Guernsey saturates with paraffine the pores of wooden cases for containing butter, etc.
Paper by *Grostowsky* . . "*Scientific American Sup.*," 1898.

Par'a-kite. A series of kites, the smaller in advance and increasing in area, are flown *en suite.* The largest and last in the series is 36' × 30', and is intended to raise a man from the ground to an elevation of several hundred feet to observe the position of an enemy.

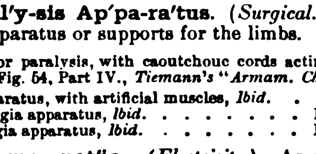
Experimented with at Woolwich, England.

"*Manufacturer & Builder*" . . . . . viii. 18.
"*Iron Age*" . . . . * viii. 300.

Par'al-lel Com-pres'sor. (*Optics.*) Beck's. A means for holding or compressing an object under the microscope.

Two plates of brass, upon each of which a piece of glass is fixed, are connected by four arms of brass of equal length,

Fig. 1874.



Parallel Compressor.

giving a parallel movement to the plates. These plates are gradually brought together by a screw at the end attached to one plate and working in a conical hole in the other.

Pa-ral'y-sis Ap'pa-ra'tus. (*Surgical.*) Electrical apparatus or supports for the limbs.

Glove for paralysis, with caoutchouc cords acting as extensors. Fig. 64, Part IV., *Tiemann's* "*Armam. Chirurg.*"

Leg apparatus, with artificial muscles, *Ibid.* . Fig. 70
Hemiplegia apparatus, *Ibid.* . . . . Fig. 71
Paraplegia apparatus, *Ibid.* . . . . Fig. 72

Par'a-mag-net'ic. (*Electricity.*) As opposed to dia-magnetic. Substances the poles of which, like iron, nickel, cobalt, etc., tend to move from the weak to the strong places of electro-magnetic force are called para-magnetic, or ferro-magnetic. — *Gordon.* See also MAGNETIC SCALE.

Par'cel-gilt. Meaning *partly gilt.* Silver ware gilt inside, as bowls, spoons, etc.

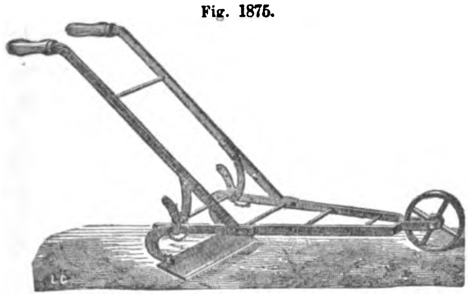
Par'cel Lift. A dumb waiter used in stores and warehouses.

Parch'ment Pa'per. Paper treated with dilute sulphuric acid. See p. 1633, "*Mech. Dict.*"

A new recipe is to use a bath of ammoniacal solution of copper, made by treating plates of copper with a concentrated solution of sal-ammoniac.

Par'er. A wide bladed hoe, drawn by a man or a horse, and used to pare the surfaces of walks in gardens and parks to kill weeds and grass.

Fig. 1875.



French Parer.

Pa'ri-an Bis'cuit. (*Ceramics.*) A fine-ware made by Minton and Copeland, of Stoke-upon-Trent, England. It is an ornamented semi-vitreous ware with a clear ring nearly like china, and is recognized as one of the best fine-wares introduced since the time of Wedgwood.

Par'ing Plow. See PARER, *supra.*

Park'e-sine. See CELLULOID, "*Mech. Dict.,*" *et supra.*

Par'lor Or'gan. A reed or pipe organ; generally the former, of small size, adapted to parlor, vestry, or school room.

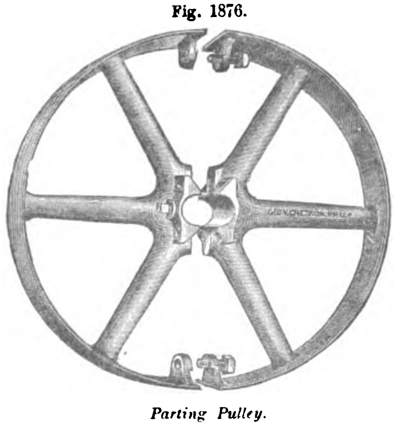
History of the parlor organ in report of *H. K. Oliver* on Group XXV., in vol. vii., "*Centennial Exhibition Report,*" p. 45.

Par'lor Skate. A skate on rollers.

Plimpton's improvement consists of an arrangement by which a skate is made to keep the floor without reference to the angle of the body or the sharpness of the curve turned. In the center of the sole of the skate is fixed a spherical spring of india-rubber, yielding to the slightest inclination of the foot, a mere change of motion by the well-known mechanical means causing the axles of the roller wheels to converge.

Part'ing Pul'ley. One capable of division, so that the parts can be attached to the shaft without dismounting the latter.

Fig. 1876.



Parting Pulley.

Part'ing Rail. (*Carpentry.*) A rail intermediate between the bottom and top rails of a door or partition.

Part'ing Strip. (*Carpentry.*) A narrow piece separating parts, as the strip between the upper and lower sashes in the window frame; or between the window and blind in a car.

Pas'sen-ger El'e-va'tor. See ELEVATOR.

Pass'ing Nip'pers. (*Nautical.*) A strong hank of untwisted but mailed yarn used in binding the messenger to the cable.

Paste. (*Ceramics.*) The material of porcelain and other fine grained pottery.

Known as *hard, soft, jasper, basalt, cream,* etc., names given to indicate relative quality or color, or names of fancy.

There are all gradations, from the soft paste of some *faïence,* which in many cases is so coarse as to be hardly deserving of the name, to the hard *china,* which resembles glass. See list under POTTERY.

Paste'board Cut'ter. See BOARD CUTTER, Fig. 354, p. 113; CARD-BOARD CUTTER, Figs. 539–541, p. 166, *supra.* Fig. 3665, p. 1636, "*Mech. Dict.*"

Paste Jag'ger. A pastry cook's convenience for notching the edges of cakes, pies, and pâtes.

Pas-tille'. An odoriferous pellet which emits an agreeable odor in burning. Its burning is due to the niter and charcoal in its composition.

French recipes: —

	Grams.
Oliban in tears	24
Storax in tears	24
Niter	16
Pulverized charcoal	124
Add for rose perfume: —	
Pulverized rose leaves	32
Essence of rose	2
For orange flower pastille: —	
Galbanum	24
Dried orange peel pulverized	32
Essence neroli	2
For vanilla pastille: —	
Galbanum	24
Girofle (cloves)	16
Vanilla	32
Essence cloves	1
Essence vanilla	16

Make into a mass with gum arabic, 4 grams; water two-thirds deciliter; mold and dry.

Pas-tille' Pa'per. Paper prepared with an odoriferous composition.

Take cascarilla bark 8 drachms, gum benzoin 4 drachms, yellow sanders 2 drachms, styrax 2 drachms, olibanum 2 drachms, charcoal dust 6 ozs., niter 1½ drachms, mucilage of gum tragacanth, sufficient quantity. Reduce the substances to a fine powder, form into a paste with the mucilage, coat the paper with this, and dry in an oven.

Pate Chan-geante'. (*Ceramics.*) A peculiar porcelain, made by Minton, which has changeable color according to the light or angle at which it is viewed, something like the changeable or shot silk. In daylight it has a grayish or celadon green color, and at night it appears pink.

This kind of chameleon paste was compounded by the chemist Regnault when director of the Sèvres establishment.

Pate de Bois. Wood pulped, and formed by compression into paper, carton, decorative cornices or panels.

Pa-tel'la Ap'pa-ra'tus. (*Surgical.*) Supports, braces, or splints for fractured patella. Fig. 3567, p. 1636, "*Mech. Dict.*"

Figs. 119–121, *Tiemann.* Dr. White's elastic patella hooks engage the upper and lower surfaces, and draw the portions together.

Pa'tent Ham'mer. (*Stone Working.*) The head holds a number of wide thin chisels held together by bolts.

It is used for giving a surface-finish to squared masonry. See Fig. 3160, p. 1444, "*Mech. Dict.*"

Pa'tent Plate. (*Glass.*) An English name for cylinder glass.

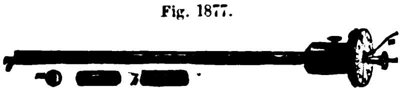
Pâte-sur-pate. (*Ceramics.*) A form of decorative work in which one colored slip is laid upon another in bands, fillets, figures, and what not; sometimes to the number of a dozen or more. Wedgwood's imitation of the Portland vase is an eminent instance of the art, and Solon has also executed some very remarkable work.

The body is usually dark olive-green, brown, turquoise blue, or black, and the paste white, and laid on in relief, the lights and shades partly due to the thickness of the slip, which is in relief. After laying a sufficient thickness the artist scrapes away portions according to the requirements of the design, the dark background showing through in parts. Re-firing renders all translucent.

It is a very old process, having long been used in China on porcelain, and in India for common ware; the Scinde and Punjab pottery, for instance. In Scinde the pattern is pricked out on paper, and drawn by laying it upon the surface of the jar and dusting along the prickings. The effect is good, and articles are sold at from eight to twenty-four cents. See "*Handbook to the British Indian Section, Paris Exposition,*" by Mr. George C. M. Birdwood, C. S. I., M. D. "*Paris Exposition* (1878) *Reports,*" iii., pp. 113, 136, 137.

Path'find-er. (*Surgical.*) An instrument by Dr. Eldridge, of Yokohama, for finding urethral strictures by means of filiform whalebone bougies placed in any position by the rotating disk and screw.

Fig. 1877.



Pathfinder.

Pa-ti'na. The peculiar color on antiques, bronzes, and medals, due to exposure and time. It is counterfeited by various processes, either by oxidation or painting. *Orugo.*

The patina given to the Japanese bronzes is a trade secret, having been handed down from father to son for ages. M. Morin has discovered that the patina of the celebrated black bronzes is due to the use of an alloy composed of copper, 80; tin, 4; lead, 10; zinc, 2; iron, 4; besides small proportions of gold, nickel, arsenic, and sulphur. Some of the bronzes analyzed show a proportion of lead varying from 10 to 20 per cent., added at the expense of the copper, and a quantity of 7 per cent. of tin. Molded in thin plates, this bronze is very easily worked, and the patina is developed by heat when the metal is subjected to a high temperature in a muffle furnace. It is, however, very brittle.

An imitation of patina can be produced by preparing a paint of carbonate of copper and any light alcoholic varnish, and applying it to the object with a brush. This green color penetrates the smallest recesses, and has, when dry, the appearance of patina. Carbonate of copper gives a blue patina, verdigris a light green, and intermediate shades of color can be obtained by mixing the two.

The French patina is effected upon bronzes of the ordinary strength by subsequent surface application. The process consists in preparing a ground by the action of chemicals having oxides and sulphides of copper as their bases. If different tints, black, brown, red, or green, be desired on the same object, it is sufficient to cover with a protecting varnish all portions of the surface except those to which it may be desired to give a certain hue; then when they have been treated for a sufficient time, they are covered with varnish, while the other parts of the surface now exposed are subjected to the action of the chemicals, and so on for as many tints as are required. See also MILDEW BRONZE.

Pat'tern-mak'ing Ma-chin'er-y. See p. 1638, "*Mech. Dict.*"

Jackson. Very elaborate methods and machinery. * "*American Artisan,*" June, 1874.

See also SWEEPING MACHINE.

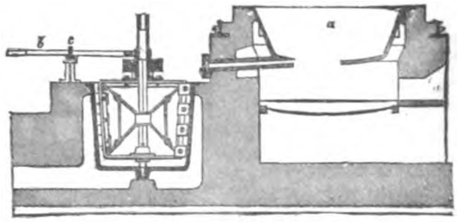
Joshua Rose. A series of valuable illustrated papers. "*Scientific American,*" xxxiv. 261, * 293, * 325, * 357, * 388.

Pat'tin-son's Pots. A process for separating silver from lead by crystallizing the latter and removing it, the remainder being richer in silver.

The principle of the process is described and the apparatus shown on pp. 1638, 1639, "*Mech. Dict.*"

The improvement of Bourdehen, as practiced at Stolberg Hozappel, and Rouin, is shown in Figs. 1878–1880.

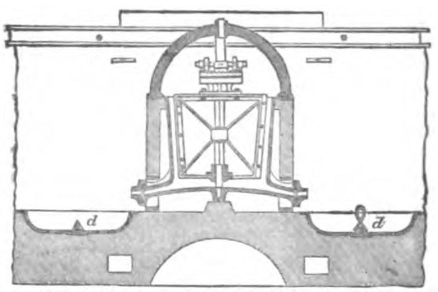
Fig. 1878.



Pattinson's Pots. (*Vertical Section on Line a B,* Fig. 1880.)

Each battery is composed of two kettles, the *melting* and *crystallization* kettles. The stirrer in the latter has two shafts, concentric, and moved in opposite directions. On the

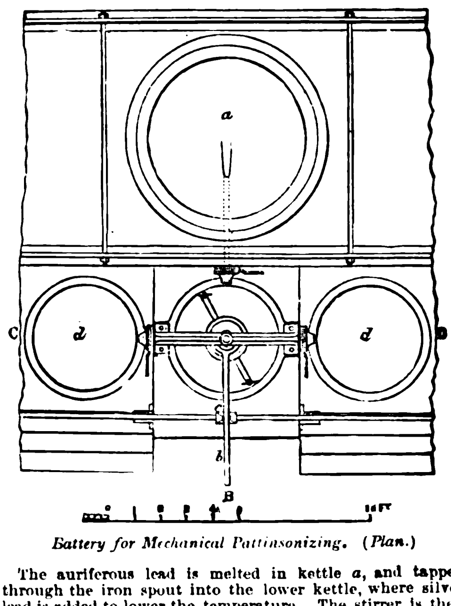
Fig. 1879.



Pattinson's Pots. (*Vertical Section on Line C D,* Fig. 1880.

outer shaft is a stirrup-like frame from the sides of which project flat-edged scrapers; on the inner shaft are flat arms, arranged spirally, and with oblique sides.

Fig. 1880.



Battery for Mechanical Pattinsonizing. (*Plan.*)

The auriferous lead is melted in kettle *a*, and tapped through the iron spout into the lower kettle, where silver lead is added to lower the temperature. The stirrer is then set in motion, and small jets of water thrown upon the molten alloy. At the end of two hours the mass will have become pasty, when the stirrer and water-streams are stopped and the mother-liquid is tapped into a heated pot, *d*. An iron hook is set in the lead while molten, and when the lead has cooled it is lifted out by means of a tackle. A fresh quantity of silver-lead, assaying about the same in silver as the remaining crystals, is added from the melting-kettle, *a*, to the crystallizing-kettle; during this operation the motion of the stirrer is reversed. The molten alloy soon liquefies the crystals, when the already-described operation is again performed. After this operation has been repeated 7 times, the poor lead contains but 0.0036 per cent. Ag. The crystals are melted, tapped off, taken to another kettle for re-melting and casting in pigs. An obstruction to the process is thus avoided. The mother-liquid is enriched in 8 operations. The mother-liquid resulting is then returned to the kettle and further enriched in 5 operations: it contains 2.4 per cent. Ag.

See *Percy's "Metallurgy of Lead,"* p. 143.

Freiberg	Painter's "*Report Vienna Exposition*," iv., § F, pp. 69, 119.
Marseilles, *Rozan* . .	*Ibid.*, pp. 11, 13.
Stolberg, *Boudehen* .	*Ibid.*, pp. 149, 150.

Pave'ment. The subject is considered on pp. 1639–1642, and Plate XXXVIII., "*Mech. Dict.*"

The Figs. 1881–1884 exhibit the latest Parisian method of laying asphalt pavement.

The asphalt paving is of two kinds: the *asphalte comprimé*, that is, beaten and compacted with hot rammers; and the *asphalte coulé*, in which the material is spread with trowels.

The *asphalte comprimé* is especially employed around the churches, schools, theaters, concert halls, banks, and public buildings, on account of its freedom from noise; and generally for the additional reasons of cleanliness and salubrity in the places mentioned, and also in the main streets of the city. In the fashionable drives macadam is preferred on account of its freedom from slipperiness, and on the quays and warehousing quarters of the city the granite block system yet remains a favorite.

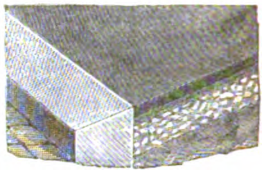
The first essential is a gravel foundation of sufficient thickness. Upon this a layer of concrete is placed to form a bed for the asphalt. There are but three materials used, and but three tools. The materials are: gravel screenings or sand; a silicious gravel in pieces, say from ½″ to 3″ in diameter; a gray hydraulic lime, usually Portland cement. The tools are: pointed shovels; two rakes with long bent prongs; two flat beaters, about 18″ square, and with handles set in obliquely. To this may be added 6 wheelbarrows, holding about a bushel each, and 18 water buckets, of 2½ gallons each.

Twenty men form a gang under a foreman, who work diligently in giving the final shape to the surface of the concrete, preserving the proper camber of the street, gage pegs being driven into the gravel foundation to work by, their tops representing the future surface of the asphalt.

The work now proceeds as follows: A man dumps a wheelbarrow load of sand, and another spreads it out to 4′ diameter. A bag of 3 pecks of lime is emptied on to it and spread evenly. On to this 3 barrow loads of silicious gravel are emptied, and the heap is trued up into conical form by shoveling from the foot of the heap and throwing it on to the apex. The materials are damp, and the lime clings to the gravel where it touches. The heap is torn down and built up in a spot alongside, the effect being to mix the materials of three different finenesses. The heap is presently flattened out to 6′ diameter, and a bucket of water distributed over it. As the middle is the wettest a cone is made at the center, so that a second bucket of water reaches the outside ring of the material. The conical heap is again constructed, and about a quarter of a bucket of water splashed by the hand upon the outside, — the outlying portions of the spread mass as it lay previously upon the ground.

It rests thus but a few minutes, and then is torn down, beginning at one side and throwing it, shovelful by shovelful, into a new location, a man with the three-pronged rake, like a manure hook, working it energetically and unceasingly as each new shovelful arrives at the heap. This mixing is a very important matter, as it insures that every particle of silicious rock shall be covered with the lime, and the heap now is, instead of the yellow of the flint gravel, a uniform gray. The water is only sufficient to cause the parts to adhere, and some little (without attempting to trace the chemical reactions) lost as such in the attack of the lime on the silex and in slaking.

Fig. 1882.



Section of Sidewalk. (Trottoir.)

The heap is ready in a few minutes to be removed in barrows and dumped on the line of working, where it is spread with shovels and with a second one of the three-tined rakes. Here the eye of the master is called for, and he gives it the final shape, so far as the shovels are concerned, due regard being paid to the gage pegs.

A man with the flat beater compacts and levels the surface by his blows, and the concrete is then surfaced with an inch thick coat of hydraulic lime mortar laid on with a trowel, and on this a coat of loose sand, which roughens it and forms a bond for the asphalt, which is afterward laid hot upon it, rolled and beaten. Of this presently. The sand appears to become partially imbedded in the yet soft mortar, and is in turn grasped by the asphalt. If the final asphalt were laid upon too smooth a surface it would be apt to fail in adherence and to flake off. Its mere adhesive quality is aided by a mechanical bind to the particles of sand which are, so to speak, riveted in the mortar, and it in the concrete.

Fig. 1883.

Section of Road.

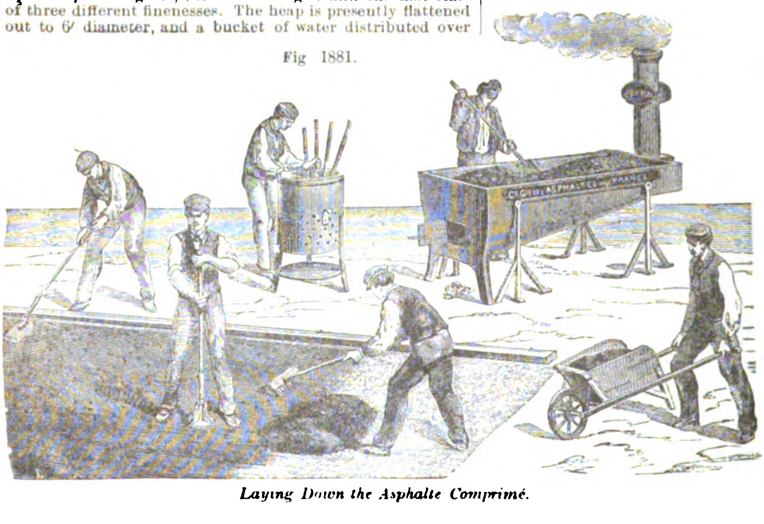
After a few days, the foundation — having been carefully guarded from disturbance by travel — having become fully set, the asphalt compound is brought hot in carts, and, being transferred to wheelbarrows, dumped upon the surface of the foundation concrete, and spread with rakes to a thickness of 4″. It is then lightly pounded with a very hot iron rammer with a circular face 10″ broad. A furnace is kept near by for heating the rammer. A second ramming with hard blows of the same rammer then takes place, condensing the asphalt to but little more than half its former thickness, and causing its intimate union with the rough surface of the layer beneath.

The final smoothing is given by a hot iron block, which is pushed and pulled over the surface, and burnishes down the elevations and the rough marks of the pounders.

The *asphalte coulé* is laid with a trowel upon the concrete basis, and is not pounded, as in the case of the *asphalte comprimé*. It is used for sidewalks, platforms and waiting saloons of railways, for prisons, skating rinks, baths, warehouses, breweries, and manufactories of all kinds.

To make a square meter of surface, 15 millimeters thick, it is necessary to use 1¼ kilos of bituminous minerals: 23 to 24 kilos of Seyssel

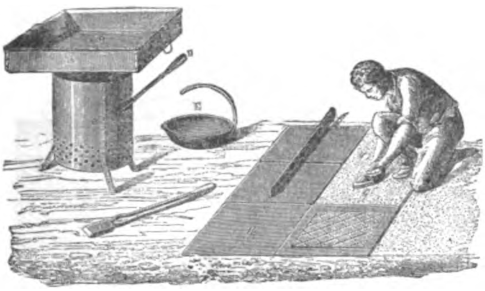
Fig. 1881.



Laying Down the Asphalte Comprimé.

mastic; and 13 to 15 kilos of washed, dried, and sifted gravel.

Fig. 1884.



Imitation of Tile Pavement in Asphalt Coulé (Carrelages).

The material is also wrought up into the form of tiles (carrelages), and laid upon a soft and level bed of concrete, melted mastic being poured into the joints and fashioned by the rule and jointing iron.

The following statement of the expense of maintenance of the pavements of Paris is taken from the "*Annales des Ponts et Chaussées*: —

"For cleaning streets, machine sweepers are employed drawn by a single horse, cleaning about 5,000 square meters an hour.

"The cost of keeping in repair is quite different for the different avenues.

"The asphalt roadways have a joint area of 225,120 sq. meters, to which should be added about 34,000 sq. meters for the walks through the macadamized streets. The price of construction varies from 12 fr. to 15 fr. per sq. meter.

"The repairing is done by contract for 1.10 fr. per sq. meter per year for the roadways, and 1.70 fr. for the walks.

"The mean cost of repairing roadways in Paris, which was 1.08 fr. in 1870, has been reduced to 0.82 fr. This reduction is due especially to a change in many places from macadam to paved roadways. The mean cost of repairing pavement never exceeds 0.60 fr., while macadam roadways cost 1.80 fr. per sq. meter. The latter should therefore be replaced, except where they serve as promenades and ornaments, as in the boulevards and avenues.

"The number of vehicles which pass daily through some of the principal thoroughfares of the city have been ascertained to be as follows: —

"Boulevard de Sebastopol	11,602
Avenue des Champs Elysees	11,734
Rue de Rivoli	13,898
Rue Royale	16,177
Boulevard des Capucines	19,043

"The paved roadways have an aggregate total area of 5,458,000 sq. meters; their maintenance requires the constant service of 431 men (*cantonniers*). The cost per sq. meter varies from 15.90 fr. to 20.40 fr., according to the gage (.10 to .16 meter).

"The cost of hand labor in keeping the pavements in order is 0.154 fr. per sq. meter.

"The macadamized roadways cover an area which, although less than in 1870, is still 1,900,000 sq. meters. The number of *cantonniers* required for their maintenance is 965.

"The steam rollers employed weigh about 30 tons each. The rolling is generally completed in a single night."

See ROAD-ROLLER, "*Mech. Dict.*"

A new pavement, composed of 85 % fine ground granite, and 15 % of bitumen, has been laid in Newgate St., London. It is stated to be free from slipperiness, and unaffected by the atmosphere.

It is laid in a heated, semi-fluid condition, 2″ thick, upon a foundation of Portland concrete 9″ thick.

Frusto pyramidal blocks of asphalt are used at Dordrecht, Netherlands.

Abbott	"*Iron Age*," xxi., May 16, p. 5.
Bituminous	"*Scientific Amer.*," xxxvi. 230.
Couzens	"*Scientific American Sup.*," 593.
Foot	"*Scientific American Sup.*," 1297.
French	"*Scientific Amer.*," xxxix. 65.
General Gilmore, on	"*Scientific American Sup.*," 223.
Iron, Hamburg	"*Iron Age*," xx., July 19, p. 24.
London	"*Iron Age*," xx., Aug. 23, p. 3.
Pig iron	"*Iron Age*," xvii., April 6, p. 1.
San Francisco	"*Iron Age*," xviii., July 27, p. 7.
Rammer, *Johnson*	* "*Scientific American Sup.*," 326.
	* "*Scientific American*," xli. 295.
Street, "*Inst. Civ. Eng.*" *Deacon*	"*Van Nostrand's Mag.*," xxi. 35.
Wood, *Henson*, Br.	* "*Engineer*," xliii. 251.
	"*Scientific American*," xxxv. 133.
Steam pavior	* "*Scientific American*," xli. 166.
Toronto, Mr. Shanley's report of various systems	"*Scientific American Sup.*," 511.
Washington, D. C., Lieut. Greene's report	"*Evening Star*," Washington, D. C., Oct. 30, 1880.

"*Paving and Roofing Compositions*" is the subject of a volume containing a digest of the United States and British Patents, by *L. W. Sinsabaugh*, Washington, 1875, and a subsequent supplement.

Gen. Q. A. Gillmore's report of Pavements is in Group II., vol. iii., "*Centennial Exhibition Reports*," p. 239, *et seq.*

Gen. Sir J. Burgoyne. "*Road-making, and Maintenance of Macadamized Roads.*"

Gen. Q. A. Gillmore. "*A Practical Treatise on the Construction of Roads, Streets, and Pavements.*"

W. M. Gillespie. "*Manual of the Principles and Practice of Road-making.*"

Pave'ment Pipe. A protection for a gas or water pipe rising to the pavement, or forming a well at the bottom of which is the square of a cock in a water or gas pipe.

Pave'ment Ram'mer. A machine for performing the labor of ramming granite blocks in forming pavement for roadways.

See references on p. 1642, "*Mech. Dict.*," under PAVING MACHINE.

The *Johnson* rammer is shown in Fig. 1885.

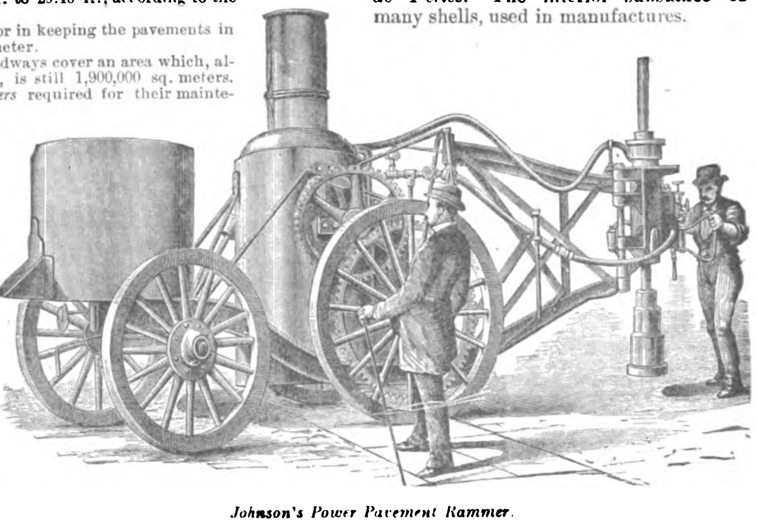
The machine is self-propelling. The crane, which projects forward, carries a steam cylinder containing a reciprocating piston, the rod of which is attached to the rammer. The piston reciprocates in much the same way as a steam hammer, and its movements are controlled by the attendant, who also moves the crane from one side to the other.

Two persons are required to work the machine, which has a power to strike from 1 to 2,200 pounds, at a rate of 160 strokes per minute.

Pav'ing. See PAVEMENT.

Pearl. (*Mother of Pearl.*) Fr. *Nacre de Perles.* The interior substance of many shells, used in manufactures.

Fig. 1885.



Johnson's Power Pavement Rammer.

The pearl oyster, *avicula margaratifera*, of the Indian seas, yields some of the best. It is hard to work, and is cut with fine saws and files, dressed with emery, and polished with calcothar.

The Sanskrit name for a pearl, *maracata*, was conveyed by *μαργάριτης* and *margarita* to the French *marguerite*, the daisy.

David Brewster was the first to explain the irisation of the surface of *nacre*, which is due to the fine ridges, which are more than 3,000 to the inch. This has been proved by taking a cast of the surface, reproducing the delicate inequalities, and producing a similar effect. See PEARL INLAYING; IRIDESCENT GLASS.

Pearls and pearl culture .	"*Scientific Amer.*," xl. 170.
Artificial	"*Scientific Amer. Sup.*," 156.

See also CAMEO CUTTING, p. 156, *supra*.

Pearl'ing. The decortication of barley; stripping the pericarp, except that portion in the crease of the grain, —

"The pearling of barley is accomplished by means of small horizontal mills made of sandstone or wood and having a diameter of about eighteen inches and a thickness of four inches. They revolve at a speed of 400 revolutions per minute, and each of them is enveloped with a covering of sheet iron which is punched with holes like a grater, with the edges of the holes turned inward. Between the sides of the mill and those of the sheet iron is a space of about half an inch. On leaving the winnowing machine the grains of barley fall, by means of a hopper, upon the upper surface of the mill, which, by reason of its rotary movement, throws them toward the circumference where they are rubbed alternately between the vertical surfaces of the mill and the covering of sheet iron. By this means they are pearled and are rounded off like balls of marble. The waste escapes without, and when it is seen that the grains are sufficiently rubbed by this action of the mill and its covering, they are made to pass out by a valve and are replaced by a fresh quantity of unpearled grain." — *Rollet.*

Pearl In'lay-ing. The kinds of pearl are: —

White pearl, so called; obtained from the shell of the pearl oyster.

Aurora shell, from the *haliotis*, sea-ear or sea-shell, as it is variously called, and is remarkable for its wrinkled appearance and iris colors.

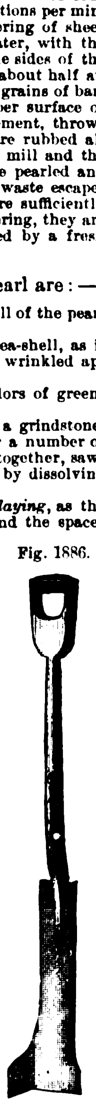
Green snail shell, which has changeable colors of green, yellow, and pink.

The shells are sawn, ground to thickness on a grindstone, cut to shape with scissors, punches, or dies, or a number of similar shape are made by glueing the films together, sawing them to shape, and then separating them by dissolving the glue.

Pearl inlaying upon metal is scarcely true *inlaying*, as the pieces of *nacre* are varnished to the object and the spaces filled with varnish. This is laid on in several coats, each being dried in the oven. The varnish is then scraped away from the pearl, and the surface leveled with pumice-stone and then polished.

Stems of leaves and veins of flowers are traced with varnish, flowers are colored, and gold added by placing leaf on varnished spots. The whole is then covered with white varnish. The process with papier-maché is similar.

Fig. 1886.



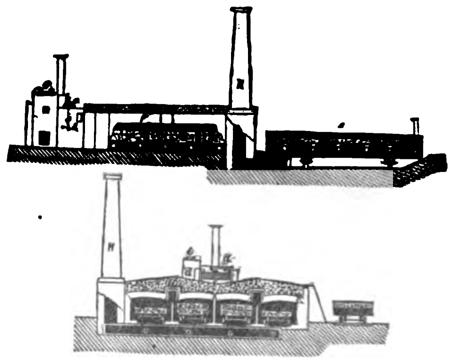
Peat Spade.

Peat Char'coal Kiln. A species of oven in which peat in blocks is dried and carbonized.

The ovens are brick arches, covered with sand to retain the heat, and are used in pairs, one being heated while the other is cooling to a sufficient degree to allow the peat to be withdrawn; if air be admitted too soon the peat will inflame. The peat is run into the kiln on trucks, the body being a sort of iron basket with wire netting bottom. The heating is by superheated steam and the heat required to carbonize the peat is 750° Fah. The flues are arranged to allow the diversion of the gases from the furnace when charring has been completed in a given oven. In some cases the peat is dried into blocks; in others it is compressed into *briquets* and dried. The peculiar processes depend upon special conditions.

Peat Spade. One having a side wing at an angle of 90°, so that a cubical prism of peat may be cut from the bank at one thrust.

Fig. 1887.



British Peat Kiln.

Charring app., *Barff*, Br.	* "*Engineer*," xlv. 392.
	* "*Scientific American Sup.*," 2175.
Condensed, *Britton* . .	"*Iron Age*," xix., April 26, p. 16.
Machine, *Hall & Bainbridge*, Br.	* "*Engineer*," xlii. 344.
Peat steel . . .	"*Iron Age*," xviii., Nov. 16, p. 11.
	"*Scientific Amer. Sup.*," 962, 986.

Leavitt's "Facts about Peat as an Article of Fuel."

Peau d'ours. (*Fabric.*) A Moscow coating made in Germany.

Peb'ble Pow'der. Gunpowder in large grains or masses. comparatively slow-burning. Cube powder; *poudre brutale.*

Pebble powder is usually formed from dense cake $\frac{3}{5}''$ in thickness by breaking it into rectangular prisms and then into cubes, by consecutive operations, the length of the faces being equal to the thickness of the cake. It is also made as large as 11-16'' to 2'' cube.

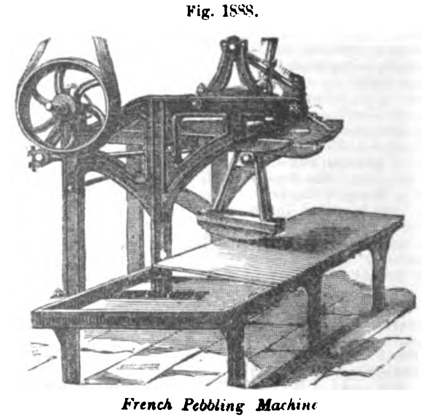
See "*Ordnance Report*," 1879, Appendix I., p. 128, and ENGINEER, September 16, 1870.

Peb'ble Pow'der Ma-chine'. A machine for making cube gunpowder.

The machine is composed of two fluted bronze rollers, each 6'' in diameter, placed about 0.5'' apart, their axes being horizontal and parallel. The teeth formed on the roller by fluting it are 0.5'' apart. The rollers revolve in opposite directions, and the corresponding teeth of the two rollers pass the place joining the axis at the same time. The cake is 14'' × 15'', and is fed vertically between the rollers which break it into right prisms 14'' long with square bases. These fall upon a board, and fed by strips on endless band to a second pair of toothed rollers which break it into cubes.

The result is sifted to remove crushed fragments and dust. The cubes are dusted and are rounded off in the glazing operation, which is done in barrels holding 400 lbs. each. The barrel makes 40 revolutions per minute, and 0.5 oz.

Fig. 1888.



French Pebbling Machine

black lead is added for each 100 lbs. 40 minutes is required for the operation.

Diagram of pebble-powder machine in "*Report of Chief of Ordnance U. S. A.*," 1877, Plate I., accompanying Colonel Laidley's report, Appendix K. See also Figs. 70, 71, Appendix L., same report, and p. 546.

See also Crispin & Baylor's report, "*Ordnance Report*," 1879, App. I., Plate VI., Fig. 18, and description on pp. 128, 1829.

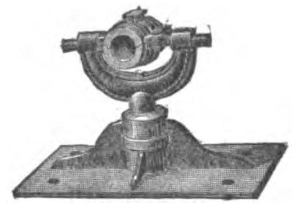
*** "*Engineering*" . . . . xxv. 236.**

Peb'bling Ma-chine'. (*Leather.*) A machine in which a pebbling roller is attached to the jack or vibratory arm. The action is known as graining, glassing, glazing, finishing, etc., according to the tool presented.

Ped'es-tal. A ground support for running shafting along a floor or through tunnels.

(*Add.*) 5. A casting on an abutment to receive the ends of the main brace (or braces) of a bridge and support the strain.

Fig. 1889.



Shaft Hanger with Ground Pedestal.

Pe-dom'e-ter. 1. An instrument for counting footsteps. A pace measurer, p. 1647, "*Mech. Dict.*" See also ODOMETER, *supra*.

* "*Scientific American*" . . . . xl. 246.

In a modern form it is an instrument looking like a watch, having a dial and a hand; the latter is counter-weighted, so that at each motion of the person in walking, the weight pulsates and the hand advances one degree.

2. A name for roller skates.

Philadelphia Exhibition . . "*Sc. Amer.*," xlii. 99; xl. 85.

Pe'do-mo'tor. A means for the mechanical application of the foot as a driving power.

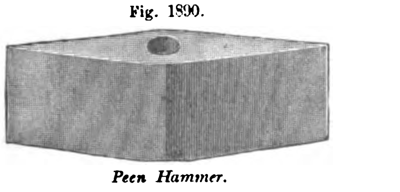
Pedal action for small machines, *Archer*, Br.	* "*Engineer*," xlviii. 344.
Bernays, Br.	* "*Engineer*," xlviii. 438.
Baromotor, *Bozerain* .	*Supra*, p. 76.
Bozerain	* "*Scientific Amer.*," xxxvii. 242.
	* "*Manuf. and Builder*," ix. 280.
Sewing machine motor .	* "*Mech. Dict.*" p. 2123, Fig. 4883.
List of same	*Ibid.*, p. 2115.

Peel. The portion of a cracker or biscuit machine beyond the cutter is known as the *peel-end*, and its capacity gives name to the machine, as *two-peel* machine. See CRACKER MACHINE, etc.

Peel'ing Axe. A double-bitted axe used in barking trees.

Peen Ham'mer. (*Stone Working.*) One which has two opposite cutting edges. It is used for making drafts around the arris or edge of stones and in reducing faces and sometimes joints to a level. Its length is about 10″ and the cutting edge about 4″. It is used after the point and before the patent hammer. See PEEN, p. 1647 "*Mech. Dict.*"

Fig. 1890.



Peen Hammer.

Peep Nick'ing Ma-chine'. A special gun tool which forms the peep in the leaf of a rifle sight.

Peep Sight. A form of hind sight for rifles. It has an opening through which the muzzle sight is lined upon the object.

The OPEN-BEAD SIGHT, Fig. 249, p. 84, *supra*, and the HAUSSE, Fig. 1329, p. 447, *supra*, are instances. See also GLOBE SIGHT, Fig. 1210, p. 406, for other instances, and list under SIGHT.

Peg'ging Ma-chine'. A machine for driving pegs into boot and shoe soles.

The subject has been considered on pp. 1648–1649, Figs. 3602–3606, "*Mech. Dict.*" Fig. 1891 shows a late form of the Varney foot-power pegging machine which operates upon a peg-strip; cutting off the peg, punching a hole, driving the peg, and feeding the boot sole to its place of apposition for the repetitive action.

Fig. 1891.

Pegging Machine.

Pel'let Pow'der. A form of British cannon powder in which each pellet is molded of a given quantity of mealed powder.

Various shapes have been tried: disks, prisms, and cylinders; the latter preferred. The shape is a right cylinder with a circular base and a small hemispherical cavity at one end. Size 0.5″ long, .75″ diameter; weight, 95 grains. The molds are bored holes in a bronze plate in which a gang of bronze pistons work by hydraulic power.

Pebble powder has superseded it, or largely so.

In France the following are the adopted sizes: —

14 centimeter gun from .275″ to .3937″.

19 to 24 centimeter gun from .51″ to .63″.

27 centimeter gun from .63″ to .787″.

See also "*Ordnance Report*," 1879, Appendix I., p. 126, and "*Engineer*," Sept. 16, 1870.

Pel'let-pow'der Ma-chine'. (*Gunpowder.*) A machine in which the powder is compressed into molds of determined shapes.

"*Ordnance Report*," 1879, Appendix I., Plate V., Figs. 11, 12, and described on pp. 126, 127.

Dr. John Anderson's machine for this purpose is shown at Figs. 11, 12, p. 198, vol. xxv., "*Engineering*." See also PEBBLE POWDER.

Pen. Dissertation on pages 1650–1657, with specimens of writing in 105 languages. Plate XXXIX.

Fountain, *Perkins* . .	* "*Scientific American*," xxxv. 98.
Solid ink pen	"*Sc. American*," xxxvii. 112.
Gold pen factory, *Faber*	* "*Scientific American*," xli. 303.
Shading pen	* "*Scientific American*," xlii. 278.

See FOUNTAIN PEN; STYLOGRAPHIC PEN.

Pen'cil. History and account of processes, pp. 1656, 1657, "*Mech. Dict.*"

***Lead pencils* are now made in Germany by rolling paper around the core of graphite to the required thickness.**

***Paper treated to render Pencil Marks Indelible:* Any ordinary drawing paper is slightly warmed and then rapidly and carefully laid on the surface of a bath consisting of a warmed solution of bleached colophonium in alcohol until the entire surface is moistened. It is then dried in a current of hot air. The surface of the paper becomes smooth, but readily takes the impression of a lead pencil. In order to make the lead pencil marks indelible the paper is warmed for a short time on a stove. This method may prove very valuable for the preservation of working drawings when it is not convenient to finish them in ink.**

COLORED PENCILS, FABER'S PROCESS.

Black:	Lampblack	10
	White wax	40
	Tallow	10

White:	Zinc white	40
	White wax	20
	Tallow	10
Light Blue:	Prussian blue	10
	White wax	20
	Tallow	10
Dark Blue:	Prussian blue	15
	Gum Arabic	5
	Tallow	10
Yellow:	Chrome yellow	10
	Wax	20
	Tallow	10

The colors are mixed with the fats in warmed vessels, levigated with the same, and are then allowed to cool until they have acquired the proper consistency for being transferred to the presses. In these the mass is treated and shaped similarly as the graphite in the presses for ordinary pencils.

COPYING.

Walpuski:	Aniline	100
	White clay	50
	Gum tragacanth	10
	Alcohol and water to dissolve.	

Petit: Aniline.
Graphite.
Chalk.
Gum.
Dextrine.
Water.

Jensen:	Sulph. mercury } Graphite } Optional	10
	Tannic acid	7
	Peroxide iron	2
	Dextrine	1
Or:	Graphite	5
	Violet aniline	4
	Dextrine	1

Schwanhauser: Logwood chips, 10, boiled in water; add oxide of chromium till blue color develops; evaporate to sirup; add fatty clay and gum tragacanth.

Indelible:	Wax	1
	Spermaceti	1
	Graphite	2
	Vermilion	1
	Heat and grind.	
	Add: Nitrate of silver	3

ANOTHER.

Clark:	Glue	2 oz.
	Water	3 oz.
	Nitrate of silver	1 oz.
	Nitric acid	8 drops.
	Lampblack	1 oz.
	Brown sugar	0.25 oz.

ANOTHER.

Pruden:	Alum	4
	Sugar	4
	Gum Arabic	1

Colored	"*Scientific American*," xli. 298.
Drafting, *McGee*	* "*Scientific American*," xxxix. 338.
Early making in U. S.	"*Scientific American Sup.*," 2498.
Indelible	"*Scientific Amer.*," xxxvii. 112.
Lines & colors, fixing	"*Scientific American*," xxxiv. 354.
Manufact. of, *Dixon's*	* "*Scientific American*," xl. 31.
Solid ink pencil, list of patents.	"*Scientific Amer.*," xxxvii. 112.

See also ADDING PENCIL; COPYING PENCIL; INK PENCIL.

Pen'dant Tack'le. (*Nautical.*) A tackle rigged from the masthead pendant.

Pen'du-lum. Considered on pp. 1660–1663, "*Mech. Dict.*"

Compensation, *Prof. Smith*	"*Scientific American*," xxxv. 133.
	* "*Manufact. & Builder*," x. 204.
Electric controll., *Smith*	* "*Engineer*," xlii. 395, 398.
Electro-motor, *Higgs*	* "*Scientific American Sup.*," 913.
Foucault	* "*Scientific American*," xl. 338.
Toolin	"*Min. & Sc. Press*," xxxv. 275.
Horizontal, *Zöllners*	"*Scientific American Sup.*," 1774.
	* "*Scientific Amer.*," xxxviii. 79.
Redier, Fr.	* "*Scientific American Sup.*," 1163.
Pump, *Stannah*, Br.	* "*Engineering*," xxiii. 56.
Stannah, Br.	* "*Engineer*," xliv. 312.
Regulator, *Jacot*	* "*Scientific American*," xxxix. 339.
Regulator, Electric	* "*Scientific American Sup.*," 2435.
Tisley	* "*Scientific American*," xxxv. 37.
Wooden	"*Scientific American*," xl. 310.

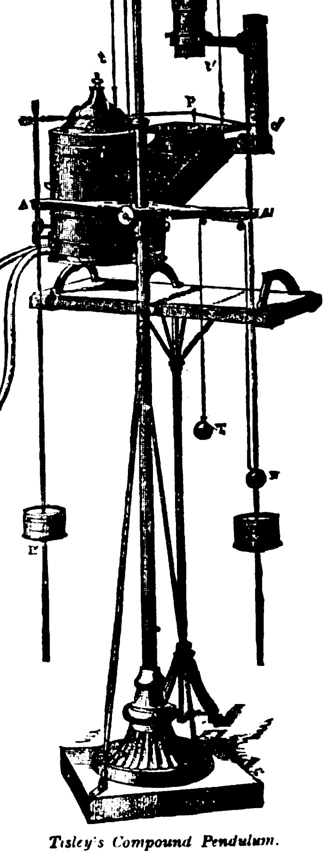
Pen'du-lum In'stru-ment. An instrument for tracing the *Lissajou curves.* In the compound form it is known as *Tisley's* compound pendulum. In the illustration, Fig. 1892, it is shown as adapted to use with the vertical lantern and reflector by which the effects are made visible and projected upon a screen to be viewed by an audience.

Reference has already been made under CURVE INSTRUMENT, p. 236, HARMOGRAPH, p. 439, and LISSAJOU'S CURVES, *supra*, to the instruments for making curves by means of a pen connected with two pendulums swinging in planes at right angles to each other; or a pen to one pendulum and a paper platform to another; also to the mode adopted by M. Lissajou of combining rectangular vibrations to form figures, by means of two tuning-forks carrying small mirrors and vibrating in planes at right angles to each other.

The peculiar curves, the resultants of two vibrations of tuning-forks, produce very instructive diagrams, illustrating definite acoustic relations, such as those corresponding, for example, to the ordinary musical intervals, making the harmonies of sound visible to the eye, and demonstrating visually the relation of the sounds which, united, produce harmonies or discords. — *Lecture of Prof. Bracket, Stevens Institute.*

Under HARMONOGRAPH, p. 439, *supra*, Prof. Tisley's instrument is described. Hopkins has a method of producing the

Fig. 1892.



Tisley's Compound Pendulum.

vibrations by electro-magnet so as to maintain the rate and amplitude of the vibrations, removing the incident of the dying motion of the pendulum without sustaining power.

The compound instrument shown in Fig. 1892 may thus be said to make visible curves representing the musical intervals, the gradual changes between unison and octave, octave and fifth, etc. The apparatus consists of two pendulums, *P P′*, balanced on knife-edges at *A A′*, and continued above their axis of suspension to *c c′*, from which points project two brass arms, *c p*, *c′ p*, which, when the pendulums are quiescent, meet at right angles, the apex being at *p*. Perfect freedom of motion is secured by connecting the arms to the pendulum at *c c′* by ball and-socket joints. Two threads, *t t′*, are fastened at their upper ends to delicate springs, attached to the brass arms, *c p*, *c′ p*, and at their lower ends to an adjustable screw, *d*, by means of which the tracing point *p* may be raised and lowered without in any way affecting the vibrations of the pendulums.

The brass plates, sliding upon the pendulums, are intended to receive the weights, which can thus be placed at different heights, and the relative rates of vibration of the two pendulums altered. The sum of the weights used should vary from 5 to 12 lbs. *W* is a weight sliding upon its pendulum, and counterpoised by a weight *T*. The object of *W* is to slightly change the rate of vibration while the pendulums are in motion. By this means the pendulums can be adjusted very accurately, or if desired, one can be given a small fraction of a vibration in excess of the other; it can be entirely removed, if desired.

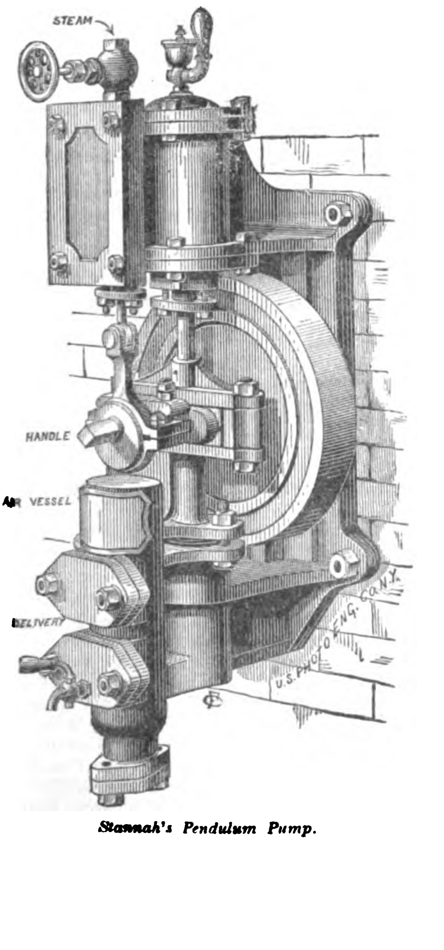
To exhibit these beautiful effects to an audience, a plate of glass blackened by burning camphor is placed upon the vertical lantern, as shown in the figure, the requisite weights are added to the pendulums, and these are set in motion.

Then if we want a curve corresponding to an octave, one of the pendulums must make two vibrations while the other makes one. Having ascertained this we start the pendulums together, then lowering the pen, the beautiful curves will be traced.

"It is not easy to imagine a more striking experiment than that afforded in the present instance, by the noiseless and gradually decreasing sweep of a pen-point gliding over its sinuous path, in obedience to the oscillations of two conjoined pendulous bodies, and tracing, before the eyes of admiring spectators curves of maze-like intricacy and yet of faultless symmetry. As in music, the simplest harmony is the most agreeable to the ear, so with these figures, the simpler the proportions between the vibrations of the pendulums, the more pleasing are the resulting curves."

See also Flame Manometer, pp. 344, 580, *supra*.

Fig. 1893.



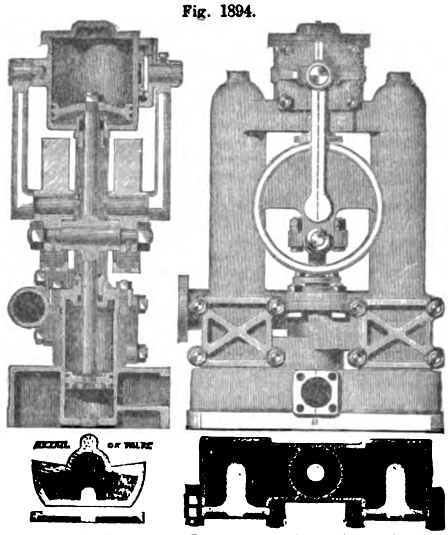
Stannah's Pendulum Pump.

Pen′du-lum Press. A form of press for sheet-metal work, in which the swinging treadle actuates the punch.

Pen′du-lum Pump. 1. A direct acting donkey pump in which the fly-wheels have an oscillatory motion in a vertical plane. Invented by Stannah, London.

The steam and water pistons are fixed on the same rod, and the action is therefore direct. A rotary movement is

Fig. 1894.



Stannah's Pendulum Pump. (Section — Elevation.)

employed to work the valves and limit the length of the pistons. The remarkable feature about the pump lies in the means adopted for causing the rotation of two fly-wheels, no dog link or connecting rod being employed. The crank-shaft is allowed to move sideways in slots carrying its bearings, and the crank pin is attached direct to a piston rod. In the pendulum pump the two fly-wheels are mounted on pins set in the ends of two hanging links, while a crank pin common to both fly-wheels passes through a suitable bearing in the piston rod. When the pump is at work the fly-wheels oscillate backwards and forwards while revolving, the motion being very moderate in range.

Fig. 1893 shows the pump in perspective, and Fig. 1894 shows it on a smaller scale, in front view and section.

2. A pump the handle of which swings each side of its center of suspension.

Perch. A pole connecting the fore and hind gears of a vehicle. See Reach.

The various irons, etc., are at the points of connection.

Perch plates are *head-blocks* and *bed* plates, above and below the perch at the king-bolt.

Perch iron is a term inclusive of the iron parts generally.

Perch loop; an iron attached to a perch, having loops for the straps which pass to the bed to limit the swinging of the latter.

Perch stays; side rods acting as braces, passing from the perch to the hind axle.

Per-chlo′ride of I′ron Bat′te-ry. (*Electricity.*) Invented by Duchenin.

Zinc in solution of sea-salt, carbon in solution of perchloride of iron.

Niaudet, American translation, 208.

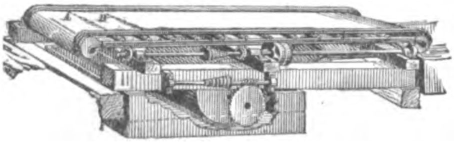
Per-cus'sion Fuse. One which explodes on impact.

The Russian pewter percussion fuse is described on p. 523, and shown in Fig. 17, "*Ordnance Report*," 1877. See also Br., * "*Engineer*," xlvii. 79.

Per-cus'sion Ta'ble. (*Ore.*) A device for sorting ores by exposing them to agitation on a slightly inclined traveling apron in a stream of water.

Frue's percussion table has a rubber belt 2′ broad, constantly shaken from side to side with a regular slow motion.

Fig. 1895.



Concentrating Percussion Table.

This belt is 27′ long, and has projecting flanges of elastic rubber along its outer edges, to keep the sand and water from splashing over. The progressive motion is communicated to the belt by a driving drum, which is connected by a small rubber belt to the front-end roller. The driving drum dips into a tank of water through which the endless apron travels in passing around. On leaving the water tank the belt passes over the tightener and guiding roller.

The ore sized, where the waste is present in larger size than the valuable material, being shaken with a small amount of water will divide evenly on the inclined plane, and the heavier and smaller ore particles will resist the down-flowing water sufficiently to be carried along by the belt over the upper edge into the water tank below; and the waste (lighter and larger particles) will pass over the lower edge. It is successful only on material classified in funnel boxes and of the size of one half millimeter or less.

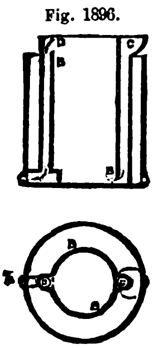
Per-fect'ing Press. A press which prints both sides of the paper at once, or at a single passage. It acts upon a continuous web of paper, and is shown in several figures, pp. 1566–1568, "*Mech. Dict.*"

See also, PRINTING PRESS, *infra.*

Per-flu'ent Bat'te-ry. (*Electricity.*) One in which the exciting liquid flows through the cells or cell to keep the battery constant.

In one form of the nickel battery of Slater the exciting fluid

Fig. 1896.



Slater's Nickel Battery.

Fig 1897.

Direct-acting Perforator.

is constantly renewed at *C*, passes into the inner cell *B*, overflows at *D*, and issues at *b*.

See also CAMACHO BATTERY.

Russell's perfluent battery . "*English Mechanic*," * xxv. 564.

Per'fo-ra'tor. 1. *For Postal Stamps. Cap.* "*Poinçonneuses*," *Laboulaye*, iv.

2. See ROCK DRILL.

3. (*Telegraphy.*) A machine for perforating slips for the rapid system of telegraph. The letters are represented by holes arrayed in special groups. The perforator has three keys.

Per'fo-ra'ting Ma-chine'. 1. A machine for making the rows of holes which separate the individual postal stamps on a sheet. See p. 1668, "*Mech. Dict.*"

They are *direct-acting* or *rotary*. Fig. 1897 is of the former kind, and the gate carrying the punches is actuated by a treadle.

Fig. 1898.

Perfume Burner.

Per'fume Burn'er. A vase in which perfumes or pastilles are burned.

Perfume bottle, *Ward* . . . * "*Sc. Amer.*," xxxvi. 230.
Recipes . . . . "*Sc. Amer. Sup.*," 1031.
Dussauce's "*Practical Guide for the Perfumer*;" *Pradal, Malepeyre, & Dussauce's* "*Complete Treatise on Perfumery.*"

Pe-ri-ne'um In'stru-ments. (*Surgical.*) For adjusting the parts of and reducing the lacerations of the perineum. They are principally needles, forceps, suture stays.

Ashton's, Skeene's, Agnew's, Peaslee's needles.
Agnew's forceps and adjuster.
Brickell's and *Munson's* stays
Sims' and *Bodenhamer's* forceps.
Suture needles.
Shot compressor.
Pages 115, 116, 123, 124 Part III., *Tiemann's* "*Armam. Chirurgicum.*"

Per'i-os'te-o-tome. (*Surgical.*) A knife for cutting or removing the periosteal membrane.

Sands' and *Sayre's*, p. 8, Part I., *Tiemann's* "*Armam. Chirurgicum.*"
Whitehead's, Goodwillie's, p. 66, 57, Part II., *Ibid.*

Per'i-os'te-um Le-va'tor. (*Surgical.*) An instrument for lifting the periosteal membrane; loosening it from the bone.

References to *Tiemann's* "*Armamentarium Chirurgicum.*"
Goodwillie's . . . . Figs. 70, 71, Part I.
Sands' . . . . Fig. 37, Part I.
See Fig. 3645, p. 1668, "*Mech. Dict.*"

Pe-riph'e-ry Con'tact Key. A key having two disks, the peripheries of which come in contact to establish the electric connection. See Fig. 847, p. 266, *supra.*

Per'nette. (*Porcelain.*) A little spur or stilt to place between pieces in the kiln.

Also called (Fr.) *Pattes de coq*, or *colifichets*; Eng. *stilts* or *spurs.*

Per'not Fur'nace. An open hearth revolving furnace. See OPEN HEARTH FURNACE, *supra.*

Springfield, Ill. . . * "*Engineering*," xxix. 374.
* "*Amer. Manuf.*," April 25, 1879, p. 8.

Per'not Steel. In each furnace is a pan that can contain 20 tons of steel, which is revolved by a connection with the engine employed for that purpose. After the pan is charged, the gas flames playing over and around it bring the contents to the desired state of fusion, while the revolving of the pan causes the intimate intermixture of the ingredients, thus overcoming the objection to melting steel in larger receptacles than crucibles. The operation is completed in a little more than five hours. See OPEN HEARTH FURNACE, *supra.*

Per-ox'ide of Lead Bat'te-ry. (*Electricity.*) An invention of De la Rive.

The negative plate is imbedded in peroxide of lead in the porous jar, the salt acting as a depolarizer. — *Niaudet*, Amer. transl., 179.

Per-ox'ide of Man'ga-nese' Bat'te-ry. (*Electricity.*) One in which peroxide of manganese surrounds the carbon plate and depolarizes the same by oxydizing the hydrogen. The invention of Leclanché. — "*Teleg. Jour.*," iv. 213.

In one of *Gaiffe's* batteries, the positive pole has a carbon cylinder pierced with holes parallel to the axis filled with binoxide of manganese; a zinc rod forms the negative pole. The solution is formed of 20 parts chloride of zinc, free from lead, dissolved in 100 parts of water. — "*Teleg. Jour.*," vi. 185.

Per-spec'to-graph. An instrument for assisting in making perspective projections.

It consists of two fixed rulers, one horizontal and the other vertical, in form like a T-square; a sliding ruler which has a lateral movement right and left along the fixed horizontal member, and a graduated quadrant, which is adjustable up and down the vertical member.

The adjustments and mode of using are described by the inventor in "*Engineering*," * xxii. 223.

Drawing apparatus, *Rosquist* .	* "*Sc. Amer.*," xli. 307.
Perspective linead	"*Man. & Build.*," x. 11.
Perspective ruler	* "*Sc. Amer. Sup.*," 2506.

Pes E-qui'nus Ap'pa-ra'tus. (*Surgical.*) References under club-foot (*Talipes*) apparatus.

Pe'tra-lite. An explosive: —

Nitrate of potassa . , ...	64
Impregnated wood or charcoal	30
Antimonium condenser	6
	100

Pe-tro'le-um. History and application, pp. 1672–1676, "*Mech. Dict.*"

PRODUCTS OF THE DISTILLATION OF CRUDE PETROLEUM.

Gravity, Beaumé.	Name.	Per cent. yielded.	
	Gases.	–	Uncondensed and Lost.
115° B. to 105° B.	Cymogene . .	–	Condensed by pump, for ice machine, boils at 32° F.
105° B. to 95° B.	Rhigolene . .	–	Condensed by ice and salt, used as an anæsthetic, boils at 65° F.
95° B. to 80° B.	Gasoline . . .	1½	Condensed in worm by cold water, used in gas machines and gas carburetors.
80° B. to 65° B.	Naphtha .	10	For *oil cloths*, cleaning, etc.; cleaning oil wells; for adulterating kerosene; fraudulent use in so-called "safety oils."
65° B. to 60° B.	Benzine . . .	4	For paints and varnishes.
60° B. to 38° B.	Kerosene or refined petroleum . . .	55	Ordinary oil for lamps.
38° B. to 25° B.	Paraffine oil .	19½	Semi-solid when cold. Chilled and pressed to separate paraffine; oil used for lubricating
	Coke, gas, and loss	10	
	Total	100	

Prof. Chandler.

See KEROSENE; PARAFFINE, *supra*.

Petroleum as fuel . .	"*Sc. American*," xxxix. 304, 352.
Burner	"*Scientific American*," xli. 290.
As lubricant in turning, *Rose*	"*Scientific American*," xxxv. 36.
Burner for locomotives, *Urquhart*, Russia . .	* "*Engineering*," xxiii. 9.
Engine	See HYDRO-CARBON ENGINE, *supra*.
Fire tests	"*Iron Age*," xxii., Dec. 5, p. 7.
Puddling furnace. *Caldwell*	* "*Scientific American Sup.*," 125.
Heating furnace. *Ramsden*	* "*Scientific American Sup.*," 125.
Furnace, *Salisbury* . .	"*Scientific American*," xxxix. 336. "*Scientific American Sup.*," 47.

See also LIQUID FUEL FURNACE, *supra*.

Hydro-carbon retort for gas grates, *Holland* .	* "*Scientific American*," xliii. 54.
Naphtha, benzine, gasoline	"*Scientific American*," xxxv. 7.
Storage (cellars) *Donny*	* "*Scientific American*," xxxvii. 4.
Stove	Figs. 3664, 3665, p. 1676, "*Mech. Dict.*"
Tanks	"*Scientific American*," xxxv. 223. * Fig. 6317, pp. 2536, 2537, "*Mech. Dict.*" * Page 1558, "*Mech. Dict.*"
Tester	* Fig. 3666, p. 1676, "*Mech. Dict.*" * "*Scientific American*," xliii. 42.
Well, steam in, *Hardison*	* "*Scientific American Sup.*," 141.

History, geology, development of the industry and statistics, Brodhead's report in Group I., "*Centennial Reports*," vol. iii., p. 2, *et seq.*

Prof. J. Lawrence Smith's report, *Ibid.*, vol. iv., Group III., p. 121.

Petroleum as fuel, *Ibid.*, p. 161.

Prof. Chandler's report to Board of Health, N. Y.

History, *Prof. J. Sterry Hunt's*, Smithsonian Report, 1861, pp. 319–329.

Pe-tro'le-um Stove. One heated by a coal-oil lamp.

See OIL STOVE, *supra*.
Also PETROLEUM STOVE, Figs. 3664, 3665, p. 1676, "*Mech. Dict.*"

Pe-tro'le-um Test'er. 1. An apparatus to ascertain the flashing point of petroleum oils.

See PETROLEUM TESTER, Fig. 3666, p. 1676, "*Mech. Dict.*"; 6317, 6318, pp. 2536, 2537, *Ibid.*
See also OIL TEST, p. 1558, *Ibid.*
See *Prof. Chandler's* "*Report on Petroleum as an Illuminator*," p. 37, "*Sc. American*," xl. 342.

Mr. Holly modifies the apparatus usually employed by arranging the poles of a battery within ⅛" from the surface of the oil, so as to pass a spark between them, as the thermometer registers an increase of 1° in temperature. By this means the disturbing influences of a flame are avoided.

2. A lubricant tester, which see, *supra*.

Pet'ti-coat Pipe. Shown at Fig. 3667, p. 1676, "*Mech. Dict.*"

Pollock & Wilkinson, Br. * "*Engineer*," xlvi. 57.
* "*Railroad Gazette*," viii 23.

Pew'-gaff. (*Fishing.*) A hook on a staff, used in handling and pitching fish.

Pha'lan-ges Dis'lo-ca'tion Ap'pa-ra'tus. (*Surgical.*) For reducing luxation of the fingers.

Figs. 134–137, Part IV., *Tiemann's* "*Armam. Chirurg.*"

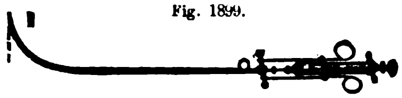
Pha-na'ro-gri-sou'me-ter. An apparatus invented by M. Gossiaux, of Gardanne (Fr.), for indicating the presence of dangerous gases in fiery mines. A lamp of peculiar construction and a pyrometer make up the instrument.

The lamp is covered with a cylinder of wire gauze. A wire spiral encircles this, and extends the entire length of the cylinder; the wires are held in place by grooves cut in vertical bars forming a frame to the lamp, and are fastened at the top to a ring attached to the cap of the lamp. The wire at the lower end terminates in a tube closed at one end. As the wire dilates under heat, the end of the tube moves a small lever terminating in a sector gearing into a pinion, on which a needle moving on a graduated semicircle is fixed. Constant contact between the end of the lever and the tube is maintained by a small spring, the indicating arrangement being protected by a glass. The heat generated by the presence of the burning gas in the lamp expands the coil and actuates the needle. To graduate the scale, the lamp is lighted in pure air, and zero is marked when the needle is stationary. A piece of iron, a fifth of the volume of the wire envelope, being brought to a red heat, is placed within the gauze, and as the gauze begins to redden — which represents the condition of the lamp burning in an atmosphere saturated with gas — the position of the needle is marked 100, after which the interval is marked off into a scale of 100 parts.

See also GRISOUMETER; FIRE-DAMP ALARM, *supra*.

Pha-ryn'go-la-ryn'ge-al Syr'inge. An instrument for operating upon the posterior fauces, pharynx, and adjacent parts.

Fig. 1899.



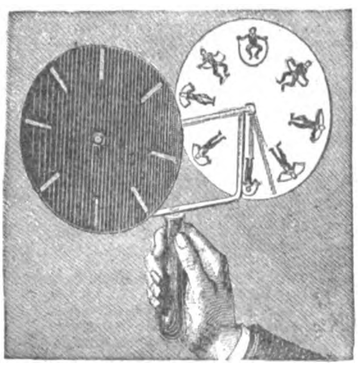
Pharyngo-laryngeal Syringe.

Fig. 1899 shows *Upson's* Pharyngo-laryngeal syringe and aspirator, with flexible hypodermic syringe point.

Phen'a-kis'to-scope. On a disk are painted figures in series representing successive motions; these are viewed in succession as the disk revolves, and give the appearance of motion.

Dr. Roget's phenakistoscope is shown in Fig. 3669, p. 1677,

Fig. 1900.



Plateau's Phenakistoscope.

"*Mech. Dict.*" The Plateau instrument is shown in Fig. 1900. The observer looks through slits in one disk and observes the figures in succession upon the opposite disk. The disks revolve simultaneously.

See PRAXINOSCOPE and references *passim*.

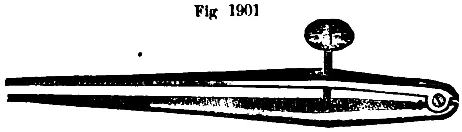
* "*Scientific American Supplement*," 4031.

Phi-mo'sis In'stru-ment. An instrument to excise the inner inelastic mucous membrane of the prepuce without removing the normal skin.

The limbs, or blades, terminate in blunt points, and are deeply serrated on their outer surfaces, with points or teeth set backward, like fine saw-teeth, for the purpose of firmly holding the mucous membrane, without the risk of slipping when traction is made The blades are forced apart by a thumb-screw.

In operating, the blades, closed to a point, are introduced

Fig 1901



Phimosis Instrument.

within the prepuce up beyond the corona of the glans. They are then, by turning the thumb-screw, strongly separated, so as to render the mucous membrane tense. Traction is then made, and the outer elastic skin is drawn back fully, so as to be away from the portion to be excised, and excision is effected by transfixing the prepuce through the middle with the bistoury, and cutting laterally in both directions toward the blades of the instrument.

Phimosis forceps.	Rupturing forceps.
Phimosis scissors.	Circumcision scissors.
Frenum probe and spatula.	

Page 1, Part III., *Tiemann's* "*Armam. Chirurgicum.*"

Phle-bot'o-my In'stru-ments. (*Surgical.*) See CUPPING INSTRUMENTS, *supra*, and p. * 659, "*Mech. Dict.*"

LEACH, ARTIFICIAL	* p. 1283, "*Mech. Dict.*"
SCARIFICATOR	* p. 2052, *Ibid.*
LANCET	* p. 1249, *Ibid.*
TRANSFUSION APPARATUS . .	* p. 2613, *Ibid.*

Phœ'nix Stone. An artificial stone, in which the sand is replaced by furnace slag. Made by the Phœnix Stone Co., of Philadelphia.

See *Gen. Q. A. Gillmore's* Report, "*Centennial Exhibition Reports*," * vol. iii., Group II., p 178.

Phon-ei'do-scope. An instrument for observing the color figures of liquid films under the action of sonorous vibrations.

The instrument invented by Sedley Taylor for showing the action of sound waves upon a film of soap solution contained in a disk laid over a vertical opening in a tube into which articulate sounds are projected.

In one form it is a visible demonstration of the vibratory and molecular motion of a telephone plate. — *S. C. Tisley*, "*Nature*," December 30, 1880.

See also —

"*Engineer*"	* xlv. 421.
"*Manufacturer & Builder*" . . .	xi. 86.
"*Scientific American Sup*" .	2041, * 2304, 2628.

Phon'ic Ap'par-a'tus. See under the following heads: —

Aërophone.	Phonometer.
Audiometer.	Phonomotor.
Audiphone.	Phonophote.
Autophone.	Phonoscope.
Crown telephone.	Photophone.
Dentiphone.	Receiver.
Dual telephone.	Sphygmophone.
Inductophone.	Stethoscopic microphone.
Magnophone.	Tasimeter.
Megaphone.	Telemicrophone.
Microphone.	Telephone.
Microphone relay	Telephone call.
Microtasimiter.	Telephonograph.
Microtelephone	Thermophone.
Motophone.	Topophone.
Phoneidoscope.	Transmitter.
Phonic wheel.	Triple telephone.
Phonograph.	Watch telephone.

Phon'ic Wheel. Apparatus devised by M. Paul de la Cour.

It consists of a toothed wheel of soft iron turning round on an axis, so that the teeth pass very closely to but do not touch the pole of an electro-magnet. If a phono-electro current be caused to pass through the electro-magnet, so that the pole exerts a periodic series of attractions on the tooth nearest to it, then the wheel will be in stable equilibrium when at rest and also when it turns at definite speeds, as when the time of a magnetic impulse is equal to that of the turning of the wheel a distance equal to one tooth. The attraction tends to retard the wheel when it attempts to increase its speed, and to accelerate it when it lags.

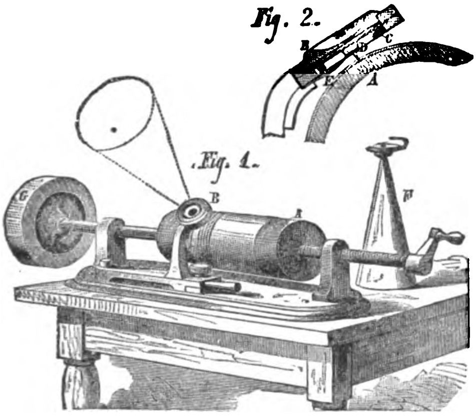
"*Telegraphic Journal*"	* vi. 476.
"*Scientific American Supplement*" . . .	2562.

Pho'no-graph. 1. An apparatus for repeating sound. It consists, as shown in Fig. 1902, of a brass spirally grooved cylinder, *A*, mounted on a long, horizontal screw, the cylinder being rotated, and at the same time, moved laterally by turning a crank on the end of its axis. One diaphragm, *B*, serves the double purpose of vibrating in response to the voice, and so indenting by the diamond-tipped point *D* attached to the spring *E*, the tinfoil wrapped about the cylinder, and also revibrating in response to the movements mechanically imparted to it by

the indentations already made passing under the point.

"The exhibitor sang into the machine an entire verse, and it was repeated as often as the cylinder was readjusted. Sounds of coughing, clearing the throat, knocks, noises of

Fig. 1902.



Edison's Phonograph.

all kinds, were as accurately reproduced. A curious effect is produced by whistling, the apparatus giving forth every note clearly and fully; but more remarkable still is it to hear two voices at once come from the machine. The exhibitor first sang a verse which was registered, and then running the cylinder back talked so that the indentations produced by the speech vibrations came over those made by the song. The instrument repeated both utterances simultaneously, each, however, being clearly distinguishable. Another odd performance is turning the cylinder the wrong way, and making the machine talk the language backward."

A modification of the phonograph is called by Mr. Edison the *airophone*. In this machine the vibrating plate, which in the phonograph moves a sharp point over the revolving cylinder, operates as a valve to shut off and open a flow of steam through the pipe which leads from the boiler to a peculiarly-constructed tube. By this contrivance the steam, instead of producing a discordant whistle, pronounces words with considerable distinctness, and audible at a great distance.

2. A flame manometer which obtains graphic representations of the condition of the human vocal organ. Fig. 1046, p. 344, *supra*.

Phonautograph, *Tyndall*, *Leon Scott* . . . . * "*Scientific Amer.*," xxxvii. 376.
Phonograph, paper by *du Moncel* . . . . "*Technologiste*," xl. 197.
Phipson . . . . . "*Technologiste*," xv. 188.
Preece . . . . . . * "*Jour. Soc. Tel. Eng.*," vii. 68.
Phonograph, *Edison* . "*Technologiste*," xl. 123.
* "*Engineer*," xlv. 438.
* "*Engineering*," xxv. 187.
* "*Manuf. & Builder*," x. 84.
* "*Harper's Weekly*," Mar. 30, 1878.
* "*Eng. & Min. Jour.*," xxv. 236.
* "*Harper's Weekly*," Mar. 30, 1878.
"*Iron Age*," xxi., Mar. 28, p. 24.
* "*Scientific American Sup.*," 1893.
* "*Scientific Amer.*," xxxviii. 193.
"*Scientific Amer.*," xxxviii. 86.
"*Scientific American Sup.*," 636.
* "*Teleg. Journal*," vi. 782.
* "*Teleg. Journal*," vi. 6.
* "*Scientific Amer.*," xxxvii. 384.
"*Scientific Amer.*," xxxviii. 405.
Automatic, *Marey & Rosapelly* . . . . * "*Scientific Amer.*," xxxvii. 304.
Exhibition of it . . "*Sc. Amer. Sup.*," 1828, 1904.
Its future, *Edison*. . "*Scientific American Sup.*," 1973.
* "*Engineering*," xxv. 52.
Lambrigot . . . . "*Jour. Soc. Tel. Eng.*," viii. 327.
Preece-Stroh . . . . * "*Engineering*," xxvii. 201.
Koenig. . . . . . "*Scientific American Sup.*," 636.
Clock calling the hours, *Edison* . . "*Teleg. Journal*," vi. 142.
Photographing sound "*Man. & Builder*," Feb., 1876.
"*Scientific American Sup.*," 615.
Koenig . . . . . "*Scientific American Sup.*," 636.
Piano . . . . . . "*Scientific American*," xxxiv. 111.
* "*Scientific Amer.*," xlii. 6.
Recording sounds of Levy's cornet . . "*Scientific Amer.*," xxxviii. 384.
Sixpenny . . . . . * "*Engineering*," xxvii. 327.
Eng. . . . . . . * "*Scientific American*," xl. 356.
Working drawings . * "*Scientific American Sup.*," 2112.
Phonophone . . . . "*Manuf. & Builder*," i. 95.

Pho-nom'e-ter. An apparatus designed to assist the signal-man on steamships in marking the intervals of time at which the fog-horn or whistle is to be blown, and to regulate the sounds in such a way as to cause them to announce the ship's course.

It consists of a horizontal clock, placed, face up, in sight of the signal-man. The face is about 8″ in diameter, and indicates seconds only, the minute and hour figures and hands being upon a small dial near one edge. The second-hand has four arms at right angles with each other, and above the face is a movable disk, or dumb card, that obscures about three-fourths of the whole dial. Around the edge of the clock face are painted sections or segments. One of these covers ten seconds' space; four mark five seconds each, and between each are blanks of three seconds each. Outside of the clock is a flat brass ring, having the points of the compass marked upon it.

In using the phonometer, the disk is moved round till the open part comes opposite the ship's head and in line with her course. The segments on the dial that are then visible indicate the number of blasts to be given on the whistle. The second-hands, as they then come into view, give the duration in seconds of each blast and each pause. The signal-man merely watches the hands as they traverse the segments in sight, and sounds his whistle accordingly, announcing the ship's direction. For instance, one blast of ten seconds indicates that the ship is steering within the points north and east, quarter north. Two blasts of five seconds each, with an interval of three seconds between them, would announce the ship's direction as between east and south, quarter east. Three blasts, and two pauses of five and three seconds, would mean south to west, quarter south, while four blasts of five seconds, with the same pauses, would indicate the ship's course to be between west and north, quarter west, and so on. The disk employed is designed to prevent mistakes, and the four hands serve to save time in watching for their appearance and journey over the visible portion of the dial.

Pho-no-mo'tor. The machine has a diaphragm and mouth-piece similar to a phonograph. A spring which is secured to the bed-piece rests on a piece of rubber tubing placed against the diaphragm. This spring carries a pawl that acts on a ratchet or roughened wheel on the fly-wheel shaft. A sound made in the mouth-piece creates vibrations in the diaphragm which are caused to propel a fly-wheel.

"*Scientific American*" . . . . xxxix. 51.

Pho'no-phone. A term proposed for the phonograph, as the latter term had been previously applied to Scott's machine, which is of different character, and invented many years since.

See PHONAUTOGRAPH, p. 1678, and TELEPHONE, pp. 2514, 2515, "*Mech. Dict.*"

Pho'no-phote. An apparatus for the transformation of sound into light, devised by M. Coulon, Conservator of the Industrial Museum of Rouen.

Two Geissler tubes are put in quick rotation on an axis. The induction coil of the first is worked by an ordinary interrupter, and gives the deviation of a luminous cross. The interrupter of the second is replaced by a telephone. The figure presented by the second tube projects on the first one, which is colored by uranoxide glass, and exhibits the most rapid changes according to the height of the tone delivered in the telephone trumpet. The sensibility of the changes are said to be startling and most interesting. —"*Nature*."

"*Eng. & Mining Journal*" . . . . . xxviii. 147.

Pho'no-scope. An instrument invented by Henry Edmunds for producing figures of light from vibrations of sound. It consists essentially of three parts, an induction coil, an interrupter, and a rotary vacuum tube. The action of the instrument is as follows: —

"Sounds from the voice or other sources produce vibrations on the diaphragm of the interrupter, which, being in the primary circuit of the induction coil, induce at each interruption a current in the secondary coil similar to the action of a contact-breaker or rheotome; therefore, each vibration is made visible as a flash in the vacuum tube. This tube revolving all the time at a constant speed, the flashes produce a symmetrical figure like the spokes of a wheel, as in the *Gassiot Star*. The number of spokes or radii is according to the number of vibrations in the interrupter during a revolution of the tube, and the number of vibrations being varied to any extent, according to the sounds produced, the figures in the revolving tube will be varied accordingly. The same sounds always produce the same figures, providing the revolution be constant. In case of rhythmical interruption being produced in a given sound, as in a trill, most beautiful effects are noticeable, owing to the omission of certain radii in regular positions in the figure. The uses of this instrument are the rendering visible of sounds, and showing the vibrations required in their production, and it forms a mode of confirming by sight an appeal to the ear." — *W. Ladd.*

* "*Engineer*"	xlv. 421.
"*Eng. & Min. Jour.*"	xxvi. 207.
"*Scientific American Supplement*" . .	2182, 2308.

Phos'phide of Cop'per. See PHOSPHOR BRONZE.

Phos'phor Bronze. Invented by Montefiore & Künzel, the founder of the Val-Benoît nickel manufactory, near Liege.

"Phosphorus bronze is made by fusing phosphorus tin with copper or with phosphorus copper. It fuses at 1230° to 1250°; the finished product usually contains 0.053 to 0.76 per cent. phosphorus and 4 to 9 per cent. tin." — *Dr. Stammer.*

The result of analyses and observations indicates that the phosphorus exercises a double chemical action over the metals which compose the alloys. While reducing on the whole the oxide of tin contained in the mixture, it at the same time forms with the metals it has thus purified a perfectly homogeneous alloy, the hardness and resistance of which are subject to control by varying the proportion of phosphorus.

Experiments have established the superiority of phosphorus alloys over ordinary bronze, copper, coke-iron, charcoal iron, and steel. Under the influence of strains exceeding the limit of elasticity, or of violent shocks, their texture does not become crystalline. They are completely free from metals easily liable to attack, such as zinc. Sea-water, or diluted solutions of sulphuric acid, have only a very feeble action upon them, and in all cases much less than on pure copper. One of their most valuable qualities is, that recasting does not occasion loss in tin. Moreover, their degree of liquidity, which may be compared to that of mercury, renders it possible to obtain them without blisters, and to have perfect moldings. Their degree of fusibility is nearly the same as that of ordinary cannon bronze.

A number of phosphor-bronze alloys are now manufactured, varying in composition to suit the objects for which they are intended. The scope of their application is very great. For instance: —

Bearings.	Locomotive fittings.
Bell metal.	Nails.
Boiler tubes.	Oil cups.
Bolts.	Ornaments.
Buckles.	Printing rollers.
Busts.	Rivets.
Cannon.	Tools.
Cocks.	Tubes.
Engraving plates.	Tuyeres.
Fire-arms.	Valves.
Gun fittings.	Wire.
Hammers.	Wire rope.
Harness fittings.	Wrenches.
Keys.	Etc.
Locks.	

The great features of phosphor-bronze are that it can be made to any degree of hardness, toughness, or elasticity. It can be rendered more ductile than copper, as tough as wrought iron, or as hard as steel. It possesses great fluidity, its homogeneity is complete, and its grain is as fine as that of cast steel. It may be controlled with ease and accuracy to suit the particular purpose for which it is intended, and can be remelted as often as may be desired without any appreciable loss or material alteration of its quality. The phosphor-bronze alloy made for rolling, drawing, or embossing, will stretch more than copper or any of its ordinary compounds. Plates have been reduced by a single cold rolling to one fifth of their thickness, the edge remaining perfectly sound, and without cracks.

The following shows the results of tests made by Mr. David Kirkaldy, of London: —

CAST METAL.	Diminution of Section before Rupture.	Resistance in pounds per square inch. Elastic.	Resistance in pounds per square inch. Absolute.
	Per Cent.	*Pounds.*	*Pounds.*
Pure copper	3.30	4,400	6,975
Ordinary gun metal, containing 9 parts copper, 1 part tin .	3.60	12,800	16,650
Phosphor-bronze . .	8.40	23,800	52,625
Phosphor-bronze . .	1.50	24,700	46,100
Phosphor-bronze . .	33.40	16,100	44,448

DRAWN METAL.	Pulling Stress per Square Inch. Wire as drawn.	Pulling Stress per Square Inch. Annealed.	Twist in 5 Inches. Wire as drawn.	Twist in 5 Inches. Annealed.	Ultimate Extension.
	lbs.	*lbs.*	*lbs.*	*lbs.*	*Per Cent.*
Various Alloys. Phosphor-Bronze	102,759	49,851	6.7	89	37.5
" "	120,957	47,787	22.8	52	34.1
" "	120,953	53,381	13.0	124	42.1
" "	139,141	54,111	17.3	53	44.9
" "	159,515	58,853	18 3	66	46.6
" "	151,119	64,569	15.8	60	42.8
Copper	63,122	37,002	86.7	96	34.1
Steel	120,976	74,637	22.4	79	10.9
Iron, Galvanized best Charcoal E . . .	65,834	46,160	48.0	87	28.0

N. B. — The wire used for these experiments was No. 16, Birmingham wire gage.

"The following analyses of specimens of phosphor-bronzes show that phosphorus enters into them in very small proportion, though it has a most useful effect: —

Copper . .	93.68	94.11	90.86	94.71	90.34
Tin	5.82	5.15	8.56	4.88	8.99
Phosphorus .	.17	.21	.19	.55	.76
Zinc . . .	.34	.23	-	-	-

"Phosphorus may be introduced directly into the alloy in a state of fusion. In this case a great part of it is lost; only a small quantity combines chemically with the metal. The copper may also be melted in a crucible, lined inside with bone-ash, nitric acid, and charcoal. This mixture should surround the copper on all sides before the closing of the crucible." — *Revue Industrielle.*

See also the following United States patents: —

118,372 *Lavroff*, Phosphor bronze.
115,220 *Levi & Künzell*, Phosphorized bronze.
120,984 *Levi & Künzell*, Phosphorized bronze.
125,549 *Dick*, Phosphorized bronze.
130,702 *Dick*, Phosphor bronze for telegraph wire.
209,240 *Duplaine.*

Copper	100
Nickel	100
Arsenic	8
Phosphorus	3

228,615 *Dick*, Wrought iron, tin, phosphorus; lead, optional.

The subject is considered on p. 1678, "*Mech. Dict.*," where a table is given showing phosphor bronzes from Parke, 1848, to Lavroff and Levi & Künzell, 1871.

The subject may be pursued by reference to the following: —

	"*Scientific American*," xxxvii. 267; xxxix. 71, 409.
	"*Sc. Amer. Sup.*," 91, 718, 756.
Wire	"*Sc. Am. Sup.*," 283, 1250, 786, 796.
	"*Iron Age*," xvii., Feb. 10, p. 28; March 23, p. 20.

Applications	"*Iron Age*," xix., May 24, p. 16.
Wire ropes	"*Iron Age*," xx., July 12, p. 9; xxi., May 9, p. 14; May 16, p. 15.
	"*Engineering*," xxiii. 346.
	"*Van Nostrand's Eng. Mag.*," xvi. 572; xvii. 48.
	"*Manufact. & Builder*," viii. 167.
	"*Am. Man. & Iron World*," xxvi., April 23, p. 11.
	"*Eng. & Min. Journal*," xxi. 298; xxii. 44; xxiii. 62, 378; xxvi. 257, 276; xxix. 317, 391.
At Centennial	"*Eng. & Min. Journal*," xxiii. 14.
	"*Min. & Sc. Press*," xxxii. 99, 243; xxxv. 195; xxxvi. 19.
	"*Teleg. Journal*," vi. 86.
	"*English Mechanic*," xxiii. 62, 467; xxiv. 325, 352; xxvi. 173, 431.
	"*Engineer*," xlii. 26, 393, 431, 466; xliii. 8, 43, 59, 310; xlvii. 26.

Phos'phor Cop'per. An alloy used in the making of phosphor bronze.

"Phosphorus copper may be made by heating together four parts acid calcium phosphate, two of granulated copper, and one part of charcoal; the copper must be pure." — *Dr. Stammer.*

"A crucible is fettled with a mixture of bone ash, silicic acid, and carbon, granulated copper is laid in and covered with a quantity of the fettling mixture, and the whole is fastened down with a cemented cover. Soda and glass can be added to promote fusion. At a fusing heat, the silicic acid acts on the phosphate, the phosphoric acid is reduced and taken up as freed by the copper." — *Dr. Schwarz.*

Phos'pho-res'cent Di'al. Usually made of paper or thin cardboard enameled like visiting cards; covered with an adhesive varnish, or white wax mixed with a little turpentine, over which is dusted with a fine sieve powdered sulphide of barium. Sulphides of strontium and calcium possess the property in a lower degree. The dial loses its phosphorescence after a while in darkness, but is restored by sunlight or burning magnesium wire.

Phosphorescent time-piece	"*Sc. American*," xxxix. 339.
Phosphorescent bodies . .	"*Sc. American Sup.*," 3887.
Phosphorus manufactory	"*Sc. American Sup.*," 2790.
Dial, illuminated . . .	p. 254, *supra*.
Illuminated sign . . .	p. 489, *Ibid.*

Phos'pho-res'cent Pho'to-graph. A plate coated with a mixture of dextrine, honey, and bichromate of potash is exposed under a negative, the result being that those portions which are exposed to the effect of the light through the transparent portions of the negative harden, while those which are protected from the light remain adhesive. The lines of the image retain any fine powder which is dusted over it, while the hard portions will not retain it. A phosphorescent powder — for instance — sulphite of lime, is dusted over the positive, and, after having been exposed to sunlight, or any strong artificial light, becomes luminous in the dark.

Phos'phor Tin. By heating 6 parts phosphorus with 94 parts moist tin sponge prepared from the chloride by reduction with zinc, the substance formed is Sn_9P, fusible at 370° C.

Made at Graupen tin works at Mariaschein, in Bohemia.

Useful in making phosphor bronze, as it removes the oxides, which tend to harden the latter. See —

"*Iron Age*"	xx., Nov. 8, p. 15.
"*Engineering & Min. Jour.*" . . .	xxiii. 62; xxiv. 70.
"*Am. Manuf. & Iron World*" . .	xxvi., Aug. 13, p. 13.
"*Scientific American*"	xl. 118.

Phos'pho-rus Steel. *Metallurgy.* The invention of Tessie du Motay; the steel contains carbon, 0.12; phosphorus, 0.25; manganese, 0.75.

A. L. Holley . . .	"*Iron Age*," xxii., Aug. 29, p. 7.
	"*Eng. & Min. Jour.*," xxvi. 217.

Phos'phor Zinc. Zinc with an addition of phosphorus. The combination is, however, much more frequent with the bronze. See PHOSPHOR BRONZE.

Pho'to-col'lo-graph. A photograph in natural colors.

On methods of obtaining natural colors in the camera, from London, "*Photographic News*."

Captain Abney's process considered. Reference to *Niépce* and *Becquerel*.

Albert's (Munich) process for printing photocollographs. — "*Scientific American*," xli. 260.

Pho'to-col'lo-type. A photograph printed in natural colors.

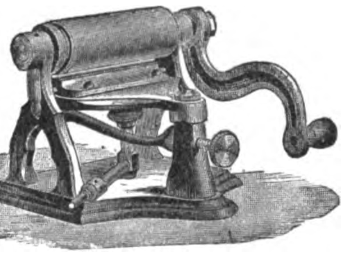
Herr Albert's method .	"*Scientific American*," xli. 260.
Mr. Bolas' method . .	"*Scientific American Sup.*," 2770.

Pho'to-drome. A scientific instrument for producing optical effects by flashes of light.

It consists of a strong rotator, carrying three disks of devices, each 30″ in diameter, painted on paper; and a small rotator carrying a smaller disk of card-board, with openings in it, to allow the light from a calcium, magnesium, or electric lantern to be thrown upon the first disk by flashes. Each rotator is revolved rapidly, producing curious effects upon the large disk. See PHENAKISTOSCOPE.

Pho'to-graph Bur'nish-er. A little machine in which a brilliant surface is given to a photograph by passing it under pressure over the surface of a burnishing tool. The feeding roller is slightly roughened; the picture is fed, face downward over the burnisher, which is heated by an alcohol lamp beneath.

Fig. 1903.



Schuyler's Photograph Burnisher.

Ewing	"*Scientific American Supplement*," 809.

Pho'to-graph'ic Ri'fle. A device to take photographs of birds in flight.

Capt. Vassel proposes a small dark rifle chamber of 2.27″ interior diameter, surmounted by a proper level and sight. By means of Muybridge's, Janssen's, or other contrivances for taking instantaneous pictures, he thinks that small views might be easily taken which could be subsequently enlarged. He also proposes a photographic revolver for taking a series of successive attitudes at a single operation — "*La Nature*."

Pho-tog'ra-phom'e-ter. An automatic apparatus to record the angular position of objects situated around a given point.

The objective is mounted vertically on a circular platform capable of rotating, by means of clock-work, in a horizontal plane.

The picture is formed, not in a vertical plane, as ordinarily, but in a horizontal; the rays, passing in through the objective, are deflected 90°, by means of a reflecting prism so as to fall on the horizontal sensitive surface, which is collodionized glass, and is placed in such a way that its center corresponds with the point at which the center point of the diaphragm would be represented. To prevent a number of confused images superimposed on each other being formed during the rotation of the objective, an opaque screen, having a narrow oblong opening, the medial line of which passes through the axis of rotation, is placed over the whole of the sensitized surface, and revolves along with the objective.

The result of this arrangement is the production on the sensitized plate of images of the different points that lie around the observer; the angles formed by lines joining the center of the plate, and the different objects being exactly the same as those formed by lines joining the center of the instrument and the objects themselves. The position of the objects thus accurately obtained may be transferred to paper, etc., in the ordinary way.

See also OROHELIOGRAPH, *supra*.

Pho-tog'ra-phon. A complete portable photographic apparatus for field-work.

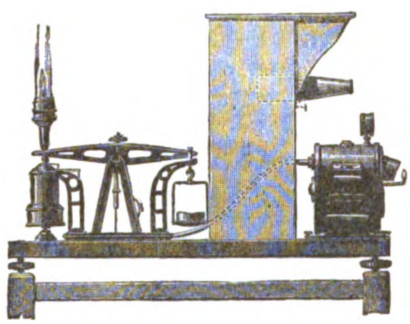
Brice's "English Mechanic" . . . . . . xxvii. 141.

Pho-tom'e-ter. A measurer of illuminating power. See instances pp. 1687, 1688, *"Mech. Dict."*

The official gas-testing apparatus used in the city of Paris is the result of consultations of the *Compagnie Parisienne du Gaz*, and *MM. Dumas* and *Regnault*, and is shown in Figs. 1904–1906.

The table has leveling screws. One extremity of the table has a meter with a dial, one hand registering units of 1-20 liter of gas, and the other hand fixable in any position as a

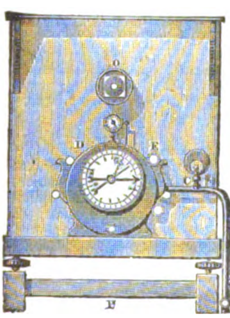
Fig. 1904.



City of Paris Photometer. (Side Elevation.)

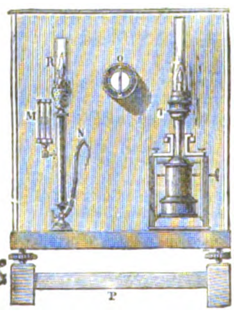
mark at the commencement of an evaluation, and in connection with the dial-hand of departure is a lever which sets in consentaneous movement the dial-hand of a seconds chronometer placed above the dial of the meter. Behind the meter is a hood beneath which the observer places his

Fig. 1905.



City of Paris Photometer. (Front End View.)

Fig. 1906.



City of Paris Photometer. (Rear End View.)

head, and looks through the tube which is shown projecting to the right. In the tube is placed a glass plate on which is a thin film of starch, and behind this a vertical plate, set edgewise so as to divide the field of view, and allow the light under evaluation and the standard light to be compared.

The chemical photometer of Herr Eden, of Vienna, is based upon the observation that chloride of mercury is very easily reduced to insoluble chloride in sunlight whenever it is mixed with organic substances.

The sensitive solution consists of two volumes of a solution of 40 grams of oxalate of ammonia in one liter of water, and one volume of a solution of 50 grams of sublimate in one liter of water. In sunlight turbidity is immediately produced, the action of the light being weaker as the solution is more dilute. Tables are furnished for the corrections necessary to allow for the influence of increasing dilution and varying temperature on the quantity of the chloride of mercury separated by the photo-chemical process of decomposition.

The pocket photometer of M. Schutte, of Paris, has the form of a small telescope.

Putting the eye to the narrow end and looking through at a light, one sees a small luminous circle, on which is detached some figure in black. On turning the wider part of the instrument, successive numbers are seen, and the higher the number the weaker is the light perceived, and at length it quite disappears. This effect is obtained by means of leaves of waxed paper, the number of which increases with the figures. Thus a weak, luminous source does not allow one to see the same number as a strong one, and the variation between the figures increases with the difference in intensity. The instrument can be used for determining the time of exposure in photography.

The same principle is involved in the actinometer, described on p. 11, *"Mech. Dict."*

Chemical, *Dr. Eden*, Vienna. *"Scientific American,"* xlii. 137.
Edgerton . . . . . * *"Eng. and Min. Jour.,"* xxv. 94.
French . . . . . . * *Laboulaye's "Dict.,"* ii., *"Eclairage."*
Letheby . . . . . . * *"Plumb. & San. Eng.,"* ii. 445.
Lighthouse Board, U. S. *"Scientific American Sup.,"* 467.
Munzinger . . . . . *"Scientific American Sup.,"* 125.
Napoli . . . . . . * *"Scientific American Sup.,"* 3773.
Phenakistiscope.
Plateau . . . . . . * *"Scientific American Sup.,"* 4031.

Goodwin's electric photometer extinguishes candle and gas, and stops meter and clock by electricity.

"American Gas-light Journal" . . . * July 3, 1876, p. 5.
Goodwin's candle-power jet photometer * *Ibid.*, p. 6.
Portable photometer . . . * *Ibid.*, p. 7.

See JET PHOTOMETER, Fig. 1483, p. 512, *supra*.

Pho'to-met'ric Stan'dard. The *carcel.* A carcel lamp burning 42 grams of refined colza oil per hour, with a flame 40 millimeters high. Equal to $\left\{\begin{matrix}\text{9.5 British}\\\text{7.6 German}\end{matrix}\right\}$ standard candles.

"Popular Science Monthly" . . October, 1882, p. 864.

Pho'to-phone. An apparatus devised by Alexander Graham Bell and Sumner Tainter for the production and reproduction of sound by means of the undulations of light. Vibrations are conveyed between distantly separated diaphragms by a beam of light.

It is founded upon the sensitiveness of matter to light vibrations, and selenium offers the most promising results of the numerous substances experimented with. Professor Bell's description of one form of the apparatus is as follows: —

"The simplest form of the apparatus for producing the effect . . . . consists of a plane mirror of flexible material, such as silvered mica or microscope glass. Against the back of this mirror the speaker's voice is directed. The light reflected from this mirror is thus thrown into vibrations corresponding to those of the diaphragm itself."

"The beam is received at a distant station upon a parabolic reflector, in the focus of which is placed a sensitive selenium cell, connected in a local circuit with a battery and telephone."

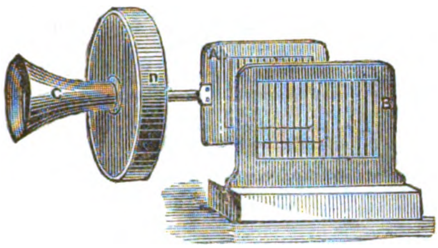
Articulate sentences have been conveyed 213 meters. See address by Professor Bell, at the annual meeting of the *"American Association of Science,"* August 25, 1880. Reported in Boston *"Daily Advertiser"* of that period, and reproduced in —

"Sc. American Supplement" . . p. 3921.
"Iron Age" . . . . xxvi., Dec. 2, p. 1.
"Manufacturer and Builder" . . xii. 255.

Fig. 1907 will illustrate an experimental instrument.

"In order to obtain a beam of light, the illuminating intensity of which at a distance could be directly controlled by, and bear a relation to, the sonorous vibrations constituting musical notes or articulate speech, Prof. Bell interposed in the path of a beam of sunlight a screen consisting

Fig. 1907.



Photophone (Illustrative Instrument).

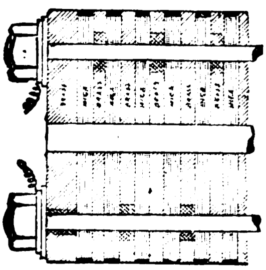
of two thin plates of metal, perforated with a number of fine slits, one of these plates, *B*, being fixed, while the other, *A*, was attached to the center of a diaphragm, *D*, which could be thrown into vibrations by the human voice at *C*, so that the motions of the diaphragm would cause the movable screen to slide backward and forward over the fixed plate, and in so doing alternately enlarge and contract the orifices through which the luminous beam was transmitted." — *Engineering.*

In the illustration the intervals are exaggerated, to render them more clearly visible. "The width of the slits, as well as their distance apart, are so determined with respect to the rigidity of the diaphragm that at no position in the amplitude of the motion is the passage of the beam entirely closed, a certain amount of light passing continuously to the receiver, the opening and contracting of the orifices of the screen merely varying the intensity, for although a rapidly intermittent beam of light would by this means transmit musical notes, it would be powerless to convey even an approximation to the complications of articulate speech." — *Ibid.*

The construction of the selenium cells of the receiver by Messrs. Bell and Tainter is one of the most interesting of the series of ingenious contrivances involved. There is but room here for a sketch of results; the references appended will furnish details omitted here.

Fig. 1908 is the cylindrical form of selenium cell employed by Prof. Bell. The sensitive portion is the cylindrical surface upon which the rays of undulatory light are thrown by a paraboloid reflector in the focus of which it is placed. It consists of a number of circular disks of brass about 2″ in diameter strung upon a rod passing through their common center, and separated by a similar series of disks of mica of slightly smaller diameter. When the compound series is built upon the mandrel a number of grooves occur around the mica, owing to the relatively smaller diameter of its disks. These grooves are filled with melted selenium. The bolts which pass through the disks form the connecting screws for placing the instrument in circuit with a telephone and battery. Every other disk of brass is in connection with the upper bolt, and the alternate disks with the lower bolt.

Fig. 1908.



Bell's Photopile of Receiver.

This alternate connection is shown by the diagram, Fig. 1909, the odd numbered disks being connected by wire *M*

Fig. 1909

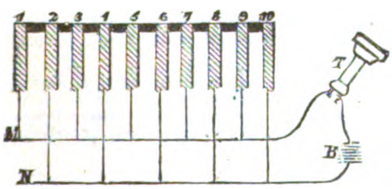


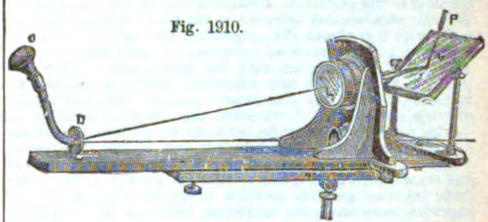
Diagram of Photopile and Connections.

with the telephone *T*, and the even numbered by the wire *N* to the battery *B*, and thence to the telephone *T* in circuit.

Figs. 1910, 1911 illustrate the photophone, the former showing the transmitter, and the latter the receiver.

The transmitting instrument of the photophone (shown in Fig. 1910) consists of a long board, with suitable adjust-

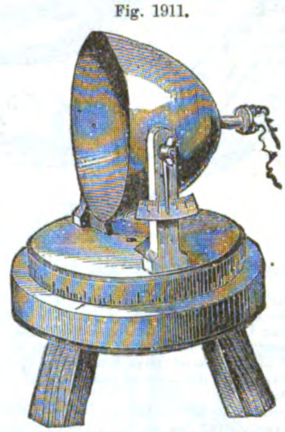
Fig. 1910.



Transmitter.

ments for directing it, within certain limits, in both altitude and azimuth. To the board are attached the various parts of the apparatus. *O* is the mouth-piece, with its reflecting diaphragm, *D*, of silvered glass or mica, and *M* is the mirror by which a ray of light from the sun, or any other powerful source of light, may be projected on to the diaphragm *D* by the condensing lens *L*, below which is fixed another lens, *E*, for the purpose of parallelizing the beam after reflection from the silvered diaphragm, and projecting it to the distant station, where it is received by the paraboloidal reflector of the receiving instrument shown in Fig. 1911, in the focus of which is placed one of the cylindrical

Fig. 1911.



Receiver.

photopiles, Fig. 1908, and in circuit with the latter is placed a pair of telephones and a voltaic battery, which in Professor Bell's experiments consisted of nine Leclanché cells.

The general arrangement and disposition of the whole installation is clearly shown in the diagram, Fig. 1912, in which the portion to the left of the figure is the transmit-

Fig. 1912.

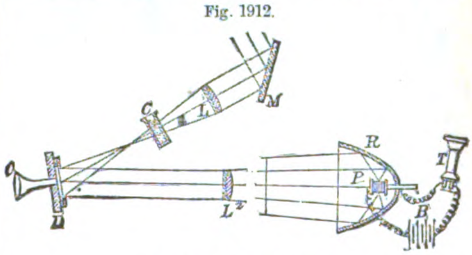
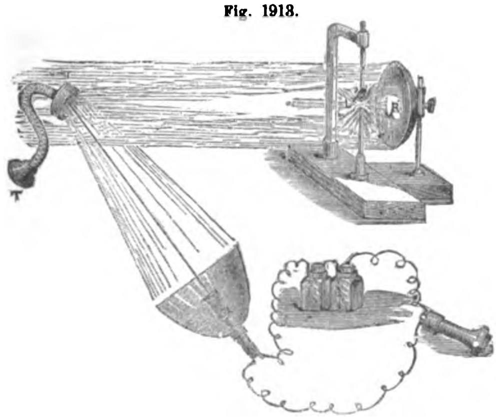


Diagram of Installation.

ting apparatus, and that to the right the receiving instrument. The rays from the sun, or from whatever source of light is employed, after being reflected by the plane mirror *M*, are concentrated upon the face of the reflecting diaphragm *D* by means of the lens *L*, and a small glass trough *C* containing a solution of alum is interposed in their path for the purpose of absorbing the heat rays which, by altering the figure of the diaphragm mirror and introducing other irregularities, might produce disturbing influences which are better eliminated. At L^2 is placed a second lens for the purpose of either parallelizing the rays and projecting them to the receiving apparatus, or of rendering them divergent according to the particular circumstances of the experiment. *R* is the paraboloidal reflector, in the focus of which and co-axial with it is placed the cylindrical photopile *P*, which is included in the circuit of a battery, *B*, and telephone, *T*. When words are spoken into the mouth-piece *O*, the diaphragm *D* is thrown into vibration, becoming thereby alternately more or less convex and concave with continually varying amplitudes of vibration, the effect of which is to confer upon the beam reflected from its surface a continually varying illuminating intensity and, as this undulatory beam is projected by the reflector, *R*, upon every portion of the sensitive surface of the cylindrical photopile, the latter is in the best possible position to produce by its varying electrical resistance the maximum effect in the telephone. — "*Engineering*."

Fig. 1913 is a diagram showing an apparatus by Prof. Bell, used in Paris in photophonic experiments, with electric light as the source of illumination.

Fig. 1913.

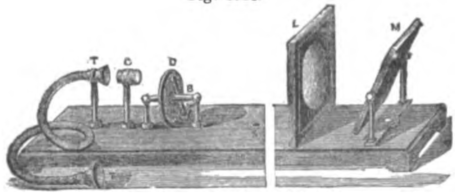


Photophone with Electric Light Illumination.

L is the electric lamp, the arc of which is in the focus of a paraboloidal silvered reflector, *R*, by which the divergent rays emanating from the arc are condensed and projected as a parallel beam to the reflecting diaphragm *T*, by which a certain small proportion of them is reflected to the receiving instrument through a distance of nearly 50′, as shown in the figure.

Fig. 1914 shows an apparatus devised by Messrs. Bell & Tainter in investigating the transmission of sounds from one

Fig. 1914.



Photophone without Electricity.

station to another without the aid of electrical arrangement, or of any thermopile. Almost all substances emit a sound when placed in the path of a beam of soniferous light, such for instance as is reflected from the vibrating diaphragm of the photophone in action, or as is produced by giving to the beam of light a rapidly intermittent character. In the instrument shown in Fig. 1914 rays of solar light are by the lens *L* condensed, after reflection from the surface of the mirror *M*, to a focus on the *D* disk, in which is perforated an annular series of some forty holes, and which can be set into very rapid rotation by arrangements not shown in the figure. By this means a beam of light projected by the lens *L* on to the tube *T* can be interrupted from a hundred to six hundred times in a second, which corresponds to the rapidity of vibration of a musical note of high pitch. When such an intermittent beam is allowed to fall upon diaphragms of different substances placed at the end of the tube *T*, they, with doubtful exceptions, are thrown into vibration, and the corresponding note is heard in the hearing-tube.

When the hearing tube *I* is removed, the apparatus shown in Fig. 1914 may be used as a transmitting instrument for the sending of photophonic signals on the Morse or any other prearranged system to a distant station. In this case, while the disk is in rapid rotation, a shutter operated by a key (shown in the figure) is made either to obstruct the light or to allow it to pass for longer and shorter periods of time corresponding to the dashes or dots in the Morse code. When the instrument is employed for this purpose a plano-convex lens is placed at *C* for parallelizing the beam of intermittent light.

MM. Bell & Tainter have also devised an apparatus for bringing about the variation of the intensity of a luminous beam, by the application of Faraday's discovery of the rotation of the plane of polarization of a beam of light in its passage through a magnetized field. Rays of light emanating from a source of light are parallelized by a lens and projected to a receiving photophone, passing successively through a polarizing Nicols' prism, a hollow coil of insulated wire and an analyzing Nicols' prism. — * "*Engineering*," xxx. 409.

Following in the same line of research is a new apparatus in which a beam of light from a lime light, or even a candle, is thrown upon a common glass flask having a long neck. To this is fastened a rubber speaking tube that may be placed to the ear, so that any sounds in the flask may be heard through the tube.

Between the flask and the light is placed a circular disk of metal, having narrow slots or openings, placed like the spokes of a wheel round the edge. When the disk is at rest, the beam of light may pass through one of the slots and fall on the flask.

If, now, the disk is made to turn rapidly on its axis, the light will reach the flask in a series of flashes, as it shines through the slots one after the other. Here the curious discovery comes in. When the flask is filled with a gas or a vapor, say the vapor of sulphuric ether, common street gas, oxygen, perfumes like patchouli or cassia, or even smoke, and the beam of light is made to fall on the flask in a series of alternate flashes, the operator, listening with the speaking tube at his ear, will hear strange musical sounds inside the flask.

The pitch of these tones will correspond exactly with the speed with which the disk is made to turn, and each kind of gas or vapor in the flask will give a different kind of note, some soft, some loud, and some very sweet and musical.

"This shows that light may be made the means of making sounds audible at a distance, even when the eye can see no difference in the light. It even suggests the idea that we may yet be able to hear the sounds of the fires raging in the sun. It may, indeed, be only a hint to yet more wonderful and unthought of relationships between light and sound, which may be utilized as a medium of communication."

Selenium, on. *Bell* . .	"*Engineering*," xxx. 240.
On the photophone . .	"*Engineering*," xxx. 253 . * 407.
Lecture and diagram .	* "*Engineering*," l. 285.
	* "*Manufact. & Builder*," xii. 255.
	"*American Manuf.*," Oct. 8, 1880, p. 9.
	* "*Scientific American*," xliii. 209.
	"*Eng. & Min. Jour.*," xxx. 222.

See discussion by Bell, Latimer-Clark, Tyndall, etc., "*Journal Soc. Telegraph Engineers*," * ix. 263, *et seq.*; 404, *et seq.*

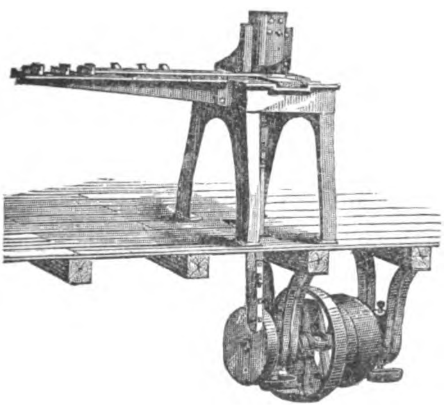
Pho′to-print′ing Pro′cess. Numerous inventions, processes, and modifications are given in the "*Mech. Dict.*," a list being appended on p. 1686. Notices of the following methods may be found in the references cited. There are so many systems, and they anastomose in so intricate a manner, that it is not easy within allowable limits to make even a digest.

In the following list the term printing is used somewhat generally, including relief process, gelatine, and metallic, bichromate or acid processes; also printing from negatives either to make clichés, positive pictures, or transfers.

Name.	Process.	Result.	
Abney, discussion of methods			"*Scientific American Sup.*," 3774.
Bachrach, paper by			"*Scientific American Sup.*," 2196.
Photo-engraving works			* "*Scientific Amer.*," xxxvii. 386.
Asser	photolithograph	print from stone	"*Scientific American Sup.*," 1514.
Bowen	wax-ground etching	relief plate	"*Scientific American*," xxxvi. 231.
Cros	photolitho	print from stone	"*Scientific American*," xxxvi. 23.
Gobert	bichro. albumen	cliché on glass	"*Scientific Amer.*," xxxviii. 117.
	bichro. albumen	cliché on glass	"*Scientific American Sup.*," 1891.

Name.	Process.	Result.	
Husnik	photoznico	relief plate	"*Scientific American*," xlii. 404.
	chr. gelatine	glass plate	"*Scientific American*," xxxiv. 386.
	chr. gelatine	glass plate	"*Scientific American*," xxxv. 153.
Jacobsen	gelatine	printing film	"*Scientific American*," xlii. 18.
"*Journal Photography*"	chr. albumen	mezzotint plate	"*Scientific American Sup.*," 1177.
Lenoir	albumen	printing film	"*Scientific American*," xliii. 360.
Michaud	chr. gelatine	metal plate	"*Iron Age*," xxii., Aug. 1, p. 9.
Rodreriguez	collodion	silver print	"*Scientific American Sup.*," 1958.
	etching on gelatine and carb. lead	glass negative	"*Scientific American Sup.*," 2194.
	dissolved gelatine	relief block	"*Scientific Amer.*," xxxviii. 26.
	swelled gelatine	relief block	"*Scientific Amer.*," xxxviii. 26.
Vidal	carbon process	film on artificial stone	"*Scientific American*," xli. 104.
Volkmer	photolithograph	. . . .	"*Scientific American Sup.*," 3929.
Waterhouse	gelatine	copper plate	"*Scientific American Sup.*," 2276.
	asphaltum	relief	"*Scientific American Sup.*," 2507.
Albert	chr. gelatine cliché	print	"*Mech. Dict.*," 57.
Aubel	fluoric acid on glass	glass plate	"*Scientific American Sup.*," 1310.
Baldus	asphaltum	copper plate	"*Sc. American Sup.*," 1310, 2509.
Bolas	chr. gelatine	relief block	"*Scientific American Sup.*," 2663.
	photolitho:	stone	"*Scientific American Sup.*," 2276.
	photozinco	relief	"*Scientific American Sup.*," 2276.
	chr. gelatine	cliché	"*Scientific American Sup.*," 2326.
Brand	glass negative	ink print	"*Scientific American*," xxxix. 101.
Despaquis	chr. gelatine cliché	print	"*Scientific American Sup.*," 1481.
			"*Scientific Amer.*," xxxvii. 74.
Fox-Talbot	bichr. chr. gelatine	print	"*Mech. Dict.*," 1686.
Lichtdruck	bichr.	print	"*Scientific American Sup.*," 1310.
Negre	asphaltum	printing plate	"*Sc. American Sup.*," 1319, 2507.
Niépce	asphaltum	printing plate	"*Scientific American Sup.*," 1310.
Niépce de St Victor	asphaltum	printing plate	"*Mech. Dict.*," 1686.
Poitevin	chr. gelatine	transfer to stone	"*Mech. Dict.*," 1687.
			"*Scientific American*," xli. 395.
Poitevin	chr. gelatine	copper plate	"*Scientific American Sup.*," 1810.
Pretsch	chr. gelatine	copper plate	"*Scientific American Sup.*," 1810.
Scamoni	photo. print	copper plate	"*Sc. Amer. Sup.*," 1310, 1994.
Schahl	chr. gelatine cliché	print	"*Scientific American*," xli. 261.
Warnecke	carb. gelatine	metal plate	"*Scientific American Sup.*," 8775.
Woodbury	chr. gelatine	metal plate	"*Scientific American Sup.*," 1810.
	silver print	print on wooden block	"*Scientific American*," xxxiv. 361.
Woolwich	photolitho:	. . . .	"*Scientific American Sup.*,"4092.

Fig. 1915.



Picket-heading Machine.

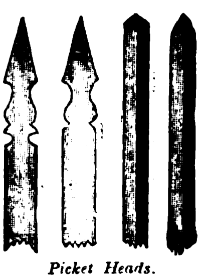
Phy-mo'sis For'ceps. See PHIMOSIS INSTRUMENT.

Phys'i-cal Ap'pa-ra'tus. See EXERCISING MACHINE; HEALTH LIFT; and references *passim.*

Hopkins' simple physical apparatus, * "*Sc. Am.*," xl. 35.

Pick'et Ma-chine'. A machine for making fence pickets.

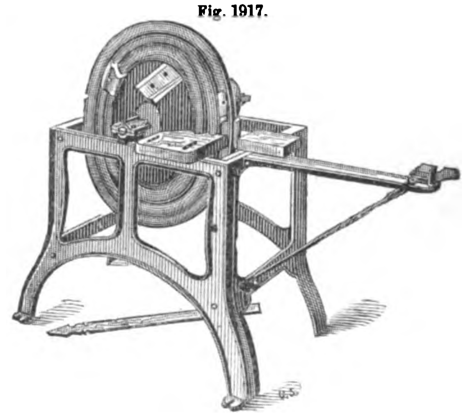
Fig. 1916.



Picket Heads.

Fig. 1915 is *Snyder's* picket-heading machine. Its action is a planing motion, the cutter being drawn down by the pitman, operated by a shaft beneath the floor. It cuts heads such as those shown in Fig. 1916. On the arm is a series of checks which are thrown back in a moment to change the length of picket or paling from 5′ to 2.5′ or any intermediate length.

Fig. 1917.



Picket-heading Machine.

Fig. 1917 is another style of picket header, the cutters being on a revolving wheel.

Fig. 1916 shows four styles of picket heads.

Pick'et Pin. A pin to which an animal is tied by a lariat.

Fig. 1918.

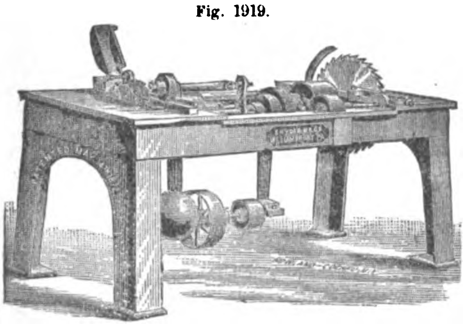
Picket Pin.

Fig. 1918 shows one with swivel link on a sleeve; to prevent kinking, and allow the animal to graze around the pin without winding up the lariat.

Pick'et-saw'ing Ma-chine'. One for sawing pickets or palings from the bolt.

Zierden's iron-frame gang, lath, and picket sawing machine is shown in Fig. 1919. The illustration shows the cowl or iron cover thrown back. This, when in use, covers and protects the gang of saws, and prevents sawdust being scattered over the mill.

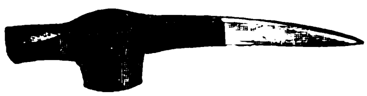
Fig. 1919.



Picket-sawing Machine.

Pick Ham'mer. A miner's tool, which has hammer and pick at the respective ends.

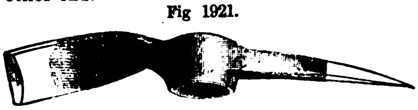
Fig. 1920.



Pick Hammer.

Pick Mat'tock. One with a blade at one end transverse to the line of the handle, and a point at the other end.

Fig 1921.



Pick Mattock.

Differs from an *axe mattock*, a simple *mattock*, a *pick*, or a *pick hammer*.

Pic'no-hy-drom'e-ter. A combination of the picnometer and hydrometer. — *Wiegand.*

Described in * "*Scientific American,*" xxxiv. 340.

Pic'nom'e-ter. A specific gravity glass.

Pic'ture Lens. (*Optics.*) A large, double convex lens of very long focus, and mounted in a hand-frame; for examining pictures or paintings when hung upon a wall. See also CLAUDE LORRAINE.

Pier. The subject is considered under various heads in the "*Mech. Dict.*" AIR LOCK, Plate II., p. 49; PIER, p. 1699, etc. See list under HYDRAULIC ENGINEERING, pp. 1129–1148, *Ibid.*

See: Promenade, Aldborough, Br. . . .	* "*Engineer,*" xlvi. 182.
Ore shipping, Bilboa, Spain	* "*Engineer,*" xlviii. 409.
Coney Island	"*Scientific American,*" xl. 344.
Staging, E. River Bridge	* "*Engineering,*" xxv. 129, 171.
Tidal, Edgerton, Engl. .	* "*Scientific American Sup.,*" 898.
Hudson bridge, Poughkeepsie	* "*Trans. Am. Soc. Civ. Eng.,* vii 336.
Ore shipping, Huelva, Spain	* "*Engineer,*" xli. 360, 363, 374.
Iron, *Lewes*, Delaware Col. Kurtz	* "*Scientific Am. Sup.,*" 1142, 1155.
Iron, Long Branch . .	"*Scientific American,*" xl. 161.
Omaha iron piers . . .	* "*Trans. Am. So. Civ. Eng.,*" vii 338.
Rio Tinto Ry., Spain .	"*Scientific Am. Sup.,*" 1971, 2018.
Promenade iron pier. *Skegness*, Br. . . .	* "*Engineer,*" xlix. 44, 62.
Withernsea, Br. . . .	* "*Engineer,*" xlv 62.

The report by Major Turnbull on the construction of the piers of the Alexandria canal aqueduct across the Potomac, at Georgetown, D. C. (1838–1841), was reprinted for Engineer Department, U. S. A., 1873. 4to.

Pier'cing. The act of *sawing* a pattern or object out of a plate, in contra-distinction to *punching*. Jig and band saws are used for the purpose.

Pie'som'e-ter. See PIEZOMETER; PRESSURE GAGE; and references *passim.*

Pi'e-zom'e-ter. 1. (*Surgical.*) An instrument to measure the sense of pressure. It consists of a spring in a German silver graduated tube. The spring is pressed by a rod, on the end of which is a hard rubber disk $\frac{1}{3}''$ in diameter.

The sense of pressure is strongest on the forehead, tongue, and cheek; next in order come the fingers, back of hand, forearm, and arm; then the anterior portion of the thigh and leg, back of foot, and toes. The least sensitive portions are the back of thigh and leg.

Beard's Fig. 284, Part I., *Tiemann's* '*Armam. Chirurg.*" See also ÆSTHESIOMETER.

2. An instrument to ascertain the pressure set up in the bore of a gun when a charge of powder is fired.

"*Engineer,*" * Sept. 16, 1870; vol. xlvii., 83, 134, 170.
See "*Ordnance Report,*" 1879, Appendix M., pp. 228-256, and Plates I.-XI.
See also CUTTER; CRUSHER GAGE, *supra*; * PRESSURE GAGE *infra*.

The piezometer of M. Sebert consists of a metallic rod of square section fixed in the axis of a hollow projectile, and which serves as a guide to a movable mass. The latter carries a small tuning fork the prongs of which terminate in two small metallic pens which leave undulating traces of their passage on one of the faces of the rod, which has been coated with lamp black. It is designed to determine the laws of motion of a projectile in the bore of a cannon in order to deduce therefrom the law of the pressures developed by the combustion of the charge.

"*Scientific American*" . . . . xl. 1811.
* "*Scientific American Sup.*" . . . . 4042.

3. The same principle is adopted in obtaining measurements of depth in sounding. In *Thomson's* navigational sounding apparatus, shown and described on pp. 351, 352, *supra*, the observed condensation of air in a tube attached to the sinker and registering itself by the contact of sea water with a preparation lining the tube, is made the measure of depth.

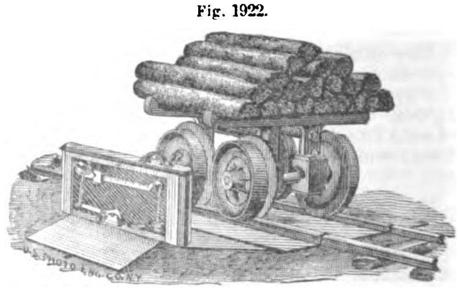
Buchanan . . . . "*Van Nostrand's Mag.,*" xviii. 61.

Pig and Ore Pro'cess. (*Metallurgy.*) A process of Dr. C. W. Siemens.

It consists in melting down a charge of pig-iron together with enough iron ore to make good the loss of pig-iron by oxidation. The ore facilitates the decarburization of the pig-iron. The pig and ore process is coming largely into use, and is in Great Britain, where it is well done on a large scale, a successful rival of the Bessemer process. — *Holley.*

Pig Met'al Scales. An iron truck to run on to a section of railway upon scale platform.

Fig. 1922.



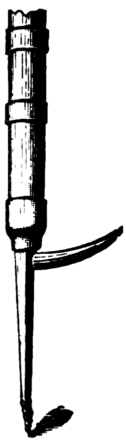
Pig Metal Scales.

The car is intended to hold a furnace charge. The beam is concealed, but has an indicator which passes through the top of the beam box.

Pike Pole. A tool used by lumbermen in driving logs in rivers. See Fig. 1923.

Pile Dam. A dam made by driving piles and filling in with stones. It usually has planking to protect the surfaces.

Fig. 1923.



Pike Pole.

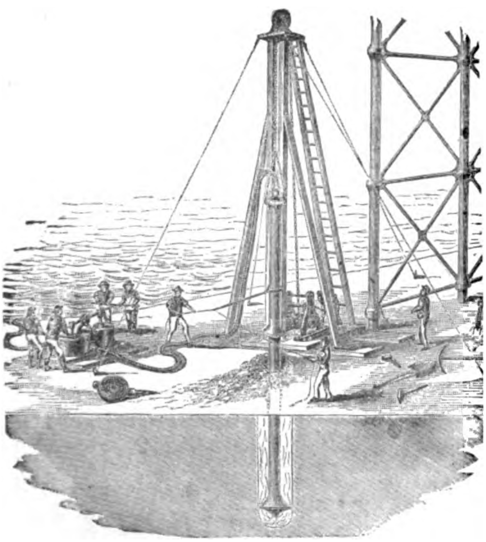
See Pile dam on the Little Kaukanna, Fox River improvements: "*Report of Chief of Engineers U. S. Army*," 1876, vol. ii., part 2, Plate II., p. 416.

Pile Dri'ver. The pile driver as a ramming engine to force piles into the ground is shown in Figs. 3717, 3718, pp. 1702, 1703, "*Mech. Dict.*" See also PILE-DRIVING ENGINE, *infra;* PNEUMATIC PILE, "*Mech. Dict.*," *et infra*, and references *passim*.

The method of driving piles by aid of hydraulic jet has been very successful in sands and soils which are free of logs and bowlders. The operation is shown in Fig. 1924. It is a device of British engineers, used at Morecombe Bay in India, in building a railway bridge crossing some treacherous sands and also used in the construction of Southport pier, England. The pile is in hollow iron sections and has a bulbous shoe.

"The columns, 9″ in diameter and of ¾″ metal, terminate in an extended base 18″ in diameter, with a contracted opening of 2½″. This disk is provided with toothed edges, and serrated flanges to scratch away any impediments, and cut through the layers of indurated mud and silt which here and there interpose and interrupt its progress. The column is clasped by moving guides on the face of an ordinary piling engine frame, and down the inside

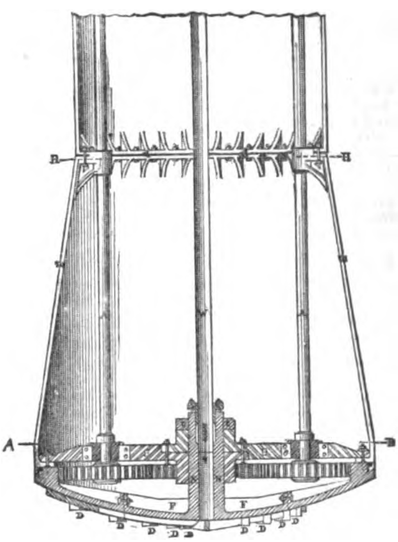
Fig. 1924.



Dickson's Hydraulic Pile Driving

is run an iron tube 2¼″ in diameter, protruding a few inches beyond the base. The upper end of this tube being brought round, is attached by screw couplings to a flexible hose, in connection with a steam pump. The whole being duly placed in position, a couple of men are told off to keep the column in reciprocating motion by means of a lever clasped round it, and all being ready the pumps are set to work. The issuing jet of water blows up the sand, which is thus kept continually agitated, and down goes the pile in the hole thus formed, steadily lowered by the men at the winch, the ascending stream keeping the sand above alive, and preventing it setting; but so soon as the requisite depth is attained, the pumps are stopped, and the tube rapidly withdrawn, and the whole in the course of a few minutes is firmly fixed. These columns, in the case cited at Southport, are all put down a depth of 15′ to 20′, the average time occupied in the actual process of sinking being but 20 to 30 minutes. Two or three were fixed in a tide, the bulk of the time being necessarily occupied in moving about the

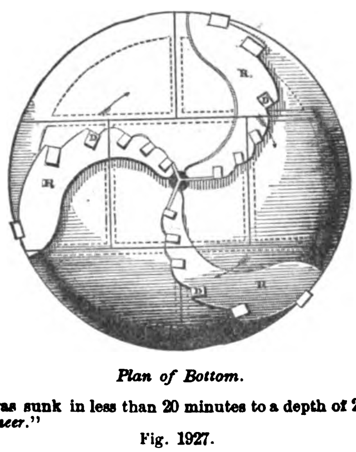
Fig. 1925.



Section through Axis of Pile.

apparatus and machinery. Some of the piles were sunk from a raft, the process answering equally as well under water as ashore. An experimental column with a reduced

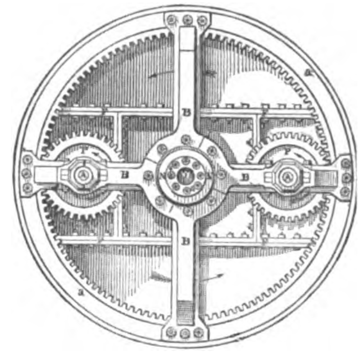
Fig. 1926



Plan of Bottom.

disk, was sunk in less than 20 minutes to a depth of 26′." — "*Engineer.*"

Fig. 1927.



Section through A-B.
(Showing Plan of Bridge-piece and Arrangement of Gearing.)

Figs. 1925–1927 show excavating shoes to be added to the end of the ordinary tubular pile when the soil is of such a nature as not to yield to the mere impact of water.

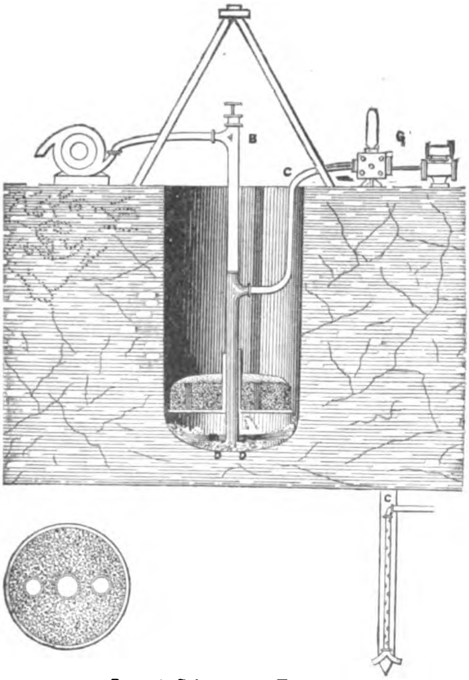
The cylinder itself is not rotated but is held upright over the spot it is to occupy and sinks as the earth is excavated beneath it. The sole of the pile is shown in section in Fig. 1925 and in plan in Fig. 1926, steel cutters *D* being placed on curved blades *R*, and driven by means of gears *P* on shafts *A* supported in sockets *R* and bridge *B*. The gears *P* mesh into an internal cog-wheel *A* which is a part of the sole *F*.

The shoe being rotated comminutes the soil which is driven away by a copious jet of water conducted down the interior of the cylinder. The required depth being reached, an air chamber is attached to the top of the pile and air forced in to empty the pile while the machinery of the bottom portion is all removed. The pile is then filled with concrete.

Pile Dri'ving. The methods of sinking piles and caissons by pneumatic methods or by combined pneumatic and other methods have been considered under * PNEUMATIC PILE, p. 1754; * CAISSON, p. 421; * AIR LOCK, p. 49; * SUBMARINE EXCAVATOR, p. 2439, "*Mech. Dict.*" See also PILE, *supra.*

Figs. 1928–1930 show views of the subaqueous excavator of Pontez, used for driving piles or making solid foundations in quicksands or unstable soils.

Fig. 1928.



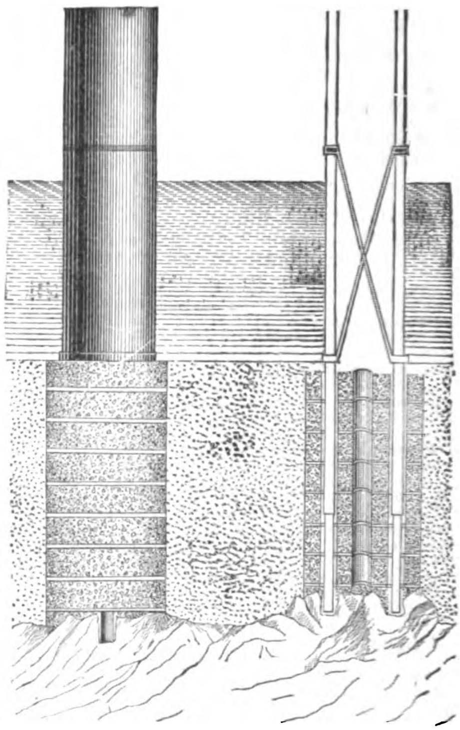
Pontez' Sub-aqueous Excavator.

Fig. 1928 is a vertical section showing the excavating cylinder in position, also the working apparatus. Beneath the view of the apparatus in situ are two detached figures: one a plan of the disk showing the central hole for the tubes, and other holes for piles which are to be driven through. On the right is a sectional elevation of the excavating cylinder, showing internal perforated tube *C*, and hydraulic jets *D D*.

The excavating cylinder *B* is formed of sheet iron, connected at its upper extremity with a powerful suction pump or air-tight receiver. The lower section of the excavator is connected with another pnmp, a force pump, by the hose *C* which passing through the side of the excavating cylinder, then feeds a pipe perforated with a number of small holes. This pipe, leading down near the open end of the cylinder *B* bifurcates and then projects outside the cylinder at opposite sides, forming two external hydraulic excavating jets *D D*.

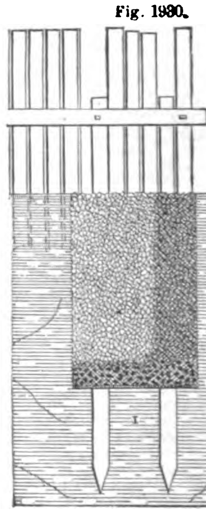
The operation for sinking a disk is as follows: The excavating cylinder is passed through the central aperture, and rests on the mud beneath; the connections are then made respectively with the force-pump and suction-pump or vacuum chamber. The first effect of the action of the suction-pump is to force the nozzle of the excavator, by atmospheric pressure, into the mud for some depth, thereby excluding the outer water. A column of permeable sand or mud now fills the cylinder; under the power of the suction it packs tightly, and the operation would cease, but simultaneously the force-pump *G* sends into the column of mud numerous small jets of water; the moment it becomes permeable it passes on in a continuous flow and is delivered by the pump, holding the maximum of solid matter with the minimum of water, or air if forced in instead of water. The diverging hydraulic or air jets acting over and beyond the area covered by the disk, excavate beneath and undermine it, the material passing into the excavator, the disk subsides. Bowlders or large stones encountered would be washed into the center of the excavation, where they could be broken through the aperture.

Fig. 1929.



Elevation and Section of Pile Foundation.

Fig. 1930.



Sheet Piling.

Fig. 1929 shows two forms of piles sunken by these means. One has a series of disks with intervening concrete or rip-rap. The sectional view shows the disks with central tube, and the side piles in position.

Fig. 1930 shows the plan as adapted to sheet piling.

Cf. Pile, *Le Grand & Sutcliff* . . . . "*Engineer*," xlvii. 183.
Pile-driver . . . . . * "*Engineering*," xxiii. 433.

Pile-driver	"*Scientific Amer.*," xxxviii. 388.
	* "*Scientific American*," xli. 147.
Machinery, *Dresden* . .	* "*Engineer*," xlii. 372.
Gunpowder, *Shaw* . .	* "*Engineering*," xxi. 408.
Machine, *Mundy* . . .	* "*Scientific Amer.*," xxxvi. 338.
Engine, *Mundy* . . .	* "*Manufact. & Builder*," ix. 129.
Powder	"*Van Nostrand's Mag.*," 2210.
Steam, *Lewicki* . . .	"*Van Nostrand's Mag.*," 2210.
Water jet, Calais . . .	* "*Scientific American Sup.*," 2050.
Water jet in 1863 . . .	"*Scientific Amer.*," xxxviii. 340.
Friction drum hoist . .	* Fig. 1099, p. 357, *supra*.
Pneumatic process, *Glenn*	"*Sc. Amer. Sup.*," 2238, * 3769.
In sand, water jet, *Pontez*	"*Scientific American*," xxxix. 20.
Explosive, *Vogler* . . .	U. S. Patent, No. 137,514.
Tubular, *Le Grand & Sutcliff*	* "*Engineering*," xxvii. 223.

Janvier, * *Laboulaye's* "*Dict.*," iv., ed. 1877, art. "*Pilotis.*" * *Bower*. * *Nasmyth*.

Austrian steam pile drivers, * "*Vienna Exposition Reports*," iii., Sec. II., p. 56, and Plate XVII.

Sabot de Pilotis, *Defontaine* . .	"*Technologiste*," xli. 793.
Driving by hyd. pressure, *Wieck* .	"*Technologiste*," xli. 206.
Driving by dynamite	"*Technologiste*," xl. 64.

Pile-dri'ving En'gine. An engine specially adapted for the working of the pile driving by monkey, and the lifting of piles into position for driving.

The lifting gear is single purchase, and is usually proportioned for working with a monkey not exceeding one ton in weight. The barrel is loose on the shaft, and is made fast to it by a powerful conical friction clutch, which is thrown in and out of contact with the barrel by the hand-lever; this lever is also connected by a rod to the throttle-valve, which automatically regulates the supply of steam.

The capstan-end is used for pitching piles or for hauling; the strap-brake is worked by the foot-lever, and is used for holding the load, or for preventing the chain from overhauling too much.

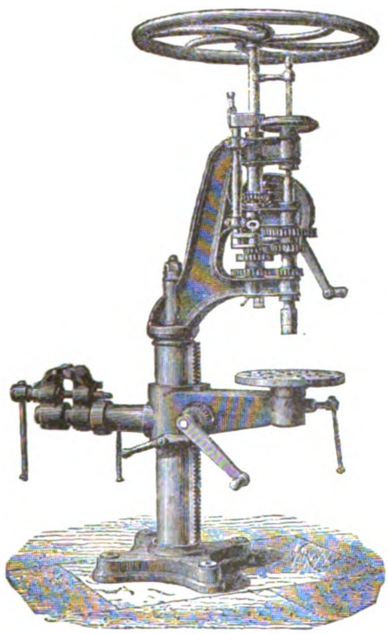
See Friction Drum Hoist, Fig. 1099, p. 357, *supra*. Also Figs. 454 and 1359.

Pile In'stru-ments. (*Surgical.*) See "Hemorrhoidal Instruments."

Pile Tel'e-phone. A telephone having a voltaic pile in the circuit.

In *Edison's* a piece of cork is fastened to the diaphragm and presses upon a strip of platinum, which is attached to a plate of copper; the latter is one of the terminals of an ordinary galvanic pile.

Fig. 1931.



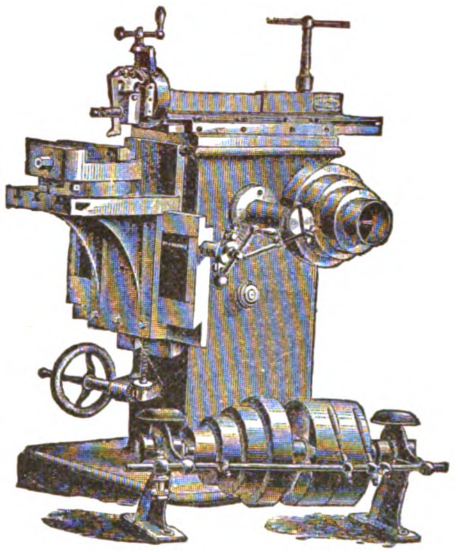
Treble-geared Pillar Drilling Machine.

* "*Scientific American Supplement*" . .	2591-2594.
* "*Engineer*"	xlvi. p. 425.

Pil'lar Dril'ling Ma-chine'. A machine tool which stands erect upon a pillar support on which the bench or platform is adjustable vertically by rack and pinion. The machine shown has treble speeds by means of sets of gearing.

Pil'lar Sha'per. A compact form of planing machine for metal.

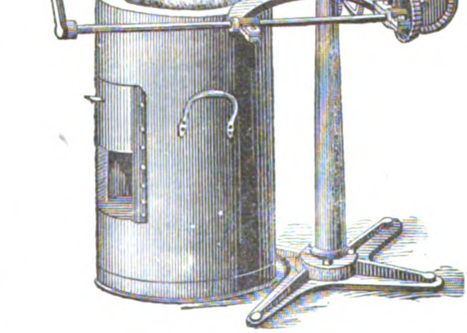
Fig. 1932.



Pillar Shaper.

The 10″ machine, for instance, stands on a hollow column, the base of which measures 36″ by 27″. The stroke may be graduated to any point within its extreme limit, the cutter-slide has a quick return, and the cross-feed is automatic and

Fig. 1933.



Pill Coater.

adjustable. The planer-vise has a slide base and operating screw; length of stroke, 10″, traverse of bed, 16″; distance between table-top and bottom of slide, 11½″.

Pratt & Whitney . . . . . . * "*Engineer*," xlii. 24.

Pill Coat′er. A machine like a comfit-making machine, in which pills are coated with sugar.

A regular rotary motion is given to the pan, which tumbles the pills over each other, exposing them to the saccharine matter which adheres to them, while the constant motion prevents mutual adherence. See Fig. 1933.

Pill coating, *Bull* . . . "*Sc. Amer. Sup.*," 2065.
Pill printing, *Vial* . . . * "*Sc. Amer.*," xliii. 194.
Confection pan . . . . * Fig. 1428, p. 611, "*Mech. Dict.*"
Brown . . . . . . "*Engineer*," xli. 226.

Pin. (*Surgical.*) Pins are used in securing parts, sutures, and what not. The primary idea is that a pin remains *in situ*, a while at least, while a needle makes a temporary puncture or carries a thread. Some varieties of the *acus* are, however, less transitory.

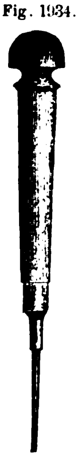
Harelip pin, with removable point, and plastic pin with conductor, p. 60, Part II., "*Tiemann's* "*Armam. Chirurg.*"
Hemorrhoidal, Fig. 599, Part III., *Ibid.*

(Toilet):
Pin industry, history of . "*Iron Age*," xxiv., Dec. 4, p. 11.
French series of operations "*Epingle*," *Laboulaye's* "*Dict.*" ii.
Pin machine . . . . . "*Iron Age*," xvii., May 18, p. 20.
Pin machinery . . . . "*Sc. Amer.*," xli. 261.

Pin′-ball Sight. (*Rifle.*) Another name for the *bead-sight;* also called pin-head sight. Left-hand illustration, Fig. 249, p. 84, *supra*.

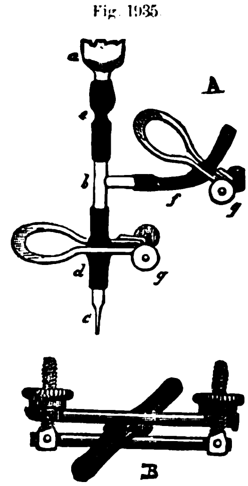
Pin Bush. A reaming or polishing tool for pin holes.

Fig. 1934.



Pin Bush.

Fig. 1935.



Pinchcocks.

A. Mohr's Pinchcock.
B. Bunsen's Pinchcock.

Pinch′cock. A clamp on a flexible pipe to regulate the flow of fluid or liquid, so as to keep up a constant action at a fixed rate.

Pinch′er. (*Glass.*) A nipping tool fitting the inside and outside of a bottle, in order to shape the mouth.

(*Metal.*) Compound lever * "*Iron Age*," xxiv., Sept. 18, p. 7.
Cutting, *Hall* . * "*Scientific Amer.*," xxxix. 388.

Pin′ion Jack. (*Milling.*) A jack for raising the stone pinion out of gear. This attachment works from below.

Another and simpler device for raising the pinion from above has a shaft worked by a hand wheel with ratchet stop, and having short chains and hooks, which are caught under the arms of the pinion, and raised by the turning of the shaft.

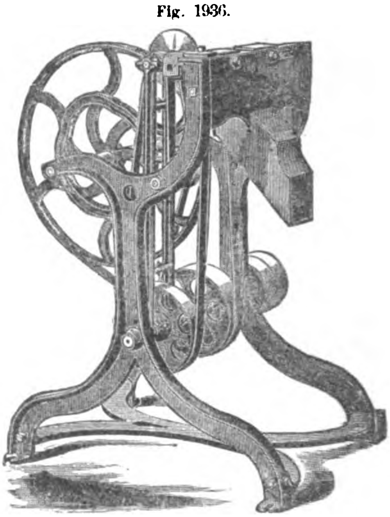
Pink′ie. A fishing vessel with a high, narrow-pointed stern. Used in the cod and coast fisheries.

Pin Ma-chine′. 1. Toilet pin. See p. 1705, "*Mech. Dict.*"

2. A machine for making wooden pins, for securing mortise and tenon joints, for dowels, etc. It is especially used in making the pins used in sash, blind, and door factories.

The square stuff is fed into the machine, rounded by passing through a hollow mandrel, and pointed by a rotary

Fig. 1936.



Wooden Pin Machine.

pointing cutter. The machine will cut off the pins at any desired length, and leave them round or square. Cuts and points 80 to 130 pins per minute; length, ½″ to 4″; diameter, ¼″ to 5-16″.

Pin Stick′ing Ma-chine′. A machine for sticking pins in paper.

The pins in bulk pass from a hopper into an inclined, slotted chute, down which they move, supported by their heads. At the bottom of the chute the pins are received singly between the projecting threads of a screw shaft, and are moved horizontally over a warped guiding and supporting surface shaped to gradually change the pins moved over it from a vertical to a horizontal position. Each pin, after it is placed in a horizontal position, is released from the control of the screw or feeding shaft, and is delivered under a spring presser or holder, and then a reciprocating driver strikes the head of, and projects the pin horizontally forward and through parallel, projecting, longitudinal ribs formed on a long strip of paper led from a suitable reel. The paper is ribbed or crimped longitudinally for the reception of the pins by the action of a foot and a wheel, between which the paper passes. The strip, with pins inserted, is then cut into proper lengths and wound on a mandrel to form rolls, which are then pressed between a concave and convex matrix into pyramidal form.

Pin Switch. (*Telegraphy.*) A simple and efficient method of connecting wires and loops with instruments, or changing from one line to another. The connections are made with pins or plugs, which give a rubbing or frictional contact when thrust into the holes on the board. See LOCK SWITCH.

Pi′o-scope. A milk test by Prof. Heeren.

It consists of a disk of black vulcanized caoutchouc, having in its middle a flat circular depression. A few drops of the milk in question, well mixed, are placed in the hollow and covered with the second part of the apparatus — a plate of glass painted with six shades of color radiating out from a

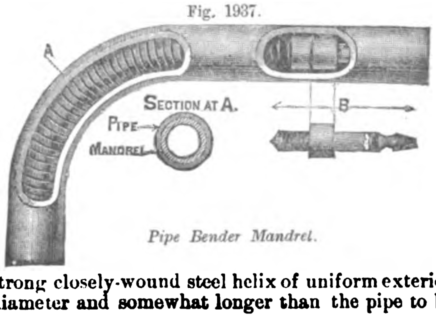
small, uncovered, circular spot in the middle. The colors range from white gray to deep bluish gray. The layer of milk is seen through the uncolored spot in the center, and its color can thus be compared with the radiating colors, and its quality judged according to the color with which it coincides. The whiter the color the more creamy the milk. See LACTOSCOPE **and references** *passim*.

Pipes, Valves, and Plumb'ing. Apparatus included under the following heads : —

Adapter.
Angle check-valve.
Angle cock.
Angle pressure valve.
Angle valve.
Back-pressure valve.
Ball-and-socket pipe.
Basin cock.
Basin grate.
Basin plug.
Basin stopper.
Basin trap.
Basin waste.
Basin wrench.
Bath.
Bath-boiler union.
Bath cock.
Bath tub.
Bath-tub strainer.
Bell.
Bend.
Bevel hub.
Bibb.
Bidet.
Bidet pan.
Blank flange.
Blow-off cock.
Blow-off hose cock.
Blow-through cock.
Bottle capsule.
Bottle carrier.
Bottle holder.
Bottle jack.
Bottle stopper.
Bottle washer.
Bottling machine.
Box valve.
Bracket cock.
Branch.
Bulk-head union.
Bung.
Bushing.
Can.
Cap.
Carboy.
Centrifugal filter.
Cesspool trap.
Champagne apparatus.
Check valve.
Chipping knife.
Clear-way hydrant.
Closet cistern.
Coil. See varieties under HEATING AND LIGHTING APPARATUS.
Combination basin cock.
Commode.
Compression cock.
Cone joint.
Conical valve.
Corking machine.
Cork wiring.
Corner valve.
Corporation stop.
Counter cock.
Cross.
Cross valve.
Curve.
Decanting apparatus.
Diaphragm valve.
Differential screw pipe-joint.
Double-bell pipe.
Double-connecting section.
Double-face valve.
Double fire-cock.
Double-hub bend.
Double valve.
Double-Y branch.
Drain cock.
Drain grate.
Drain pipe.
Draw-off cock.
Dresser.
Drop elbow.
Drop tee.
Dudgeon expander.
Earth closet.
Elbow.
Ell.
Equilibrium valve.
Exhaust nozzle.
Expansion joint.
Faucet.
Ferrule.
Filter.
Filtering apparatus.
Flange.
Flange coupling.
Flange pipe.
Flexible valve.
Floating board.
Float valve.
Flush box.
Flushing box.
Flush joint.
Foot valve.
Forty-five ° elbow.
Four-way cock.
Frost valve.
Fullway valve.
Gage cock.
Gas bath.
Gas drip box.
Gas pipe.
Gas soldering apparatus.
Gas trap.
Gas valve.
Gate valve.
Gland cock.
Globe valve.
Gooseneck.
Ground cock.
Gulley trap.
Half hose-coupling.
Half-S hopper trap.
Half-S trap.
Half trap.
Hand hole trap.
Hawser pipe.
H-branch.
Hopper.
Hopper closet.
Hopper cock.
Horizontal check-valve.
Hose.
Hose cart.
Hose clamp.
Hose coupling.
Hose nipple.
Hose pipe.
Hose screw.
Hose sprinkler.
Hose union.
Hose union cap.
Hose wrench.
Hub.
Hydrant.
Hydrant cock.
Hydrant nozzle.
Hydrant suction.
Hydrant valve.
Hydrostatic joint.
Injection check valve.
Inserted joint.
L.
Lateral branch.
Latrine.
Leaden pipe.
Lever and cam valve.
Lever faucet.
Lever-handle cock.
Liquor cock.
Lock faucet.
Main.
Molasses gate.
Mushroom strainer.
Nipple.
Nozzle.
Offset.
Offset pipe.
Oil pipe.
Oil pipe line.
Open return bend.
Pantry cock.
Pavement pipe.
Pet cock.
Pipe.
Pipe connection.
Pipe coupling.
Pipe covering.
Pipe fittings.
Pipe joint.
Pipe-laying apparatus.
Pipe line.
Pipe reducer.
Pipe stop.
Pipe union.
Pitcher nose.
Plug.
Plug basin.
Plug cock.
Plug valve.
P-trap.
Quarter bend.
Quarter-turn gooseneck.
Racking faucet.
Rain and well water stop.
Reducer.
Reducing coupling.
Reducing tee.
Reflux valve.
Regulating valve.
Retaining valve.
Return bend.
Return valve.
Ring valve.
Rose.
Round way cock.
Running trap.
Screw-down stop cock.
Screw valve.
Seal.
Self-closing faucet.
Service cock.
Sewer-gas check.
Sewer-gas trap.
Sewer-trap.
S-hopper trap.
Shower bath.
Sink.
Sink pipe.
Sink plug.
Siphon.
Siphon bottle.
Siphon-cleaning box.
Siphon filler.
Siphon pipe.
Siphon trap.
Slab.
Slant.
Sleeve.
Slide valve.
Sluice.
Sluice valve.
Socket.
Socket pipe.
Soda-water apparatus.
Soda-water fountain.
Soda-water fountain cock.
Soda-water machinery.
Soil branch.
Soil pipe.
Soldering nipple.
Stand pipe.
Stand post.
Starting valve.
Steam trap.
Steam valve.
Stench trap.
Stop valve.
Straightway valve.
Strainer.
Strainer foot valve.
S-trap.
Street washer.
Street washer screw.
Stuffing cock.
Suction basket.
Suction butt.
Swinging coupling.
Swinging valve.
Swing joint.
T.
Tail pipe.
Tank check valve.
Tank regulator.
Tank screw.
Tank valve.
Tap.
Taper screw joint.
Tap-hole protector.
Tasting cock.
T-branch.
Tee.
Telegraph cock.
Telegraph faucet.
T-handle.
Thimble.
Three-quarter-S trap.
Three-way cock.
Throttle damper.
Tide flap.
Tip-up basin.
Trap.
Trap mold.
Tube.
Tube valve.
Twin safety valve.
Union.
Vacuum valve.
Valve gearing.
Vertical check-valve.
Wash basin.
Wash-basin valve.
Wash stand.
Wash-tub waste.
Waste.
Waste preventer.
Waste stop-cock.
Waste way.
Water-back coupling.
Water closet.
Water gate.
Water main.
Water pipe.
Water shoes.
Water valve.
Wedge valve.
Weighted gage-cock.
Wiped joint.
Wiring stand.
Y.
Y-branch.
Y-cross.
Yoke.

Pipe Bend'er, 1. A mandrel consisting of a

Fig. 1937.



Pipe Bender Mandrel.

strong closely-wound steel helix of uniform exterior diameter and somewhat longer than the pipe to be bent. This is thrust into the pipe and keeps it from becoming distorted. See FLEXIBLE MANDREL, Fig. 1058, p. 347, *supra*.

2. Miller's machine for bending stove-pipe elbows consists of sets of clamps in pairs which seize the pipe, and, turning on horizontal axes, force it to bend at each operation through a small angle. The pipe is then released and a new hold taken at a point a little farther along, and the operation repeated until the pipe has been given the required bend.

Pipe Coup'ling. A joint or piece to connect two pipes or a pipe with another object.

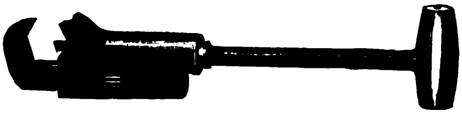
See:		
	Bell.	Hub.
	Bend.	Offset.
	Branch.	Reducer.
	Cross.	Sleeve.
	Elbow.	Tee.
	Expansion joint.	Y.

Pipe Cut'ter. 1. A machine for cutting pipe into lengths or trueing the ends. Associated with a threader in Fig. 1744, p. 1712, *"Mech. Dict."*

2. A tool for cutting off pipes. Four forms are shown in Figs. 3735–3738, p. 1711, *"Mech. Dict."*

Fig. 1938 is a form in which the body of the tool is threaded internally for the reception of the threaded end of the stem of the handle, and has at the rear a chamber for the reception and guidance of the stem of the movable jaw. This stem has a screw thread cut upon it so that it can be moved

Fig. 1938.



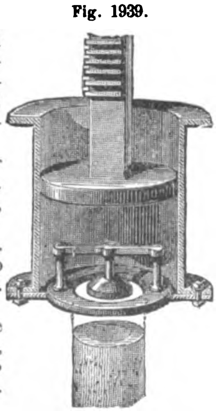
"Acme" Pipe Cutter.

in or out by means of a knurled nut. The pipe is cut by a chisel on the end of the handle stem which is fed into the pipe by means of the thread on the stem, while the tool is revolved around the pipe.

Pipe Die. 1. (*Ceramics.*) Pipes of stone-ware are made in a press, in the usual manner of pressing the plastic clay out of an annular hole made by suspending a cone in the circular exit. They are finished with a lead glaze and second firing.

2. The threaded nut for chasing a screw on a pipe. See Figs. 812–815, p. 256, *supra*.

Fig. 1939.



Clay-pipe Die.

Pipe Fit'ter's Vise. See PIPE VISE, *infra*, also Fig. 3752, p. 1713, *"Mech. Dict."*

Pipe Fit'tings. See list under PIPE TOOLS, etc., *infra*. Also GAS PIPES AND CONNECTIONS, Fig. 1174, p. 390, *supra*.

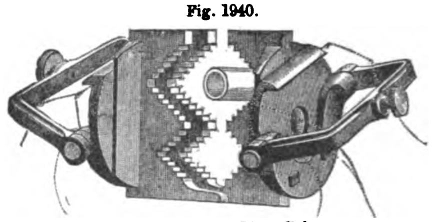
Pipe Grip. Toothed or stepped jaws, to be placed in a vise, to hold round objects, such as pipes and rods.

In Fig. 1940 the device adjusts itself to any size, one jaw slipping between the two apposed ones. A capacity for rotation in a vertical plane enables the jaw to grasp the pipe at any vertical angle. The dotted lines indicate the jaws of the vise. See also PIPE VISE, p. 1713, *"Mech. Dict."*

Pipe Kiln. The form of kiln used in France for baking clay pipes is shown in Fig. 1941.

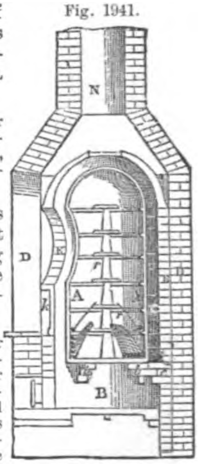
B is the furnace, *A* the chamber with pipe trays *r* of refractory material on a central stem. *N* is the chimney; *D* the walls; *E* the aperture for charging and discharging.

Fig. 1940.



"Challenge" Pipe Grip.

Fig. 1941.



French Pipe Kiln.

Pipe Line. A means of transporting liquids by pipes laid above the ground or beneath the surface. See OIL PIPE LINE, *supra*.

Description of pipe lines for transport of beet-root juice to factories, Dr. McMurtrie's report, 1880, in *"Dept. of Agric., Special Report,"* No. 28, pp. 131 *et seq.*

Pipe Mold. Primard's mold for iron pipe to be cast vertically is a metallic casing rolled in a spiral and capable of being expanded or contracted at will.

"A plunger attached to the lower end of a spindle, and having a diameter equal to the outer diameter of the pipe, passes through the interior of the casing, which is placed in the center of the mold. This spiral casing is placed in its contracted state into the center of the mold, and sand is run between them. The plunger, in passing through the spiral, enlarges it and compresses the sand uniformly. When it is withdrawn the spiral contracts and may be easily withdrawn. The casting of the neck and flange on one end of the pipe is provided by a simple contrivance." — *"Moniteur Industriel."*

Pipe O'ven. A hot blast oven in which the air passes through pipes exposed to the heat of the furnace. In contra-distinction to a fire-brick oven. See HOT-BLAST STOVE, *supra*.

Pipe Re-du'cer. A pipe coupling which is larger at one end than the other, to unite pipes of different diameters. *c*, Fig. 271, p. 92, *supra*.

Pipe Screw'ing. See PIPE THREADER, Fig. 3744, p. 1712, *"Mech. Dict."*

Pipe Stand. A frame to support radiator pipes. See COIL STAND; COIL PLATE, *supra*.

Pipe Stay. A device to hold a pipe in place; or to hang a pipe.

Pipe Stop. A spigot in a pipe.

Pipe Test'ing Ma-chine'. See PIPE PROVER, Fig. 3741, p. 1711, *"Mech. Dict."*

Pipes, Tools, and Ma-chin'er-y. See under the following: —

Bend and union, universal, *Royle*, Br.	* *"Engineer,"* xlix. 53.
Boring & turning lathe. *Hind*, Br.	* *"Engineer,"* xli. 60, 69; xliv. 42.
Coupling, adjustable, Fr.	* *"Engineer,"* l. 72.
Smith, Br.	* *"Engineer,"* xlvii. 388.
	* *"Scientific American,"* xxxv. 118.
Chapell	* *"Scientific Amer.,"* xxxviii. 55.
Covering, *Pierce* (air chamber)	* *"Iron Age,"* xxiii., March 13, p. 9.
" Acme "	* *"Iron Age,"* xviii., Sept. 7, p. 9.
Pipe cutter and threader	* *"Manufact. & Builder,"* xii. 78.
Chase	* *"Scientific American,"* xlii. 74.
Eaton	* *"Scientific American,"* xxxv. 163.
Roberts	* *"Iron Age,"* xx., Aug. 16, p. 3.
Sanford	* *"Iron Age,"* xviii., Aug. 24, p. 16.
Saunders	* *"Scientific American,"* xl. 374.
	* *"Iron Age,"* xxiv., Nov. 6, p. 7.

Fittings	* "*Scientific American Sup.*," 1273.
Gas and water	* "*Sc. Am. Sup.*," 985, 1016, 1048, 1060, 1072, 1092.
Hydrostatic joint . . .	* "*Iron Age*," xxii., vol. xxiv., p. 9.
Joints and pipes . . .	* "*Sc. Am. Sup.*," Nos. 62, 64, 66, 67, 68, 69.
Joint, differential screw.	
Bourry, Switz. . . .	* "*Engineering*," xxiii. 388.
Painter, Br.	* "*Engineer*," xlix. 181.
	* "*Engineering*," xxix. 147.
	* "*Laboulaye*," "*Éclairage au Gas*," ii., Figs. 69–72.
Thomas	* "*Scientific American*," xxxix. 88.
Elastic, *Roche* . . .	"*Scientific American Sup.*," 896.
Laying apparatus . . .	* "*Scientific American Sup.*," 1109, * 1137, * 1217.
Pipe maker's oven . .	* "*Scientific American*," xl. 82.
Manufact. wrought iron	* "*Iron Age*," xxi., May 16, p. 3.
	* "*Scientific American Sup.*," 2164.
Plumbing	"*Scientific American Sup.*," 1920.
Press	*Laboulaye*, iv., "*Poteries*," Fig. 3693.
Screwing machine.	
Heap, Br.	* "*Engineer*," xliv. 454.
Tongs, "Acme" . . .	* "*Sc. Amer.*," xlii. 246; xliii. 122.
Barnes	* "*Iron Age*," xxii., Nov. 21, p. 9.
Macdonald	* "*Scientific American*," xxxiv. 274.
Thornton	* "*Iron Age*," xx., Dec. 20, p. 5.
	* "*Scientific Amer.*," xxxviii. 281.
Tongs, wrench, etc., combined, *States* . . .	* "*Scientific American*," xxxvi. 310.
Vise	* "*Scientific American*," xxxvi. 19.
Wooden, *Wyckoff* . .	* "*Min. & Sc. Press*," xxxvi. 49.
Wrench, "Climax."	
Hull & Belden . . .	* "*Manufact. & Builder*," viii. 248.
	* "*Iron Age*," xviii., July 27, p. 1.
Coleman	* "*Sc. American*," xxxviii. 264.
Truland	* "*Scientific American*," xxxix. 810.

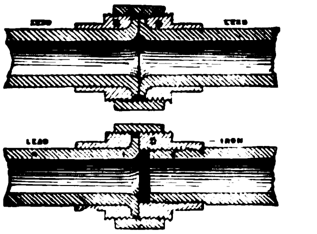
Pipe Turn′buck-le. A pipe or rod coupling, consisting of a pipe with internal threaded ends, having respectively right and left-hand threads. Into these the ends of other threaded pipes or rods are inserted, and by rotating the turnbuckle are drawn towards each other.

Its function is the same as that of the ordinary turnbuckle, but the latter is made of rods and a link, Fig. 6794, p. 2659, "*Mech. Dict.*"

Pipe Un′ion. A pipe coupling. See 18 varieties, Fig. 3734, p. 1710, "*Mech. Dict.*"

That shown in Fig. 1942 is for connecting lead, or lead and iron pipes without solder.

Fig. 1942.



Pipe Joint.

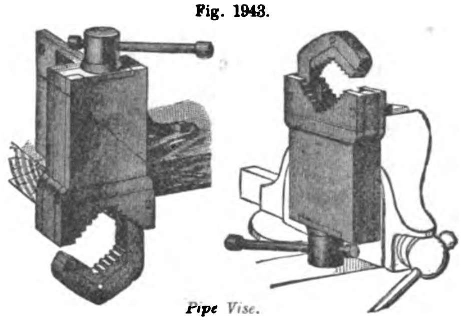
In connecting two lead pipes, the conical rings are placed loosely on the ends; the ends of the pipes are then forced out by a taper plug, the pipes being allowed to project above the rim; the ends are flattened over the edges of the conical rings with a small hammer until they form a flange, as shown on section; the outside hoop is then screwed on, and the whole tightened firmly together by screwing with two spanners in opposite directions.

In connecting a lead and iron pipe, the lead pipe undergoes the same operation as above described, the plain conical ring being placed on the end of the lead pipe, and the screwed ring on the iron pipe, the face of the ring being firmly screwed up to the face of the lead pipe.

Pipe Vise. A special vise for pipes. Attachments to vises, to enable them to grasp pipes and rods, are shown under Pipe Grip, *supra*. Pipe Vise, Vise, "*Mech. Dict.*"

The *Pancoast & Maule* vise, shown in Fig. 1943, can be used either as a permanent fixture to a work-bench, attached to an angle plate, or can be held between the jaws of any machinist's or blacksmith's vise. The movable jaw being open on the side permits work to be gripped at any desired point without slipping it in from the end; the box is made of mal-

Fig. 1943.



Pipe Vise.

leable iron, the screw of wrought iron, and the remainder of solid steel. The steel gripping jaws can be duplicated and replaced when worn out.

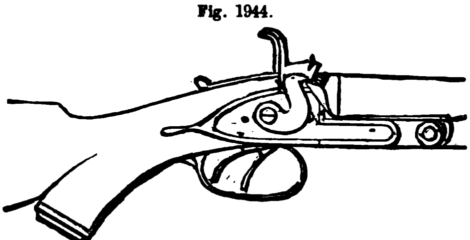
See also Fig. 3752, p. 1713, "*Mech. Dict.*;" Fig. 6986, p. 2713, *Ibid.*

Pis′ci-cul′ture. See Fish Culture, Oyster Tools, etc.

Pis′tol. See Revolver.

Pis′tol Grip. A protuberance shaped like the butt of a pistol beneath the *small* of a gun or rifle

Fig. 1944.



Pistol Grip.

stock, to be grasped by the right hand, to give steadiness to the grip in firing.

Pis′tol Ri′fling Ma-chine′. A standard machine cuts 5 grooves of an invariable pitch, in barrels 3.5″ to 5″ long, with or without feed for depth of grooves. See Rifle, p. 1939, "*Mech. Dict.*"

The twist may vary from 1 turn in 72″ to 1 turn in 12″. — *Pratt & Whitney.*

Pis′ton. See numerous illustrations, Figs. 3757–3759, pp. 1714–1716, "*Mech. Dict.*"

Church, Br.	* "*Engineer*," xlii. 281.
Rowan, Br.	* "*Engineer*," xlix. 235.
Expanding, *Wood* . .	"*Iron Age*," xxi., March 14, p. 1.
	* "*Scientific American*," xxxv. 182.
Packing, *Sprague* . .	* "*Iron Age*," xxi., March 7, p. 1.
Packing, *Hewitt* . . .	* "*Railroad Gazette*," xxiii. 678.
	* "*Scientific Am. Sup.*," 690, * 293.
Packing, metallic, *Leg & Parker*, Br.	* "*Engineering*," xxii. 191.
Pump, Ship's, *Blundell*, Br.	* "*Engineer*," xliii. 94.
Ring, *Dubied*, Fr. . . .	* "*Engineering*," xxi. 107.
Piston-rod lathe.	
Schönheyder, Br. . .	* "*Engineering*," xxi. 142.
Piston-rod lathe . . .	* "*Scientific American Sup.*," 349.
Rod packing, *Fuller* . .	* "*Eng. & Min. Jour.*," xxv. 421.
Hewitt	* "*Scientific American*," xli. 98.
Metallic, *Jagge*, Br. .	* "*Engineer*," xlv. 465.

Pis′ton Pack′ing. See 22 figures illustrating different forms of piston packing, pp. 1715, 1716, "*Mech. Dict.*"

See also list of patents on pp. 1717, 1718, *Ibid.*

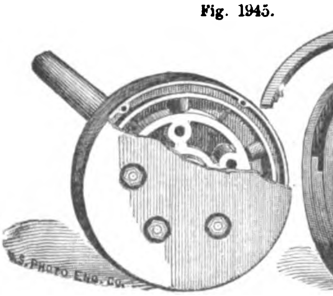
The Babbitt & Harries piston-packing is shown in Fig. 1945, which has three views.

One represents the packing in its place in the piston.

Another shows the chunk ring with two sections of the packing out.

A third shows two sections of the packing ring with its accompanying spring plate and spring.

Fig. 1945.



Piston Packing.

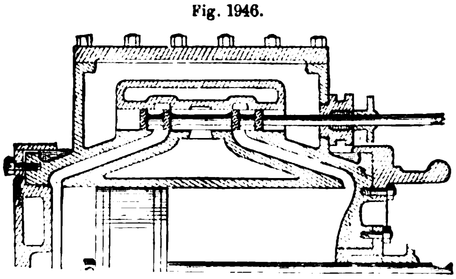
The operation of the packing is as follows: When steam is admitted into either end of the cylinder, the packing ring is carried by the steam over to the side of the grove in the chunk ring, making a joint there, and allowing the steam to pass down by and under the packing ring, thus placing it in equilibrium, when a very light spring is able to do the holding of the packing in contact with the bore of cylinder.

The piston-rod packing of Herr Gehrckens, of Hamburg (Philadelphia, 1876), is a wick-twisted hose stuffed with animal and mineral grease, and coiled around the piston-rod in the stuffing-box. See Packing, Fig. 1860, *supra*.

Pis'ton-pack-ing Ex-pand'er. A steel spring in a piston head, to expand the packing against the inside of the cylinder.

Pis'ton Valve. A circular valve moving in a cylindrical chamber. That used on the Norwalk Iron Works Steam Engine, consists of two peculiarly constructed pistons connected by a rod, and is

Fig. 1946.



Piston Valve of N. Y. Safety Steam Power Co. Engine.
(Section of Valve and Steam Cylinder.)

worked by an ordinary eccentric. By a simple arrangement these pistons always have the same pressure inside as out, which prevents any leakage or blowing through.

Pitch, Mu'si-cal. In addition to what was said on p. 1719, "*Mech. Dict.*," reference may be had to a late paper read before the American Association, "*On the Present Condition of Musical Pitch in Boston and Vicinity*," by Charles R. Cross and William T. Miller. It is summarized on p. 4041 of the "*Scientific American Supplement.*"

It recounts an extensive series of experiments carried on in 1880 at the "Massachusetts Institute of Technology," to determine the amount of variation of standard pitches in use by different makers of musical instruments in the neighborhood of Boston.

		No. of Vibrations. C 3.
Variations extended from	Koenig's physical pitch	256.1
	Chickering	268.5
	Covent Garden	270.3
	Weber	270.3
	Thomas	271.1
	Music Hall	271.2
	Steinway	272.2

Pitch'er Nose. Said of a faucet with a bent down lip.

Pitch Faced. (*Masonry.*) The arris is cut true, but beyond the arris edge the face is relatively rough and projecting, the *face* being merely dressed with a *pitching* chisel.

Pit Guide. A vertical bar forming a guide for the cage in mining shafts.

Pit Head Gear. The winding and emptying apparatus and framing for the transportation cars at the mouth of a mining or coal shaft.

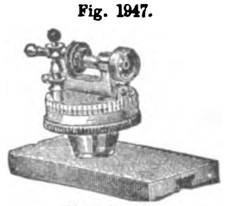
Pit'man Press. One working by pitman connection with a shaft, instead of eccentric or other equivalent. Used in drawing, cutting, stamping, and shearing presses.

Pit'ter. A device to take the pits from peaches, plums, and other stone fruit. See Fruit Pitter, Fig. 1107, p. 359, *supra.*

Piv'ot Pol'ish-er. An attachment to the watchmaker's lathe.

It is used for grinding and polishing conical pivots, snailing and drilling. The circular base being graduated into degrees, it can be set to grind at any angle. It has a finely graduated elevating screw to adjust the spindle above, or below, the center of the headstock.

Fig. 1947.



Pivot Polisher.

The spindle has a taper hole for drill chucks. This makes it very useful for drilling, either in the center or eccentric, and by using the graduations on the pulley of the headstock, an accurately spaced circle of holes may be drilled.

Piv'ot Span. (*Bridge.*) The draw span of a bridge. See Draw-bridge, *supra*, and references *passim;* Pivot Bridge, Fig. 3775, p. 1721, "*Mech. Dict.*"

Pla-cen'ta In'stru-ments. (*Surgical.*) For the removal of the after-birth. Forceps, hook, etc.

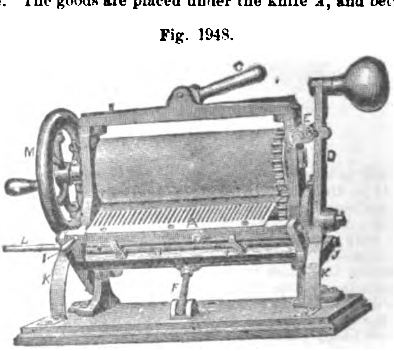
Pla'cer. (*Mining.*) A gravelly place where gold is found; includes all forms of mineral deposits excepting veins in place. Section 2,329, "*Revised Statutes of the United States.*"

Plain Sight. (*Fire-arms.*) A hind sight consisting of a simple notch in a raised plate or protuberance.

Plait'ing Ma-chine'. A machine for plaiting goods in piece or strips.

The roller is heated by gas or hot irons, and in the domestic size, it plaits strips up to 6″ wide, the plaits ⅛″ to 1″ wide. The goods are placed under the knife *A*, and between

Fig. 1948.



Plaiting Machine.

the rollers; then push down the handle, *C*, and the machine is ready. Move the lever *D* back and forth; this forms the plait, and presses it between the rollers. To change the width of plait, turn the nuts on the curved screw *E* back to the next notch on the screw, then lower the plaiting knife by adjusting the nut on screw *F*. There are 7 notches on each of these screws, answering to as many widths of plait.

See also "Crown" machine, * "*Iron Age*," xx., Nov. 29, p. 1.

Plane. A smoothing tool, having its cutter protruding from a throat in a stock.

See ADJUSTABLE PLANE, Fig. 7, p. 5, *supra*; CIRCULAR PLANE, Fig. 620, p. 197, *Ibid.*; BELL-NOSE RABBET PLANE, Fig. 460, p. 110, *Ibid.*; HAND MATCHER, Fig. 1305, p. 433, *Ibid.*; HAND PLANER, Fig. 1307, p. 434, *Ibid.*; PLOW, *infra*; SMOOTH PLANE, *infra*.

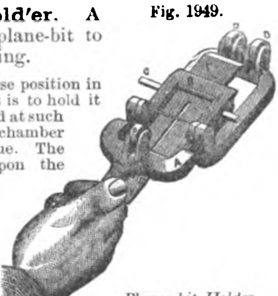
Description, illustrations, and list of varieties, pp. 1724, 1725, "*Mech. Dict.*"

See Figs. 3782–3784, and list of planes, pp. 1724, 1725, "*Mech. Dict.*"

See: Bench, *Boyce & Bruce* * "*Scientific Amer.*," xxxviii. 191.
Carpenter's, *Bailey* . . * "*Scientific American*," xl. 1.
Gallaher . . . . . * "*Scientific American*, xl. 5.
Metallic . . . . . . * "*Manuf. & Builder*," x. 88.
Rabbet plane, *Bonney* . * "*Iron Age*," xxii., Nov. 14, p. 5.
Rabbeting, grooving and turning mach., *Wood* * "*Manufact. & Builder*," x. 64.

Plane'-bit Hold'er. A device to hold a plane-bit to the stone for grinding.

Fig. 1949.



Planer-bit Holder.

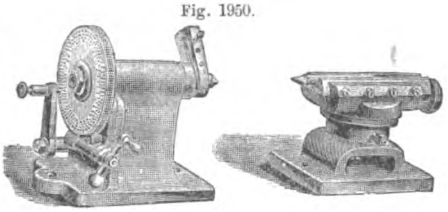
It is shown in reverse position in Fig. 1949. The object is to hold it firmly and squarely and at such an angle that the chamber shall be flat and true. The rollers *D D*, run upon the stone and it is impossible to grind the bit awry.

Pla'ner Cen'ter. A head and tail stock bolted to the table of a planer in order to hold objects centered while under treatment.

In the instance shown, Fig. 1950, the device is practically a pair of lathe stocks; the head stock has a dial with worm, gear, and index wheel. The foot stock has horizontal traverse by means of feeding screw.

See also Fig. 3788, p. 1726, "*Mech. Dict.*"

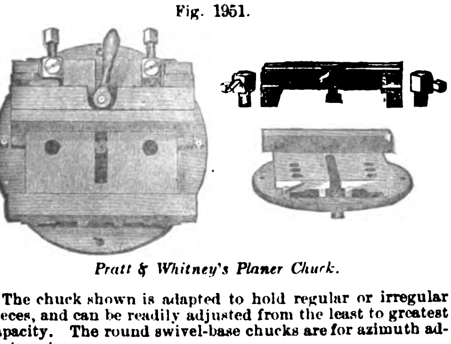
Fig. 1950.



Planer Center.

Pla'ner Chuck. A device bolted or keyed to the planer table, and serving to dog an article under the action of the plane.

Fig. 1951.



Pratt & Whitney's Planer Chuck.

The chuck shown is adapted to hold regular or irregular pieces, and can be readily adjusted from the least to greatest capacity. The round swivel-base chucks are for azimuth adjustment.

Pla'ner Knife Grind'er. An emery-wheel or stone, traversing on its mandrel in front of a knife dogged to the table or conversely.

See KNIFE GRINDER, Fig. 1515, p. 520, *supra*, and Fig. 2765, p. 1238, "*Mech. Dict.*"

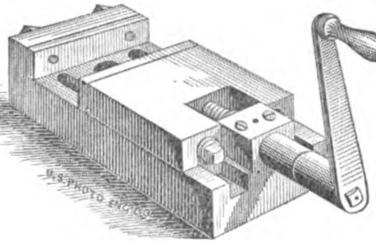
Pla'ner Vise. A device to hold work on the bed of a planing machine while under treatment.

Fig. 1952 shows a form in which the moving jaw is actuated by crank-handle and screw.

Fig. 1953 is Babbitt's planer vise.

In this chuck, instead of gripping the work with the vise jaws direct, two pivoted plates are interposed which incline

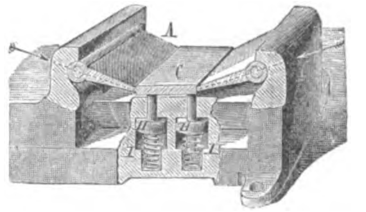
Fig. 1952.



Planer Vise.

from the pivots towards the work. *A* and *B* represent these plates, and *C* represents the work; the strain of the plates upon the work is in the direction denoted by the respective arrows, so that the work is forced downwards upon the tops of the pins. The plates are made to bear, at the back of the hinge, upon the hollow curve in the chuck jaws, as shown,

Fig. 1953.



Planer Vise

which relieves the pivot of the strain due to screwing the chuck tightly.

The pins are made adjustable for height to suit the work, being screwed into the disks *H* which are attached to spiral springs, which depress until the disks *H* meet the shoulder at *I*, resting solidly upon them.

Harris; Thomas . . . "*Sc. American*," xxxviii. 245.

Pla'ni-graph. An instrument invented by Marmet, of Versailles, France, for reducing or enlarging drawings.

It consists of a rule carrying two scales which have different graduations, and are placed end to end in opposite directions. At the common origin of the scales is a needle about which the rule can freely turn. Reading on one side the radii vector of the different points of a given figure, and marking on the other side the points designated by the same numbers, you obtain a figure reduced or enlarged in the proportion resulting from comparison of the scales. The scales are fixed to the rule by screws. There are five for each side, among which choice is made according to the reduction required.

"*Scientific American*" . . . . . . xxxvi. 328.

Pla-nim'e-ter. An instrument for measuring the area of plane figures.

Amsler's planimeter is shown in Fig. 3794, p. 1728, "*Mech. Dict.*"

Ljungström's circular planimeter consists, in its most simple form, of a circular plate of glass, through the center of which passes a vertical steel wheel that is to be placed at right angles to a radius which is etched in the pane and marked with a point. When in use, the plate of glass is brought along a rectilineal support (a ruler) so that said point accurately follows the border line of the figure once round. The reading is taken from the wheel, which is turned by friction against the paper. The instrument measures figures of a width equal to that of the whole ruler. If very large figures are to be measured (*e. g.* an ordinary map at once) the instrument is changed by a so-called *couple* into a kind of polar planimeter. The *couple* consists of a metal ring, which goes round the pane of glass, together with two legs, one of which is attached to the ring, and the other to the plate. The former moves about a fixed point, while a point marked on the other leg is moved along the border-line of the figure. The reading off is in this case also done from the steel wheel.

See also * "*Eng. & Min. Jour.*," xxvi. 24; "*Planimetre*," *Laboulaye's* "*Dict.*," vol. iii.

Plane tables, *Cutts's*, "*Report on Vienna Exposition*," ii., Sec. H, p. 8.

Austrian.	Swiss.
Japanese.	*Stupendorf*, Rus.

Pla'ning Ma-chine'. The subject of planing machine for *wood* has been considered on pp. 1728–1730, "*Mech. Dict.*," and for metal on pp. 1730, 1731, *Ibid.*

In addition, the divisions of the subject have been considered under the titles and in places mentioned in "*Mech Dict.*"

Wood.	Fig.	Page.
Bark planing machine	566	238
Cylinder planer	3797	1729
Dimension planer	3798	1729
Felly planer	1940	832
Molding machine	3197	1467
Molding and recessing machine	3201	1468
Panel planer	3502	1602
Planing and matching machine	3797	1729
Planing and molding machine	3198	1467
Shaper	4916	2133
Shingle planing machine	4995	2152
Spoke planer machine	5453	2283
Surface planer	6081	2457
Surfacing machine	6082	2458
Transverse planer	3795	1728
Traversing planer	6627	2620
Trying-up machine	6714	2640
Variety planing machine	3200	1468
Veneer planing machine	6944	2701
Metal.		
Milling machine	3151	1441
Planing machine	3800	1731
Shaping machine	4912-4	2132-3
Transverse planer	6616	2616
Traveling bed planer	3799	1730

See also Pillar Shaper; Milling Machine, etc., *supra*.

Richards's classification of planing machines divides them into three classes: —

1. The *carriage planing machine*, in which the material is carried and guided on a carriage having its movement governed and regulated by extraneous guides and independent of its own surface or shape. — The *Daniel* planer, Fig. 3796, p. 1728, "*Mech. Dict.*"

The carriage planing machine requires a length double that of the material to be worked; that is to say, the track must be twice the length of the carriage, the movement of which is reciprocating.

2. The *parallel planing machine*, such, for instance, as have feed-rollers over which the material is fed and gaged from, forming a fixed gaging surface opposite to the cutters.

3. The *surface planing machine*, having its action gaged from the surface of the material, cutting a constant amount without reference to dimensions or to producing parallel lines.

Wood.

See also: History of	"*Sc. Amer.*," xxxvi. 115, 135, 147, 200.
Arbey, trying up mach., Fr.	* "*Engineer*," xlvii. 237.
Portable	* "*Iron Age*," xx., Nov. 29, p. 1.
Fay	* "*Engineer*," xlv. 439.
Surface	* "*Scientific Amer.*," xxxvii. 246.
Hand and power	"*Scientific American*," xxxv. 406.
Frank	* "*Sc. American*," xxxviii. 297.
Furness, molding mach. Br.	* "*Engineer*," xlvii. 301.
Fay, matcher	* "*Scientific American*," xxv. 147.
Goodell & Co.	* "*Manufact. & Builder*," viii. 9.
Woods & Co.	* "*Man. & Builder*," viii. 102, 175.
Gray & Woods, dimension	* "*Manufact. & Builder*," viii. 126.
Hermance	* "*Manufact. & Builder*," xi. 161.
Houston, Smith & Co., endless belt	* "*Manufact. & Builder*," viii. 241.
Michels	* "*Am. Man.*," Feb. 14, 1879, p. 12.
Newman, "Pony"	* "*Scientific American*," xxxv. 38.
Norris, Polishing Mach.	* "*Scientific Amer.*," xxxvi. 386.
Robinson, shaping and mortising mach., Br.	* "*Engineer*," xlii. 98; xlv. 417.
Chuck	* "*Van Nost. Mag.*," xxiii. 473.
Recessing, Br.	* "*Engineer*," xlv. 216.
Ross	* "*Am. Man.*," Sept. 26, 1879, p. 13.
Rowley & Hermance. Matcher, "Sweepstakes."	* "*Scientific American*," xl. 147.
Tanite Co., knife grinder	* "*Scientific American*," xxxvi. 22.
Whitney	* *Thurston's* "*Vienna Report*," iii. 252.
Richards, transom	* "*Engineering*," xxii. 551.

Metal.

See: *Asquith*, Br.	* "*Engineering*," xxvi. 68.
Buckton, for bed plates, Br.	* "*Engineer*," xlviii. 148.
Ferris & Miles, small	* "*Iron Age*," xxi., Mar. 14, p. 1.
Kershaw, double tool box, Br.	* "*Engineer*," l. 420.
Perrin, Pauchard et cie., Fr.	* "*Engineer*," xlvii. 293.
Pratt & Whitney	* *Thurston's* "*Vienna Rpt.*," ii. 231.
	* "*Engineer*," xlii. 42.
Sellers	* *Thurston's* "*Vienna Rpt.*," ii. 205.
Sharpe, Stewart & Co., Br.	* "*Engineering*," xxvi. 103.

Plan'ish-er. For photograph planisher, see Photograph Burnisher.

(*Photography.*) See Photograph Burnisher.

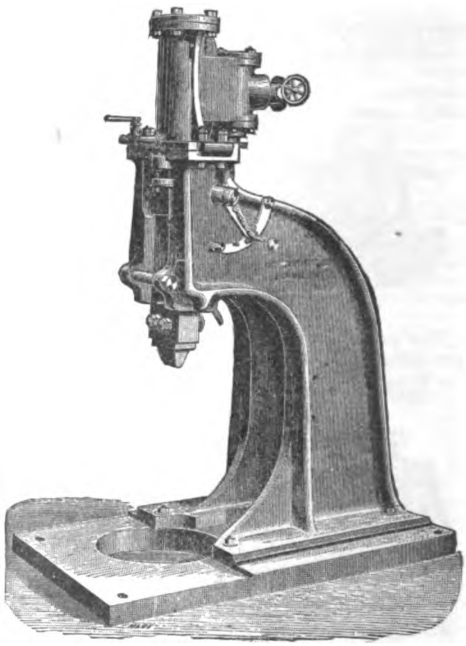
(*Paper.*) See Calender; Plater; Paper Burnisher; Paper-glazing Roller.

(*Metal.*) See Planishing Hammer.

Plan'ish-ing Ham'mer. A hammer for flattening, curving, or shaping sheet metal by properly disposing and graduating the blows upon its surface.

Saw blades are planished to straighten them. Buckling is removed by planishing, *i. e.*, giving a *plane* surface.

Fig. 1954.



Planishing Hammer.

Again: by the planishing hammer sheet metal is shaped to form kettles and what not. When the curve is regular and cylindrical the work is done by rollers. See Plate Bending Machine, *infra*.

When the object admits of being made by a stamping process, as a dish or pan, the work is done at a blow or by a series of blows.

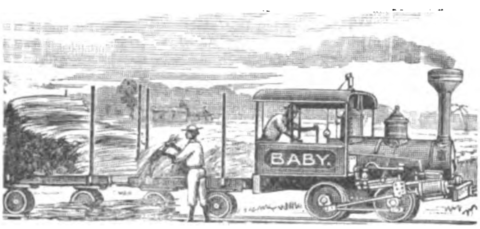
The old mode of forming the 60 gallon copper, sugar, or soap-kettle was planishing, the parts being subsequently united by brazing. The planishing hammer is yet a valuable tool and very effective, especially when worked by steam.

Plan'i-sphere. An instrument to assist in the study of the stellar heavens.

It consists of a card about 4″ square, carrying a circumpolar star-map, surrounded by a circle of the months subdivided for the days; and a smaller circular card, carrying the hours of the day, and an open space representing the horizon. These two cards are attached at the center, so as to turn one on the other.

Plan-ta'tion Lo'co-mo'tive. A four-wheeled locomotive, for use in plantation work. The tank is at the rear, beneath the floor of the cab, over which is a sheet-iron canopy. One pair of driving-

Fig. 1955.



Plantation Locomotive.

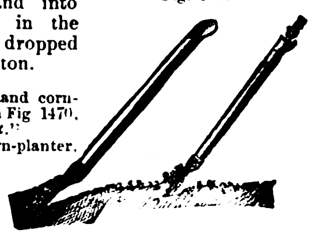
wheels is equalized across. The hauling capacity on a level is from 150 to 475 tons, with engines of from 5 × 10″ to 9 × 14″, and diameter of driving wheels, 22″ to 28″.

Plan'té Bat'te-ry. See SECONDARY BATTERY.

Plant'er. A tool or machine for planting grain or roots in hills.

Two French hand-planters are shown in Fig. 1956. In one form the seed is dropped by hand into the open end; in the other the seed is dropped by moving a piston.

Fig. 1956.



Hand Planters. (*French.*)

The American hand corn-planter is shown in Fig 1470, p. 627, "*Mech. Dict.*" The horse corn-planter. Figs. 1468, 1469, p. 627, *Ibid.* See also CORN PLANTER, Fig. 697, p. 223, *supra.* POTATO PLANTER. See Fig. 3919, p. 1776, "*Mech. Dict.*" Also see *infra.*

Plant Sprink'ler. A syringe for watering plants.

In the form shown in Fig. 1957 it is a caoutchouc bulb with valves. See also AQUAPULT; HYDRONETTE, *supra.*

Fig. 1957.

Plant Sprinkler.

Plaque. (*Ceramics.*) A decorated porcelain dish or plate.

Plas'ter. *Hard plaster:* Alum plaster, made in Paris for fine-polished walls. It does not, however, resist moisture thoroughly.

The gypsum in blocks is calcined in a reverberatory, cooled, placed in a wooden cage, and lowered into a bath with 10 per cent. of alum. After some minutes' immersion it is raised, allowed to drip into the bath, then laid on a floor to dry; again raised to a red-heat in a furnace, cooled, ground, and bolted.

Another plan is to mix the ground plaster with alum in powder and bake in a furnace.

See also STUCCO.

See plaster arch	"*Scientific American,*" xxxiv. 150.
Bronzing casts	page 139, *supra.*
Casts	"*Scientific Amer.,*" xxxvii. 343.
Machine	"*Scientific American,*" 194.
Casts, manufacture of	"*Scientific Amer.,*" xxxvii. 346.
Mill	* Bone Mill, Fig. 378, p. 119, *supra.*

See also CEMENT MILL, Fig. 575, p. 183, *supra.*

Paste, adhesive	"*Scientific American Sup.,*" 2764.
Tools	* "*Manufact. & Builder,*" xi. 155.
Trowel	* p. 2631, "*Mech. Dict.*"

Prepared slabs nailed to studding or walls. — *Hitchins.* "*Iron Age,*" xxi., Jan. 8, p. 16.

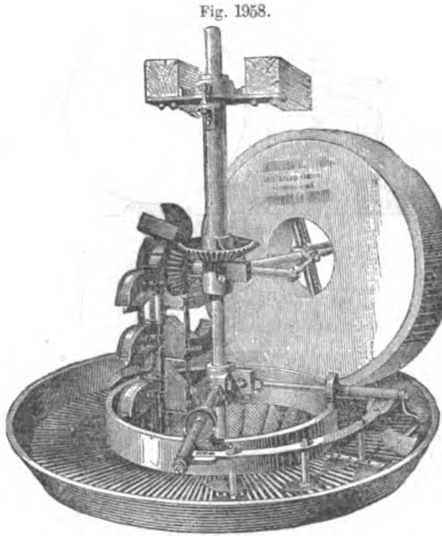
London "*Building News,*" "*Sc. American,*" xxxvii. 248.

See also BÉTON; CEMENT; MORTAR; PLASTER; STUCCO, "*Mech. Dict.*"

Plas'ter Mill. A machine in which crude plaster is ground to powder.

The form shown is by Jannot fils, Triel (*Seine et Oise*), Fr. It has the Chilian roller, followed by stirrers, scrapers, and hoes. The bottom of the annular trough is a grating,

Fig. 1958.



French Plaster Mill.

through which the powdered material passes. A series of cups on an endless band raise the material from a central well and discharge it into the trough.

See BONE MILL, Fig. 378, p. 119, *supra*; CEMENT MILL, Fig. 575, p. 183, *Ibid.*; MORTAR MILL, Fig. 2330, p. 1480, "*Mech. Dict.*"

Plas'tic Crys'tal. A variety of Portland cement remarkable for its plasticity, and consisting of —

Silica	86.42
Alumina	9.33
Oxide of iron	0.86
Lime	0.34
Magnesia	0.22
Alkalies	0.37
Loss on ignition	2.40
	99.94

"*Dingler's Polyt. Journal.*"

Plas'tic Etch'ing. (*Glass.*) The term given by Casset-Delas, of Paris, to his etched plate-glass. It is designed to give relief by etching away the glass, and to imitate plastic relief; basso, or *pâte sur pâte.*

Plas'ti-li'na. A kind of modeling clay, which remains damp, and does not require frequent wetting.

Glycerine has been mixed with the clay, but the following composition is preferred : —

Fatty acids and fats	10
Oxide of zinc	1
Sulphur	6
Clay (dried and powdered)	3

Or : —

Glue	8
Oxide of zinc	1
Oleic oil	4
Wax	2
Sulphur	6
Clay	3

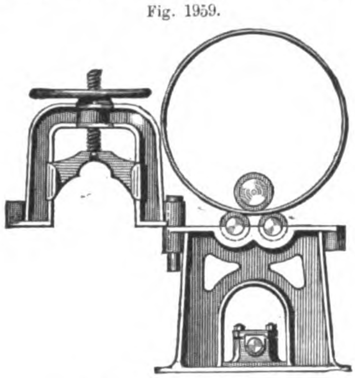
Plate. (*Fire-arm.*) The side of the lock.

Plate Bend'er. A round-bitted pinchers, for bending dental plates without showing the pinch marks.

Plate Bend'ing Ma-chine'. Machines for bending plates are shown under several specific heads. ARMOR PLATE BENDING, Fig. 296, p. 97, *supra*, and references *passim*.

In the plate-bending machine, Figs. 1959, 1960, the principal feature of the invention is, that tubular work, such as flues, cross-tubes, funnels, ship-masts, etc., can easily be removed from the machine, after they have been formed into the requisite shape and size, *without requiring to unship any of* the rollers. The plan hitherto adopted has been to draw out the top roller when releasing tubular work, which arrangement involves the labor of re-shipping the roller before the machine can be used again.

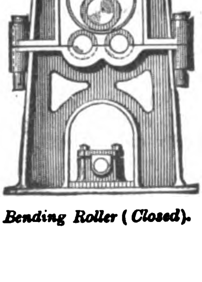
Fig. 1959.



Bending Rollers (*Arch Open*).

The whole of the driving gear of this machine is arranged at *one* end, and is made either double or triple powered, in accordance with the size of the machine. The other end is entirely free from driving gear. The framing is made in halves, held together by cotter bolts. After a plate has been formed into an entire circle, one of the cotter bolts is removed, the top part of framing is swung round out of the way, when the tube is easily drawn out, and the framing can be instantly readjusted for the following operation.

Fig. 1960.



Bending Roller (*Closed*).

Plate Glass. History and procedure on pp. 1737, 1738, "*Mech. Dict.*"

Plate XXXIV. has a plan and elevation of a French plate-glass factory.

The furnace for 12 crucibles is elliptical in form. The *siege* or crucible platform is in a single mass of fire-clay concrete work, and has a central elliptical funnel-shaped crater, at the bottom of which is the grating, and beneath the latter is the ash-pit in the sub-way of the glass-house, by which air reaches the furnace. Twelve openings, of which the sills are on the level of the crucible *siege*, serve as means of introducing and removing the pots, and each is closed with a large tile, *tuile d'ouvreau*, when the melting process is in course. Above each of these large openings is a small one known as a *pigeonnier*, through which the materials to be melted are introduced into the pots by means of a square tray on the end of a long handle. The hole affords means of judging of the progress of the melt, and is closed with a ball of fire-clay. The flame strikes against the vaulted roof, circulates around the crucibles and escapes into the little chimneys perforated in the pillars of the wall and thence to the conical sheet-metal chimney *A*.

The furnace is placed in a central position between ovens, *leers*, *B*, in which the glass plates are annealed. *D D* are cranes by which the crucibles or cuvettes *E* are lifted and moved, to carry the molten glass from the furnace to the tables *C C*, where the molten glass is rolled to a thickness, depending upon the upward projection of the rim of the table on which the roller runs. The table has wheels which run on rails so as to present the glass at the opening of either one of the annealing furnaces in the series. Each *leer* has three furnaces to heat it, a large opening in front to enter and remove the glass plates, openings for air to gradually reduce the heat, and a flue to lead the fumes to the chimney. See, also, description on p. 1738, "*Mech. Dict.*"

Factory, Jefferson Co., Mo. "*Scientific Amer. Sup.*," 3796.
Manufacture in Pa. . . . "*Iron Age*," xix., June 14, p. 11.

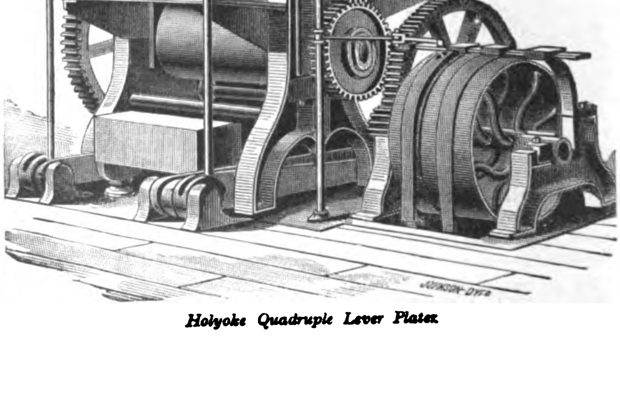
Plate Key. A flat key, notched at the ends or sides. The Yale key, for instance. See LOCK.

Plate Ma-chine'. One for making porcelain plates. The operation is — to speak more exactly — threefold, consisting in forming, molding, and turning. See PORCELAIN PLATE MAKING.

Plate Ma-chin'er-y.

See : Bending machine.
Bennie, Br. . . . . * "*Engineer*," xliv. 373.
Mill. See ROLLING MILL.
Pickling machine . . * "*Engineer*," xliii. 268.
Taylor, Br. . . . . * "*Scientific American Sup.*," 1185.

Fig. 1961.



Holyoke Quadruple Lever Plater.

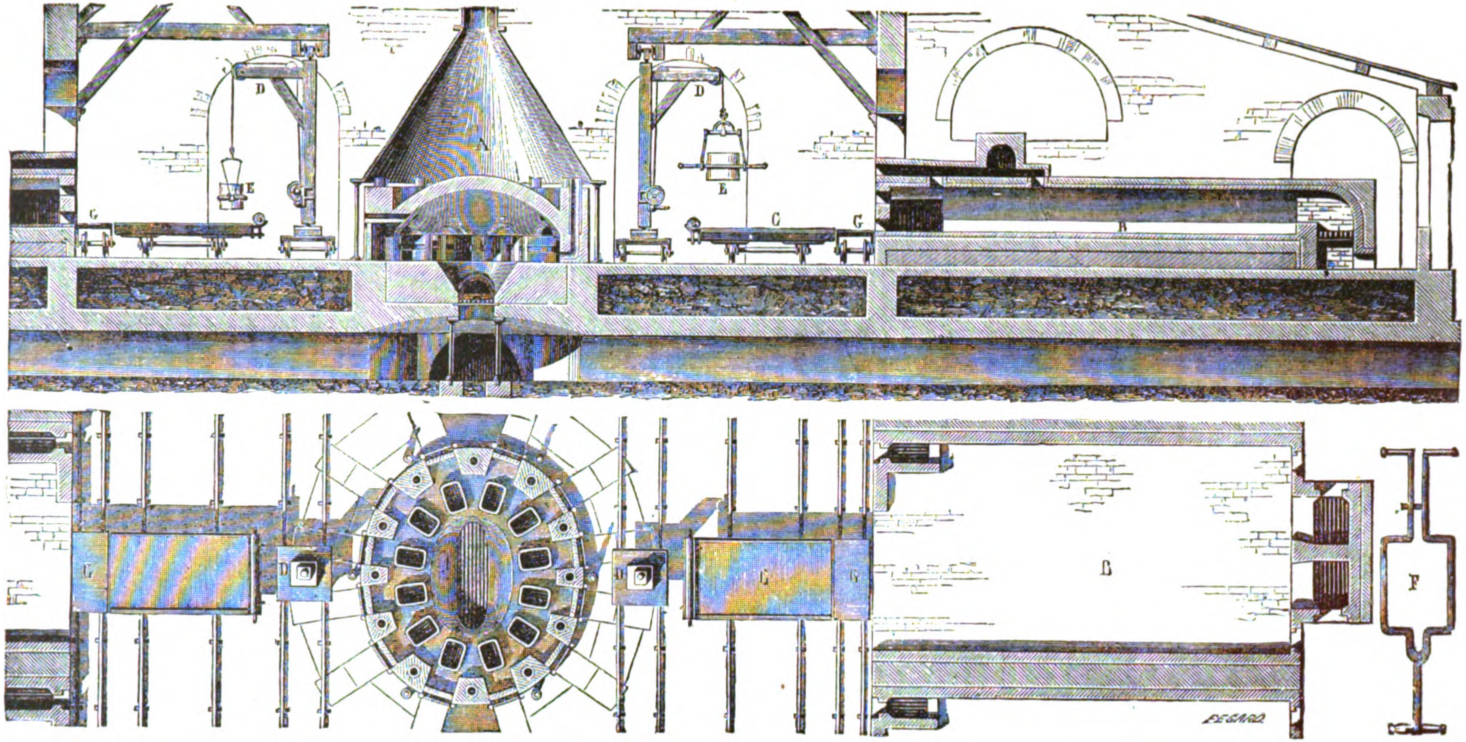


PLATE XXXIV. FRENCH PLATE-GLASS HOUSE. (*Sectional Elevation and Plan.*) *See page* 690.

Edge planing machine.
Asquith, Br. . . . . * "*Engineering*," xxix. 186.
Planing machine.
Bennie, Br. . . . . * "*Engineer*," xliv. 351.
Shears, boiler, *Johnson* . * "*Scientific Amer.*," xxxvii. 294.
Shearing mach., *Sellers* * "*Iron Age*," xviii., Aug. 24, p. 1.

Plat'en Gage. An attachment to a printing press for holding and guiding the paper. *Halleck.* * "*Scientific American*, xxxix. 338.

Plate Nip'pers. (*Dental.*) Nippers used in cutting out plate for dentures.

Plate Press. A copper or steel-plate press. Fig. 1445, p. 619, "*Mech. Dict.*"

Pla'ter. A paper calendering machine.

The weights and levers of the machine, Fig. 1961, exert a pressure of about 35 tons on the roll. The paper is packed between smooth plates of zinc or copper, and passed between the rolls back and forth till the desired finish is obtained; the motion of the machine being reversed at each passage of the pack.

Plate Shear'ing Ma-chine'. Examples are given under SHEARS in the "*Mech. Dict.*"

The Sellers plate-shearing machine, Fig. 1962, is specially adapted for cutting and trimming plates used in bridge and ship construction, and is adapted for trimming edges of long plates, or cutting off to length plates 5' wide. Will shear wrought-iron plates 1" thick. The upper blade is guided vertically in the frame of the machine, and driven down by a pitman as wide as the blade is long, this pitman receiving its motion from a long rocking shaft above it. The driving

Fig. 1962.

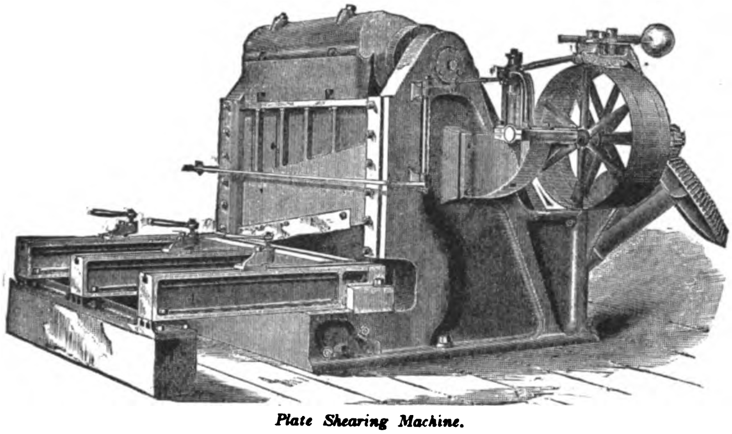


Plate Shearing Machine.

arm or lever of the machine is a rack segment engaging with the teeth of a spiral pinion, which is driven by bevel wheel and pinion and open and crossed belt, after the manner of planing machines. The cutting blade is adjustable in length of stroke, returning at double the speed of its down stroke.

The blade can be made to cut to any fixed point in its length and then stopped or raised. It is provided with an automatic adjustment to its belt-shifting motion, gaging the length of its stroke. It makes the down stroke, immediately reascends, and stops up, to wait for the readjustment of the plate.

Fisher's bevel-edge boiler and armor plate cutter is on an oblique frame so as to chamfer edge the plate presented to it. Of the jaws, one is horizontal and holds the plate, the other descends in an oblique direction and bevels the plate edge.

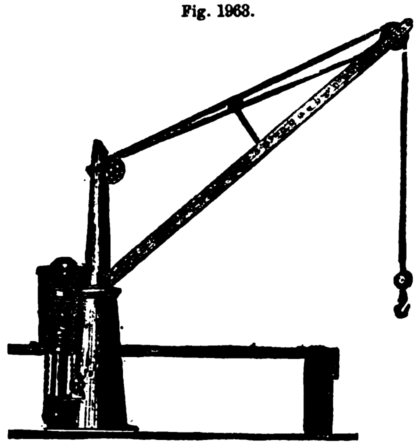
Plate Weld'ing Ham'mer. A peculiar form of steam hammer for welding plates, carried on the flat horn of a movable anvil beneath the hammer.

Adamson . . . . . . * "*Engineering*," xxx. 295.

Plate Wheel. (*Railway.*) A car-wheel, the web of which is a plate, instead of spokes.

Plat'form. (*Railway.*) Miller's platform is used in conjunction with his automatic car coupler, and is arranged so that the line of draft and the compressive strains on the car are in a direct line with the sills of the latter.

Fig. 1963.



Hydraulic Platform Crane.

Plat'form Crane. A crane upon a landing platform for discharging goods, etc., from cars or wagons.

In the hydraulic platform crane, shown in Fig. 1963, the machinery is easily accessible. The mast and jib are supported in a heavy foundation. The pipes and hydraulic cylinder are independent of the jib, and the only stuffing-boxes or working hydraulic joints are the glands of the hydraulic ram and ram spindles.

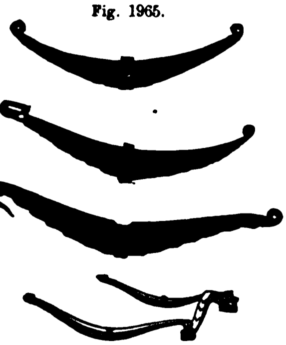
Fig. 1964.

Platform Spring Shackle.

Plat'form El'e-va-tor. One lifting a platform or cage. See ELEVATOR.

Plat'form Spring. A form of spring, Fig. 1965, used largely on city trucks; the *platform* is probably the bed of the truck and gave its name to the spring.

Fig. 1965.



Platform Springs

Fig. 1964 shows the peculiar shackle used in coupling together the springs, the ends of which meet at a right angle: as seen in the lower one of the four springs, Fig. 1965.

Plat'in-i-zing. (*Metals.*) The process of M. Dode, of Paris, is for the protection of the iron from the action of air, fire, and acid gases.

The iron first receives a coating composed of lead and copper, and then the platinum is applied. The first coating is prepared by mixing 22 parts of borate of lead and 4½ parts of cupric oxide in oil of turpentine, and is applied by means of a fine brush. The platinum coating is prepared by converting 10 parts of platinum into chloride mixed with 5 parts of ether, the latter being permitted to evaporate in the air. The residuum is mixed with a viscid combination of 20 parts borate of lead, 11 parts red lead, and some oil of lavender, and 50 parts of amylalcohol are added to the whole. Into this mixture the object to be platinized is dipped, allowed to dry in the air, and then heated to a moderate temperature.

"*Scientific American*"	xxxvi. 233, 407.
"*Scientific American Supplement*"	2818.

(*Glass.*) Platinum has been tried for a reflecting surface, but owing to the somber appearance of objects reflected by looking-glasses prepared with it, it has not met with a commercial success.

Pla-tin'o-type. A photographic print obtained upon paper in platinum in form of a finely-precipitated powder. In this state the metal possesses an intensely black color, and, as in its massive state, is wholly unalterable by atmospheric influences. — *Willis.*

"*Engineering & Mining Journal*"	xxvi. 333.
"*Scientific American Supplement*"	2466.

Pla-ti'num. Article "*Platine,*" *Laboulaye's* "*Dictionnaire des Arts et Manufactures,*" iv., ed. 1877. *Deville & Debray* osmium crucible furnace,* platinum crucible,* Figs. 3684, 3685.

Platinum, iridium, palladium, etc., at Paris Expo. in 1878.	
"*Engineering & Mining Journal*"	xxvi. 147, 164.
"*Paris Exposition* (1878) *Reports*"	iv., p. 65 *et seq.*

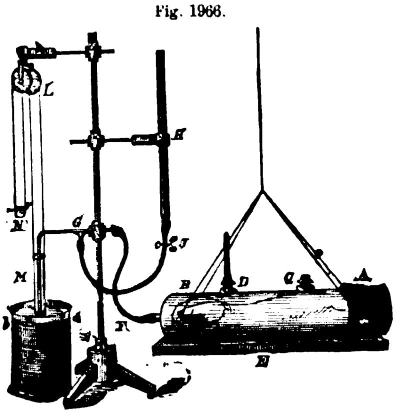
A platinum alloy, melted and cast by Matthey, of London, "is so malleable and ductile that thread 1-2500th'' in diameter has been made of it. Its composition is: Platinum, 80.600 per cent.; iridium, 19.079 per cent.; rhodium, 0.122 per cent.; iron, 0.098 per cent.; and ruthenium, 0.046 per cent. Its density at a temperature of 32° F., is 21.614." — *Phillips.*

Ple-thys'mo-graph'. An instrument invented by Sig. Mosso, of Turin, for observing the variation of the circulation of blood in various parts of the body under natural or artificial causes: as in the two arms; the acceleration in the head in case of surprise, etc.

The forearm, for instance, is inserted in a glass cylinder, *B*, which rests on suspended plank *E*, and is filled with tepid water, a rubber ring, *A*, preventing the exit of water around the arm. There is an opening, *F*, leading from the cylinder to a measuring apparatus, *C*, which indicates the quantity of water admitted or expelled by the contraction or dilation of the volume of the forearm, due to the arterial action. See also SPHYGMOGRAPH.

The test tube *M* is equilibrated by the counterweight *N* and pulley *L*; *D* is a thermometer.

Fig. 1966.



Plethysmograph.

"*English Mechanic*"	xxvi. 392.
"*Scientific American*"	* xxxiv. 403.

Pli-ca'tor. A mechanical device for making a plait or fold, as in some sewing-machine attachments, for instance. U. S. Patent, No. 229,479.

Plow. See the following varieties, and apparatus connected therewith: —

Adjustable beam plow.
Anchor.
Anti-friction plow.
Balance plow.
Beet root digger.
Bisoc.
Black-land plow.
Blade.
Brabant plow.
Breaker.
Brush plow.
Car unloading plow.
Chain harrow.
Chilled plow.
Colter.
Combination plow.
Corn plow.
Cotton cultivator.
Cotton plow.
Cotton scraper.
Cotton sweep.
Cultivator.
Cultivator plow.
Cutter.
Disk harrow.
Disking machine.
Ditching machine.
Ditching plow.
Double furrow plow.
Double mold-board plow.
Double plow.
Double shovel plow.
Double turning mold-board plow.
Draft chain.
Draft rod.
Drag.
Draining plow.
Duck's foot cultivator.
Expanding cultivator.
Fore carriage.
Gage wheel.
Gang plow.
Geddes harrow
Grubber.
Half-shovel plow.
Harrow.
Harrow cultivator.
Hillside plow.
Hoe.
Hoeing machine.
Horse hoe.
Jointer.
Jointer plow.
Leveling plow.
Listing plow.
Marker.
Mold board.
Mole plow.
Movable point plow.
Multifurrow plow.
One-horse plow.
Parer.
Paring plow.
Plow fender.
Plow holder.
Pony plow
Porter.
Potato coverer.
Potato digger.
Potato planter.
Prairie breaker.
Prairie plow.
Prairie renovator.
Railway plow.
Reclamation plow.
Ridge harrow.
Ridging plow.
Riding cultivator.
Road grader.
Road plow.
Rolling colter plow.
Rolling mold plow.
Rotary plow.
Row marker.
Scarifier.
Scraper.
Seeding plow.
Share.
Share harrow.
Shovel plow.
Single shovel plow.
Skin colter plow.
Slip share.
Snow plow.
Sod plow.
Steam plow.
Steam-plowing engine.
Subsoiler.
Subsoil plow.
Sugar-land plow.
Sulky cultivator
Sulky plow.
Sweep.
Sweet-potato digger.
Swing plow.
Swivel plow.
Three-furrow plow.
Three-horse cultivator.
Tongueless cultivator.
Tourne oreille.
Trenching plow.
Triple gang plow.
Triple plow.
Triple shovel plow.
Turning cultivator.
Turning mold-board plow.
Turn-wrest plow.
Two-furrow plow.
Vineyard bisoc.
Vineyard cultivator.
Vineyard harrow.
Vineyard plow.
Walking cultivator.
Walk scraper.
Weeding hoe.
Wheel hoe.
Wheel plow.
Windlass.
Wooden mold-board plow.

In plowing with dynamite a certain number of dynamite cartridges are buried at regular distances in the soil, and connected together by electric wires. The explosion is simultaneous; and, though nothing is thrown up, the field is effectually plowed.

The Sackett plow and pulverizer throws the soil into a cage which rotates at the side of the plow, and so pulverises the soil.

Plows of all nations.	"*Scientific American Sup.,*" 2249.
Knight	"*N. Y. Tribune,*" Aug. 20, 1878.
Early Br., etc. (40 Figs.)	* "*Engineer,*" xlviii. 26, 43, 72.
In Gt. Britain, notes on early plows	"*Engineering,*" xxvii. 534.
Daniel Webster's	* "*Scientific American,*" xxxv. 323.
Plowing with dynamite	"*Scientific Amer.,*" xxxvi. 262.

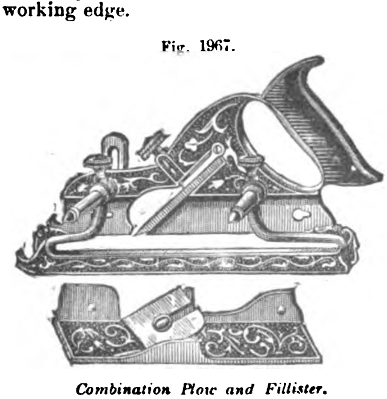
Electric, *Chrétien & Felix*, Fr.	* "*Engineer*," xlvii. 434.
Felix, Fr.	"*Scientific American Sup.*," 3791.
	"*Scientific American*," xli. 41.
Plow engine, *Burrell*, Br.	* "*Engineer*," l. 44.
Howard, Br. . . .	* "*Engineer*," l. 61.
Fowler	* "*Engineer*," l. 68.
Burrell, Br.	* "*Engineer*," xliv. 262.
Everitt & Adams, Br.	* "*Engineering*," xxviii. 218.
Iron	"*Scientific Amer.*," xxxvi. 164.
At French Expo. trials, 1878	* "*Scienifitc Amer.*," xxxix. 162.
Paris, rude plows at . .	"*Scientific American Sup.*," 2142.
French	* "*Scientific American Sup.*," 2601.
Ridging	* "*Scientific Amer.*," xxxix. 164.
Kilburn show, 1879 (20 Figs.), Br.	* "*Engineer*," xlviii. 25, 43, 72, 284, 386.
Large " Great Western," Cal.	"*Min. & Sc. Press*," xxxvii. 87.
Rotary mold	"*Scientific American*," xxxvii. 66.
Railway ditch, *Deere* .	* "*Scientific American*," xl. 294.

The report of *Dr. E. H. Knight* on Class 76, at the Paris Exposition, of 1878, contains views and descriptions of the following varieties of plows ("*Paris Exposition Reports*," v., p. 1, *et seq.*): —

Wooden mold-board plow	France
Charrue à chaine	France.
Plow mounted with avant-train	France.
Brabant simple	France.
One-wheeled plow	France.
Large two-wheeled plow, with jointer . . .	France.
Two-wheeled plow	England.
" Bridle " pattern wheel-plow	England.
Revolving mold-board plow	England.
Michigan rod-beam plow	U. S.
Movable-point plow	France.
Single plow	France.
Iron-beam plow	U. S.
Center-lever plow	U. S.
Reese combination plow	U S.
Tourne-oreille	France.
Tourne-oreille, shifting socket-piece . . .	France.
Turning mold-board plow	France.
Hillside plow	U. S.
Brabant double plow	France.
Brabant double plow, with skim-colter . .	France.
Brabant double plow, with subsoil talons .	France.
Brabant double plow, with skim-shares . .	France.
Skim-shares	France.
Subsoil plow	France.
Brabant subsoil plow	France.
Sayn's scarifier	France.
Mole plow	France.
Draining plow	France.
Trenching plow	France.
Ridging plow	France.
Clearing plow	France.
Gilpin's sulky plow; *Deere & Co.*, Moline .	U. S.
Bisoc	France.
Gang plow	U. S.
Double-furrow plow	England.
Bisoc double	France.
Charrue à trois socs	France.
Three-furrow plow	France.
Leveling implement, with 5 plows	France.

2. (*Joiners.*) A grooving plane, with adjustable fence to regulate the distance of the groove from the working edge.

Fig. 1967.



Combination Plow and Fillister.

The tool shown in Fig. 1967 embraces a combination of the carpenter's plow, an adjustable fillister, and a matching plane.

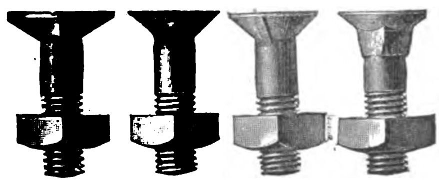
The engraving represents the stock of the tool, adjusted for use as a plow.

A metallic bed-piece, with cutter, can be attached to the stock of the tool by means of two screws passing through the slots in the base-piece of the stock. Over this bed-piece the gage, or fence, will move backward or forward, and when secured to the bars by the thumb-screw will constitute an adjustable fillister of any width required.

See also DADO; FILLISTER, "*Mech. Dict.*"

Plow Bolt. A bolt for securing the share, landside, or mold-board to the stock. It has a

Fig. 1968.



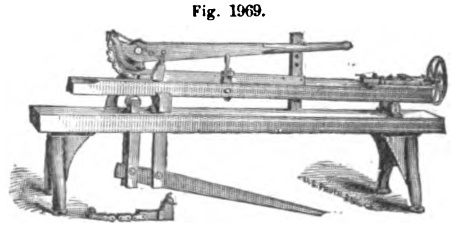
Plow Bolts.

chamfered countersunk head, and usually a square or fin to keep it from turning when the nut is screwed on.

Plow Grind'er. An emery machine specially adapted for grinding the faces of shares, mold-boards, and landsides.

Plow-han'dle Bend'ing Ma-chine'. A machine adapted for bending plow-handles after they are turned. The handle is steamed, it is locked to

Fig. 1969.



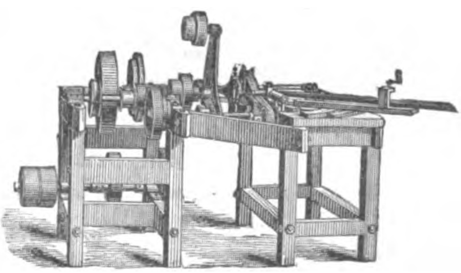
Plow-handle Bending Machine.

the bed of the machine, the grip-end attached to the lever, which is then brought down, bending the handle by means of a flexible chain on the outside. The end of the handle is then fastened by a rod to a cramp on the straight portion of the same, and the piece removed to season in drying.

See also WOOD-BENDING MACHINES, pp. 2803, 2804, "*Mech. Dict.*"

Plow-han'dle Pol'ish-ing Ma-chine'. A

Fig. 1970.



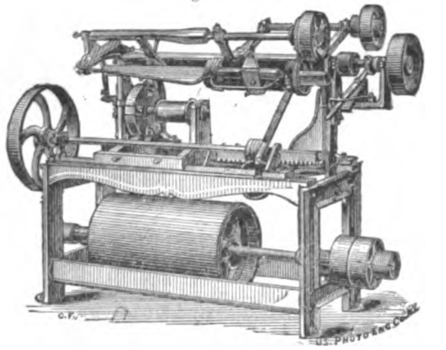
Plow-handle Polishing Machine.

machine for polishing or smoothing plow-handles after they are bent and sufficiently seasoned. It has a central shaft on which is a cast-iron frame, with pulleys and a smoothing belt. It is automatic. The handle is put in position and fastened, the feed is thrown in by the lever, which causes the frame with the polishing belt to revolve around the handle; at the same time the carriage holding the handle feeds slowly along until the bent or rounded part of the handle is finished, at which point it throws out the feed.

Plow-han'dle Lathe. A machine on the principles of the Blanchard lathe, adapted to turn plow-handles by patterns.

In the case represented the pattern-rest is adjustable so that it will turn different sizes from the same pattern without readjustment of the machine. The cutter head is so arranged and constructed that it reduces the stuff worked with great ease, leaving it in a smooth condition; it runs in a movable carriage, is automatic in its operation, and is protected by an iron cover from accident.

Fig. 1971.



Plow-handle Lathe.

Plow'ing Ma-chine'. See * STEAM PLOW, pp. 2354-2356, "*Mech Dict.*"

Knight's report of Group 76, "*Paris Exposition* (1878) *Reports*," v., pp. 53-89.

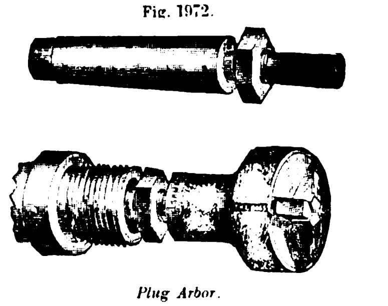
Plug. 1. A tap, made of a form intermediate. *Taper, plug, bottoming,* see Fig. 6211, p. 2495, "*Mech Dict.*"

2. A stopper screwed into the end of a pipe.

3. A short rod, split lengthwise, and the sections driven apart by a wedge known as a *feather;* for riving stone, Fig. 3834, p. 1749, "*Mech. Dict.*"

Plug Ar'bor. A lathe attachment for mounting drill chucks. *Cushman,* Fig. 1972.

Fig. 1972.



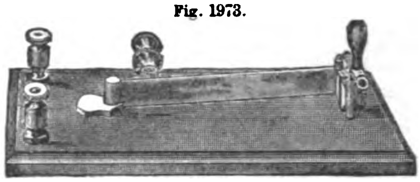
Plug Arbor.

Plug Ba'sin. A standing washbowl with plug hole at bottom for emptying.

Plug Cock. A faucet which is simply driven into the barrel, not screwed in.

Plug Cut'-out. (*Telegraphy*) Or *wedge cut-out;* a spring connected to one main-line binding-post, normally rests against a pin connected with the other main-line binding-post, thereby forming a spring-jack into which a wedge-shaped switch-loop-

Fig. 1973.

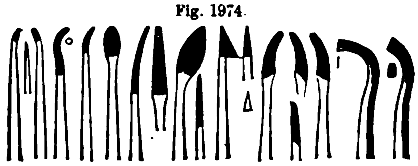


Plug Cut-out.

plug may be inserted for the purpose of connecting instruments in line without disturbing the continuity of the circuit. A set-screw bearing against the side of the spring is used for adjusting its tension.

Plug Fin'ish-er. (*Dentistry.*) A fine file for finishing the surfaces of tooth fillings.

Fig. 1974.



Plug Finishers.

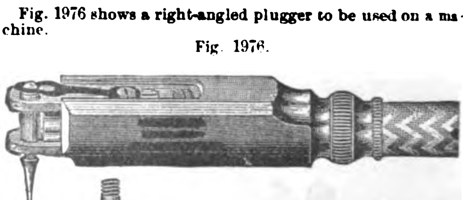
The sizes, shapes, and fineness of tooth, fit the instruments for special applications. Some are file-cut on one side and some on both.

See DENTAL FILE, Fig. 796, p. 251, *supra.*

Plug'ger. (*Dentistry.*) A tool for driving and packing filling materials into carious and excavated teeth.

Fig. 1975 shows a number of hand pluggers of various forms.

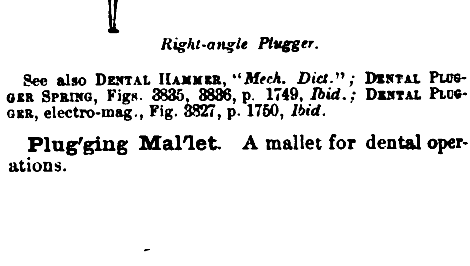
Fig. 1975.



Hand Pressure Pluggers.

Fig. 1976 shows a right-angled plugger to be used on a machine.

Fig. 1976.



Right-angle Plugger.

See also DENTAL HAMMER, "*Mech. Dict.*"; DENTAL PLUGGER SPRING, Figs. 3835, 3836, p. 1749, *Ibid.*; DENTAL PLUGGER, electro-mag., Fig. 3827, p. 1750, *Ibid.*

Plug'ging Mal'let. A mallet for dental operations.

The heads are *lignum vitæ*, soft steel, wood with metal core. See DENTAL MALLET, p. 251, *supra*.

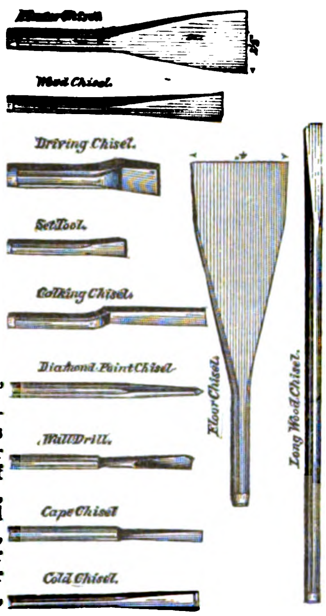
Plug Tap. One somewhat tapered at the end to facilitate its entrance in commencing to tap a hole. See PLUG, *supra*.

Plumb. The suspending string is wound upon a reel concealed in the interior, and the friction of the reel will keep the bob suspended at any point. On release of the cord it rewinds.

Fig. 1977.

Plumb Bob.

Fig. 1978.

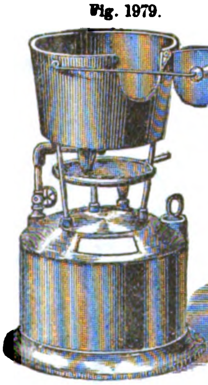


Plumbers' Chisels.

Plumb'ers' Chis'els. Various lengths and widths, for cutting walls of brick, plaster, and wood; cold chisels for iron, long chisels for boring holes for pipes or wires, etc.

Plumb'ers' Fur'nace. A portable soldering furnace. That shown is heated with petroleum elevated from the reservoir below and burned in the tray. The handle forms a rest for soldering bits.

Fig. 1979.



Plumbers' Furnace.

Plumb'er's Tools. See list under PIPES, etc., *supra*.

Plun'ger. (*Fire-arm.*) *a.* A pin struck by the hammer and exploding the priming by force of the communicated blow.

b. In other cases the plunger has the exploding point on its own end, as in the bolt gun.

Plun'ging Bat'te-ry. (*Electricity.*) One in which the positive or the positive and negative elements may be withdrawn from the fluid to render the battery inoperative, or to prevent the consumption of the plates when the battery is not required.

Grenet's bichromate battery is a familiar instance. *Prescott's "Electricity,"* * p. 72.

c c', Fig. 2148, p. 938, "*Mech. Dict.*," is an early form of plunging battery used by Sir Humphrey Davy.

See also Fig. 14, p. 2490, * "*Scientific American Sup.*"

It may be added that there are three principal modes: —

1. By plunging the elements into the liquid.

2. By raising the trough so that the liquid surrounds the elements.

3. By displacement of the liquid, raising it to the level of the elements.

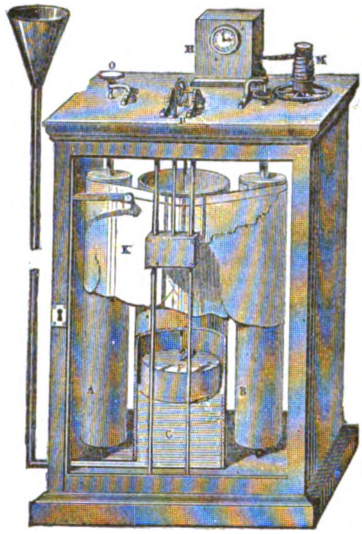
Plush. (*Fabric.*) The fabric known as *furniture plush* is a mohair fabric known also as *Utrecht velvet*. It is of mohair filling with cotton warp, or, in the better qualities, of mohair entirely. See MOHAIR.

Plush Bat'te-ry. A modification of the Callaud. Fr., * "*Engineer*," xlvii. 333.

Plu'vi-am'e-ter. An instrument used to measure the quantity of rain which falls over a given surface.

A new apparatus by M. Hervé Mangon is shown in Fig. 1980. A cylinder, *C*, receives the rain water led from the receiver *P*. In the cylinder is a copper float *F*, which, by means of a very fine cord passing over the pulley *N*, is connected to the weight *K* which is a little the heavier. The weight *K* slides on two guides of tightly stretched pianoforte wire, and carries a pencil, the point of which comes in contact with the

Fig. 1980.



Pluviameter.

exterior of the cylinder *C*. Inside the weight *K*, which is hollow, is a small electric interrupter, which, whenever a current is transmitted to it from the regulator, strikes against the pencil and produces indicated points on a curve, which serves to control the clock movement by which are actuated the two copper cylinders *A* and *B*. Over these last a belt of paper is passed, as shown; and the mechanism in *H*, which moves them, is provided with a regulating fusee *M*, so as to compensate for the difference caused in the diameter of the cylinder *B*, by the rolling thereon of several thicknesses of paper. *I* is a fixed pencil which traces a horizontal base-line on the paper. The latter, after first being rolled about the cylinder *A*, is carried over cylinder *C* and attached to cylinder *B*. In the middle cylinder sufficient water is then introduced to completely buoy up the float *F*. If rain falls, the float, by the addition of water beneath it, is lifted; and the weight *K* following the movement, the pencil thereon traces a curve on the paper, which gives in millimeters the corresponding depth of rain. If, on the contrary, no rain falls, the line left by the weight pencil is straight and parallel to that made by the fixed pencil.

Lysimeter	p. 865, *supra*.
Pluviameter, *Mangon* .	* "*Scientific American*," xxxiv, 150.
Pluviametrograph, *Salleron*	*Laboulaye's "Dict.*," iv., Fig. 16, cap. "*Météorographe*."
Pluviascope, *Mangon* .	*Ibid.*, same article.
Rain gage	Fig. 4146, pp. 1872-1874, "*Mech. Dict.*"

Ply. 1. A web — as of a carpet. *Two ply* means two webs, woven together so as to interchange yarns at the points required to bring a color to the surface in accordance with the pattern.

2. When the union of the two webs or plies occurs is the *ingrain*, which gives the name to this description of carpet.

Pneu-mat'ic Bat'te-ry. (*Electricity.*) One in which a blast of air is introduced to agitate the exciting liquids, and depolarize the elements. *Dr. Byrne's* is an instance. See AERATED BATTERY; BYRNE BATTERY.

Also . . . * "*Telegraphic Journal*," vi. 222, 269.
* "*Engineer*," xlv. 279, 406.
"*Scientific American Supplement*," 1922.
* "*Engineering*," xxv. 417.
* "*English Mechanic*," xxvii. 307.
"*Scientific American*," xxxviii. 228.
Paper by Preece * "*Jour. Soc. Tel. Eng.*," vii. 60; 82.

Pneu-mat'ic Clock. A clock which is driven or regulated by air.

In the Parisian system, handsome public illuminated timepieces have been erected in the middle of the causeway of the leading thoroughfares of Paris. These are all in communication with the works of the new Pneumatic Clock Company, in the Rue St. Anne. By means of subterranean tubes this company receives the time direct from the Observatoire every morning, and regulates all the timepieces in connection simultaneously. In future it will be possible to have the correct time laid on in any house, like gas or water, at the trifling cost of from three to five centimes per clock per day.

To supply the whole of Paris, three or four central clocks are required, designated *Directing Normal Clocks*. These are placed at convenient centers, and connect with the ordinary or "Reception Clocks" of their system or district. Each of these central clocks is connected with a system of pipes, including, first, those running through principal streets; next, those branching therefrom into the minor streets; next, those running from the streets into the buildings; and, finally, smaller ones running as required in the interior of the buildings.

The central clocks are provided with a small engine, worked by steam or gas, which every minute sends a pulsation of compressed air through the entire system of pipes and acts upon every clock in the circuit, advancing the hands on the dial of the clock by one minute. The clocks are of simple construction.

See: . . . . * "*Scientific American*," xliii. 19; * xxxix. 207; xli. 5.
Paris . . . . * "*Manufact. & Builder*," xii. 217.
Vienna . . . . * "*Engineer*," xliii. 448.
* "*Scientific American Sup.*," 1331.
Regulator, *Maybridge* . * "*Scientific American*," xl. 130.
Regulator, *Wenzell* . . * "*Min. & Sc. Press*," xxxviii. 281.

Pneu-mat'ic Con-duct'or. A fan blower and tube, to lead away air, foul air, fire damp, fumes, smoke, dust, shavings, etc.

Such are used in connection with stones which grind dry, such as in some departments of cutlery.

Shavings from a planing mill in Chicago are driven by air blast 700' through a 15'' sheet-iron pipe to a distillery, where they are burned.

See SHAVINGS CONDUCTOR, p. 2134, "*Mech. Dict.*"; FAN BLOWER, Fig. 1918, p. 825, *Ibid.*

Pneu-mat'ic Dis-patch'. A mode of conveying letters, parcels, etc., by sending them through a tube by force of air; vacuum or plenum systems. See PNEUMATIC TUBE.

Pneu-mat'ic Ex'ca-va'tor. A method of raising of sand, silt, or debris from a shaft in course of excavation.

Several forms are given in the "*Mech. Dict.*" under PNEUMATIC CAISSON, p. 1752; PNEUMATIC PILE, p. 1754; CAISSON, p. 421; AIR LOCK, p. 49, and Plate II.; SUBMARINE EXCAVATOR, Fig. 6028, p. 2439, etc.

The methods vary: 1. In the *Potts* system, the pile is a tube with the top closed, and the air being exhausted from within, the atmospheric pressure drives the cylinder into the sand. Used on the Goodwin Sands, England.

2. In the *Triger* system, the workmen are in the lower end of the chamber, and communicate with the exterior by air locks. See AIR LOCK, "*Mech Dict.*," p. 49. The system was used in sinking the caissons of the St. Louis and Brooklyn bridges. See references above quoted.

3. A mode of moving silt, mud, or sand by a pipe, the open end of which is exposed to the matter to be moved, and the air exhausted from the pipe. A vacuum system; a form of dredging apparatus.

4. The converse of the last mentioned; a pipe with blast of air, carrying with it detritus, silt, sand. Used in removing the matters from the caissons of the Brooklyn and St. Louis Bridges. See AIR LOCK, "*Mech. Dict.*;" PILE DRIVING, *supra.*

A form of pneumatic excavator which comes under the first cited of the four methods, is used in British harbor improvements.

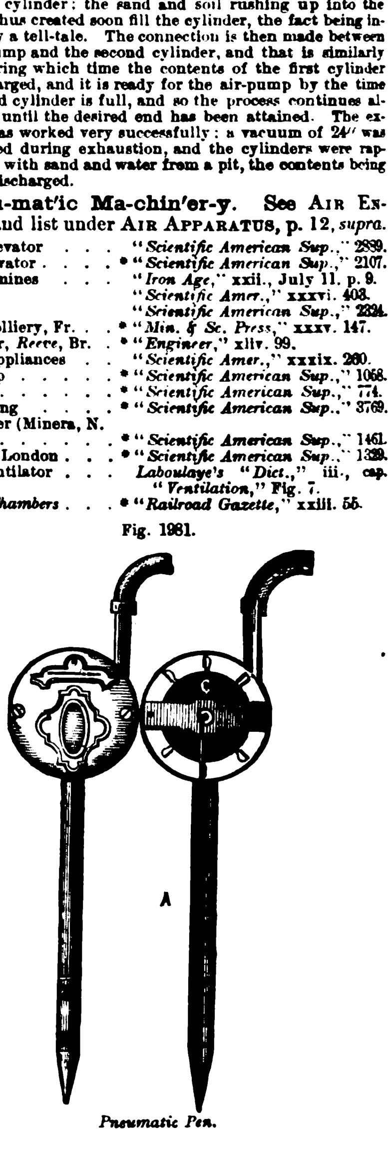
It is chiefly used for sinking the cylinders for the piers of bridges in sandy soil. The apparatus consists of a pair of cast-iron cylinders 4' in diameter, carried on a staging and placed in connection at their tops with an air-pump, driven by a small steam engine. The connections are so arranged that the air can be exhausted either from one cylinder singly or both at the same time. The bottoms of the cylinders are connected with a suction tube 3¼'' in diameter, which leads down to the sand. Here again it is so arranged that the cylinders can be worked, either singly or in combination, by means of self-acting valves. The soil is discharged from each cylinder by a trap door placed in its front. The engine and air-pump are carried on the same framing, and the whole forms a very compact arrangement.

In operation, the engine being started, the air is exhausted from one cylinder: the sand and soil rushing up into the vacuum thus created soon fill the cylinder, the fact being indicated by a tell-tale. The connection is then made between the air-pump and the second cylinder, and that is similarly filled, during which time the contents of the first cylinder are discharged, and it is ready for the air-pump by the time the second cylinder is full, and so the process continues alternately until the desired end has been attained. The excavator has worked very successfully: a vacuum of 24'' was maintained during exhaustion, and the cylinders were rapidly filled with sand and water from a pit, the contents being quickly discharged.

Pneu-mat'ic Ma-chin'er-y. See AIR ENGINES, and list under AIR APPARATUS, p. 12, *supra.*

Also: Elevator . . . "*Scientific American Sup.*," 2889.
Grain elevator . . . . * "*Scientific American Sup.*," 2107.
Hoist in mines . . . "*Iron Age*," xxii., July 11, p. 9.
"*Scientific Amer.*," xxxvi. 403.
"*Scientific American Sup.*," 2324.
Épinac colliery, Fr. . * "*Min. & Sc. Press*," xxxv. 147.
Excavator, *Reeve*, Br. . * "*Engineer*," xliv. 99.
Mining appliances . . "*Scientific Amer.*," xxxix. 260.
Ore stamp . . . . . * "*Scientific American Sup.*," 1058.
Pen . . . . * "*Scientific American Sup.*," 774.
Pile driving . . . . * "*Scientific American Sup.*," 3769.
Rock borer (Miners, N. Wales) . . . . . * "*Scientific American Sup.*," 1461.
Railway, London . . . * "*Scientific American Sup.*," 1329.
Screw ventilator . . . *Laboulaye's* "*Dict.*," iii., cap. "*Ventilation*," Fig. 7.
Signal, *Chambers* . . . * "*Railroad Gazette*," xxiii. 55.

Fig. 1981.



Pneumatic Pen.

Pneu-mat'ic Pen. An instrument for obtaining a stencil for copying purposes. Fig. 1981. Numerous perforations are made through the paper by the instrument which follows the lines of the letters. See ELECTRIC PEN.

The instrument is guided as an ordinary pen. The tube *A* contains the needle *B*, which is connected to a crank on the axis of the fan-wheel *C*. Rapid motion is imparted to the fan by means of a blast of air either from the mouth of the writer or an air-bellows, through the flexible rubber tube *D*, connected with a foot-bellows or otherwise. On moving the point of the pen over a sheet of paper, it becomes pierced with very fine holes in lines of the desired pattern. Ink or color is then spread over the surface, which fills the holes, and passes through the stencil to as many sheets of paper as may be brought successively in contact with it.

Pneu-mat'ic Pile. See PILE DRIVING, *supra*.

Pneu-mat'ic Pile Dri'ver. See * PNEUMATIC PILE, p. 1754, "*Mech. Dict.*"; PNEUMATIC EXCAVATOR, *supra*;" see also PILE, *supra*, and * "*Scientific American Supplement*," 3769.

Pneu-mat'ic Pump. A pump in which the pressure of air upon a liquid is made the means of forcing or elevating. An application of the air pump.

The pump shown in Fig. 1982 is used for the discharge of the contents of casks, carboys, etc. It is a caoutchouc bulb

Fig. 1982.

Pneumatic Pump.

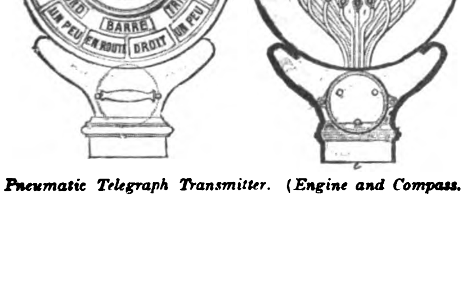
with valves. The pipe passes through the bung of the cask and condenses the air above the liquid in the latter. The liquid passes out by another pipe to the vessel placed to receive it.

Pneu-mat'ic Tel'e-graph. The pneumatic telegraph of Count Sparre, of Sweden, is shown and described on p. 1755, "*Mech. Dict.*" It acts by the impulse given to a column of water by pneumatic pressure.

Under PNEUMATIC CLOCK, *supra*, is described the method of running all the clocks of a district by means of an impulse of air, at definite intervals, carried by pipes to each clock in the district, and moving the hand on the dial one step.

The *télégraphe à air* of M. Walcker, of Paris, is shown in Figs. 1983–1986, as applied to the vessels of the French navy and transatlantic service.

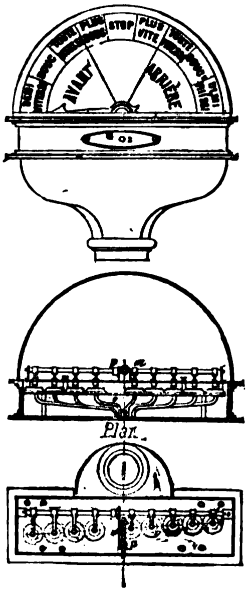
Fig. 1983.



Pneumatic Telegraph Transmitter. (Engine and Compass.)

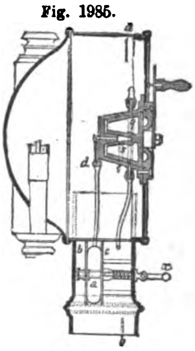
Fig. 1983 gives two views of the transmitter, — a front elevation and a vertical section on the same plane, a little behind the dial, on the line *a b*, Fig. 1985.

Fig. 1984.



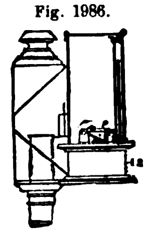
Pneumatic Telegraph Receiver. (Engine.)

Fig. 1985.



Pneumatic Telegraph Transmitter. (Transverse Section.)

Fig. 1986.



Pneumatic Telegraph Receiver. (Transverse Section.)

Fig. 1984 has three views of the receiver, — a front elevation, a vertical section in the rear of the dial exposing the machinery, and a horizontal section giving a plan of the acting parts.

Fig. 1985 is a vertical section on a plane transverse to the former.

Fig. 1986 is a vertical transverse section of the receiver.

The purpose of the apparatus is to convey to the engineer and to the steersman the directions of the captain or pilot on the bridge of the steamer.

The apparatus is double or single; in the former case, the dial has a full circle, the upper hemisphere concerns the engine, and the lower portion the rudder. In the single apparatus the engine or the rudder is alone concerned, — one single transmitting apparatus for each being placed on the bridge.

The operation of the apparatus is by compressed air, caused by a pressure brought upon the caoutchouc reservoir *a*, which is compressed between plates *b c* when the piston *x* is pulled. Air escapes to the chamber *d* and thence to passages *e f*, which, by devices to be described, sound a bell and move a pointer respectively in the receiver, which may be in the engine-room or the wheelhouse, as the case may be.

The operation is as follows: The needle being at zero, in the horizontal position shown in Fig. 1983, and the vessel supposed to be on her course, the officer on the bridge wishing to stop the engines, takes hold of the pointer (the handle is seen projecting to the right in Fig. 1985), and moves it to "*stop*," at the same time pulling the piston *x* and compressing the air in *a*. There are as many pipes to convey the air from the transmitter to the receiver as there are directions; for the engineer there are 9, — 1 for "*stop*" and 4 each for graduations of speed in "*forward*," "*astern*," respectively. In the example cited, "*stop*," the air passes in two bodies, one to the bell in the engine-room which calls the alarm, and the other by the special pipe which actuates the needle in the receiver, Fig. 1985, to bring it from its horizontal (zero) position to "*stop*" on the dial. The position of the pointer on the transmitter governs the choice of pipe openings, which are shown in a circular series in the sectional view Fig. 1983. The transverse section, Fig. 1985, shows the lamp at the rear which illuminates the glass dial on which the various indications are pointed.

The receiver is shown in Figs. 1984, 1986. It requires but a half-dial to hold its indications, and is but a single machine which belongs to the engine room. The fellow machine, which responds to the other half of the transmitter, is in the wheel-house. Taking the receiver in the engine-room: the pointer, when at zero, is horizontal, and the action of the air is to cause it to make a sweep within the range of a semicircle. The 9 air-tubes from the transmitter lead to as many levers in the receiver. As the levers are of different lengths an equal motion of the end of each will have a corresponding effect upon the axis *m*, with which they are connected, and upon the level gear *p* which actuates the needle. Thus the latter is moved less or more to bring it to the required place on the dial, which, in the example cited, "*stop*," is midway, that is, vertical. It stays at its indication until the engineer pulls on the button *z* and releases the air. The engineer then calls "*Aye, aye, sir*" through an acoustic tube. The same description, *mutatis mutandis*, applies to the steering.

Pneumatic telegraphy .	"*Scientific American Sup.*," 75.
Pneumatic telegraph .	"*Scientific American*," xxxiv. 19.
	"*Scientific Amer.*," xxxvi. 175.
Signal, *Chambers* . . .	* "*Railroad Gazette*," xxiii. 55.

Pneu-mat'ic Tube Dis-patch'. See the history and details, pp. 1755–1757, "*Mech. Dict.*"

The tubes of the Western Union Telegraph Co., New York, are 2¼″ interior diameter, with a capacity for sending 4 boxes a minute. The pipes, which are 18′ long, and joined by air-tight screw-joints, are laid 3′ under ground. The curves have a radius of 12′. The engine in use is a 30 horse-power compressing engine; and exhausting at the same time from two separate reservoirs. It has a capacity for 40 tubes.

The pneumatic dispatch service, of Berlin, Germany, embraces 26 kilometers of tube, and has 15 initial stations. The wrought iron tubes have a clear breadth of 65 millimeters, and lie about one meter below the surface of the ground. The letters and cards which are to be forwarded have a prescribed size, and are inclosed in iron boxes, or cartridges, each of which can hold 20 letters or cards. In order that they may pack closely, they are covered with leather. From 10 to 15 cartridges are packed and forwarded at a time; behind the last cartridge is placed a box with a leather ruffle, in order to secure the best possible closure of the tube. At four of the stations are the machines and apparatus needed for the business. The forwarding of the boxes is effected either through compressed or rarefied air, or through a combination of the two. Steam engines of about 12 horse-power are used for the condensation or exhaustion of the air. Each main station has two engines, which drive a compressing and an exhausting apparatus, the steam for each engine being furnished by two boilers. Large reservoirs are employed, both for the condensed and for the rarefied air. The former has a tension of about three atmospheres; the latter of about 35 millimeters of mercury. The air, which is heated to 45° C. by the compression, is cooled again in double-walled cylinders which are surrounded by water. The velocity of the boxes averages 1,000 meters per minute, and a train is dispatched every 15 minutes. Each of the two circuits is traversed in 20 minutes, including stoppages.

The service between Paris and the chambers where the sittings of the National Assembly were held at the Palais in Versailles, involved a line of 11 miles, and the packages were dispatched at an average of 8 minutes for the course. The tubes were 4″ in diameter, and required three steam engines of an aggregate of 50 horse-power. An apparatus called a relay acts as an accumulator, and comes in aid of the original impulse at points along the route. The air is forced in at one end and exhausted at the other, the messages are in boxes forming a train, and the relays come into action immediately that a train passes a station.

The French method of locating the position of an obstruction in a pneumatic tube is by firing a pistol into the tube. The resulting wave of compressed air, traversing the tube at the rate of 1,000′ a second, strikes the obstruction, and is then reflected back to its origin, where it strikes against a delicate diaphragm, and its arrival is recorded electrically upon a very sensitive chronograph, on which also the instant of firing the pistol had been duly recorded.

Berlin	"*Telegraphic Journal*," iv. 246.
	* "*Scientific Amer.*," xxxviii. 18.
	"*Scientific American Sup.*," 376.
	"*Min. & Sc. Press*," xxxvi. 51.
New York	* "*Scientific American*," xxxii. 223.
	"*Scientific American*," xxxv. 328.
London	* "*Scientific American Sup.*," 31.
Postal, Vienna	* "*Scientific American Sup.*," 1426.
Western Union . . .	"*Telegraphic Journal*," iv. 161.
System, *Culley* . . .	"*Van Nostrand's Mag.*," xiv. 111.

Pneu'mo-graph. The *cardiograph* of M. Marey is capable of being used also as a *pneumograph* by an adaptation of the apparatus of exploration.

This consists of a spiral spring inclosed in rubber and forming a hollow extensible cylinder of which the ends are closed. A lateral tube places the interior of the cylinder in communication with the registering apparatus, which is shown under CARDIOGRAPH. Each action of inspiration and expiration produces a movement of contraction or extension of the cylinder, which reacts upon the registering lever.

The elastic cylinder is placed with its end on the breast of the subject, and is included within an inelastic band which encircles the chest. As the chest expands and contracts in the act of breathing, the cylinder is condensed and dilated respectively, the air passing by the tube to the registering apparatus.

Laboulaye's "*Dictionnaire*," *cap.* "*Graphiques*."

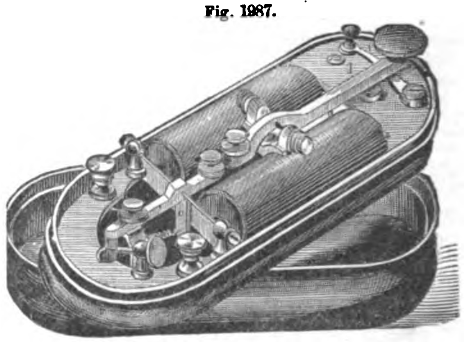
Pock'et. (*Mining.*) A rich spot in a vein or deposit.

Pock'et Mi'cro-scope. (*Optics.*) A portable microscope, to be carried in the pocket for field purposes; sometimes a set of single lenses; sometimes supplied with a compound body.

Pock'et Net. (*Fishing.*) One with a relatively small compartment in which the fish are collected. See TRAP NET. See also TRAMMEL NET.

Pock'et Re'lay. An instrument for making telegraphic connection at any point on a line, to communicate in case of accidents, etc. Also known, from its use, as a *wrecking instrument*.

Fig. 1987.



Pocket Relay.

Po-dom'e-ter. See PEDOMETER.

Po'do-scaph. A foot boat; one in which canoe-shaped floats are attached to or support the feet.

The one shown is that made by Mr. Fowler, of Bordeaux, and used by him in crossing the Straits of Dover.

The dimensions are: length, 3 meters.
Each podoscaph: width, 20 cm.
Above water: height, 30 cm.
Time of crossing: about 12 hours. Distance 21 miles.

Fig. 1988.

Fowler's Podoscaph.

Pog'gen-dorf Bat'te-ry. (*Electricity.*) 1. A Smee battery, in which pulverized copper is deposited upon the copper electrode.

Niaudet, American translation . . . . . . p. 59.

2. A modification of the Grove battery, in which

the platinum is in the shape of an S, and is fastened to a porcelain stopper, which nearly closes the porous jar.

Niaudet, American translation . . . . . . * p. 155.

Point Find'er. An instrument for finding the vanishing point in making perspective projections.

"*Engineering*" . . . . * xxii. 223.

Point'ing. 1. (*Milling.*) A preliminary in the preparation of grain for the mill in the modern process; it consists in rubbing off the points of the grain, *clipping* the *brush*, and removing the germ end.

This is done in a machine like a *smut mill* (which see), or by passing the grain between mill-stones separated from each other by a distance a little less than the length of the grain. The grain is only abraded when in a position vertical to the surface of the stones. This is the first operation in the *high-milling* process, *which see*.

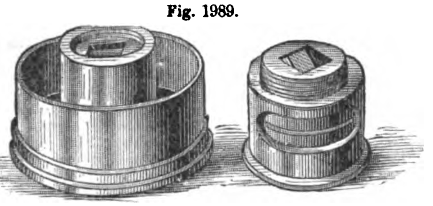
2. (*Metal Working.*) A machine for finishing the ends of nails, pins, or wire.

* "*Iron Age*" . . . . xxii., December 26, p. 1.

Po-lar'i-scope. (*Optics.*) An instrument for analyzing the light thrown through an object, whereby, in accordance with its varied texture, varied shades of the spectrum are given to its different parts. This is usually effected by two Nichols prisms of Iceland spar; sometimes by means of tourmalines. See TOURMALINE.

One of the prisms is placed beneath the object and above the mirror, and is called the *polarizer*. The other prism is

Fig. 1989.



Polariscope.

above the object-glass, and is called the *analyzer*. By revolving either of these prisms variations in the tints of the spectrum are produced.

The polariscope is an invaluable adjunct to the microscope for detecting the structure of miner ls, animal tissues, vegetables, crystals, etc.

Laurent's polariscope, used in determination of quantity of sugar in solutions, is described in Dr. McMurtrie's report on beet sugar, 1880, "*Dept. Agric. Special Report*," No. 28, pp. 84, 85.

Polar clock . . . "*Scientific American Sup.*," 505.
"*Mech. Dict.*," Figs. 3767–3769, p. 1759.
Lockyer's "*Spectrum Analysis.*"
Schellen's "*Spectrum Analysis.*"

Po'lar-i-za'tion. Broadly, the definition is thus given by a philosopher: —

"When a particle of a body possesses qualities related to a certain line or direction in the body, and when the body, retaining these properties, is turned so that this direction is reversed, then if, as regards other bodies, these properties of the particle are reversed, the particle, in reference to these properties, is said to be polarized, and the properties are said to constitute a particular kind of polarization." — *Clerk-Maxwell.*

1. (*Galvanic Batteries.*) The accumulation of hydrogen upon the negative plate, followed by the deposition of zinc from the said plate, by which the current is weakened.

2. (*Magnets.*) The establishment of magnetic poles in a piece of steel or iron, as of a compass needle or the soft iron core of an electro-magnet by means of a generated circuit.

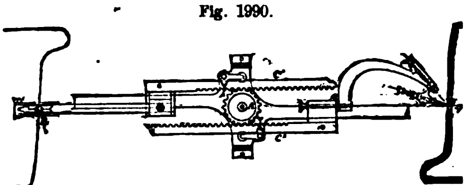
3. (*Light.*) The separation of a pencil of light into two rays, in planes at right angles to each other, known as the ordinary and extraordinary rays, which may be done by double refraction or by reflection.

4. (*Heat.*) A similar action with heat rays.

Po'lar Pan'to-graph. An apparatus devised by M. Napoli for copying on paper the profiles of worn railway-wheel tires.

The apparatus, shown in Fig. 1990, consists of a light frame, having mounted on it the toothed wheel *A*, into which gear the rack bars *C C'*, the former of these being

Fig. 1990.



Napoli's Polar Pantograph.

provided with a pencil-holder, *B*, while the latter is provided with a pointer, *D*. The arrangement of the parts is such that a line joining the center of the pencil at *B*, with the apex of the pointer at *D*, passes through the center of the wheel *A*, and is bisected by that center. The racks *C C'* are kept in gear with the wheel *A* by rollers mounted on bell-cranks, these bell-cranks being provided with springs which tend to force the rollers against the rack bars. The effect of the arrangement is that any movement in the plane of the wheel *A* imparted to the pointer *D* is exactly reproduced by the pencil *B*, and thus if the pointer *D* be moved over the profile of a tire the pencil *B* will draw that profile on a piece of paper placed under it. The whole apparatus is so mounted that it can be readily attached to the tire of which the profile has to be taken, provision being made for supporting the paper under the pencil *B*.

* "*Railroad Gazette*" . . . . . xxiii. 349.
* "*Engineering*" . . . . xxvi. p. 427, Fig. 8.

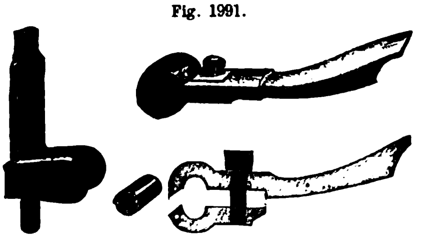
Pole. (*Electricity.*) The wire, plate, or cord leading from the battery. Their names are the opposite of those of the plates from which they lead; thus the zinc is the *positive* metal or plate of the battery, but the wire leading therefrom is the negative pole.

Pole Chan'ger. An instrument for shifting a current from negative to positive, or *vice versa*. See, for instance, the key at Fig. 847, p. 266, *supra*.

Pole Coup'ling. The connection of the pole or tongue with the front axle of a vehicle.

On the left is the clip, not yet bent to clasp the axle. To

Fig. 1991.



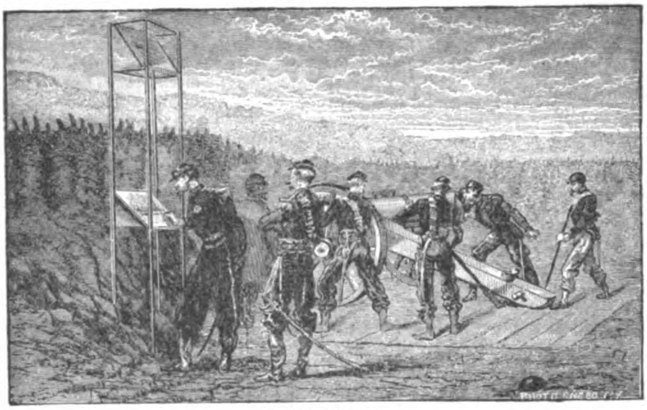
Pole and Shaft Coupling.

the right are the shaft-eye and rubber packing, shown complete and in sections detached. The rubber prevents rattling.

Po-lem'o-scope. A reflecting apparatus consisting of a combination of two plane mirrors, so inclined to each other as to enable the spectator, by glancing into one of them, to see the images of objects separated from direct view by intervening obstacles. It is used during sieges to observe the position and movements of the enemy, while the soldiers may remain in shelter behind a parapet.

A simple frame-work of wood supports at the top a plane mirror, with its reflecting surface directed towards the scene to be observed, at an angle of 45°; beneath this mirror is a second one, precisely similar, and with its reflecting surface inclined upward at the same angle as the upper one.

Fig. 1992.



Polemoscope.

The reflecting surfaces of the two mirrors are, therefore, opposite to each other, and parallel. The image received upon the first mirror is reflected directly upon the second, from which it becomes visible to an observer.

See * ALTISCOPE, Fig. 136, p. 69, "*Mech. Dict.*"; INDIRECT POINTING APPARATUS, p. 496, *supra.*

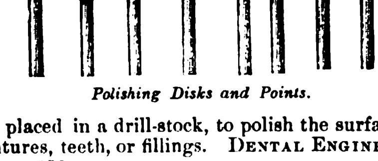
Pole Rail'way. One, the way of which consists of two parallel poles, the cars having tires with concave tread. Used for temporary purposes in the lumber regions in getting logs of a tract to the saw mill. See LOG RAILWAY.

Pol'ish-ing. Materials, tools, and machines are cited and described on p. 1762, "*Mech. Dict.*"

The forms of polishers are: —	Surfaces.	Materials.
Bands.	Bristles.	Borax.
Belts.	Brushes.	Chalk.
Cones.	Buff.	Colcothar.
Cylinders.	Catgut.	Corundum.
Disks.	Cloth.	Crocus.
Drums.	Cotton.	Emery.
Laps.	Felt,	Graphite.
Rings.	Leather.	Oxide of tin.
Sticks.	Metal.	Pumice stone.
Threads.	Stone.	Putty powder.
Wheels.	Thread.	Rotten stone.
	Walrus.	Rouge.
	Wire.	Tripoli.
	Wood.	
	Wool.	
	Yarn.	

Pol'ish-ing Disk. (*Dentistry.*) Small instruments carrying a fine powder and revolved by being placed in a drill-stock, to polish the surfaces of dentures, teeth, or fillings. DENTAL ENGINE, Fig. 795, p. 250, *supra.*

Fig. 1993.



Polishing Disks and Points.

Pol'ish-ing I'ron. A small laundry iron, sometimes curved on the face and used in putting the extra finish on shirt fronts, collars, cuffs, etc.

Pol'ish-ing Jack. (*Leather.*) A machine armed with a lignum-vitæ slicker; used for polishing leather when considerable pressure is required.

Pol'ish-ing Ma-chine'. (*Wood.*) A machine having an emery wheel which dresses the face of the work applied thereto.

See SURFACING MACHINE, Fig. 6083, p. 2458, "*Mech. Dict.*"

Speculum . * "*Sc. Amer. Sup.*," 699.
Wheels, *Rose* * "*Sc. Amer. Sup.*," 489.

Pol'y-chrome Print'ing. A process in which colors in blocks are built up together like type in a chase and themselves furnish the color to moistened paper laid thereon. A mosaic of color blocks. — *Johnson*, Br. See also British patent 14,078, 1852, and United States patent, *Laemmel*, July 4. 1871.

Pol'y-con'ic Pro-jec'tion. (*Geodesy.*) A development of the earth's surface in which each parallel of latitude is represented on a plane by the development of a cone having the parallel for its base, and its vertex in the point where a tangent at the parallel intersects a prolongation of the earth's axis.

Pol'y-gon'o-scope. (*Optics.*) An optical instrument for producing and displaying an infinite number of designs and patterns, which can be copied or photographed, and may be used for art manufactures, for amusement, or for other purposes.

The instrument consists of two mirrors fixed in a case and connected together by means of a universal hinge, which is so arranged that the mirrors can be set and fixed at any angle to produce any required design. One of the mirrors is loose in its frame, and can be moved toward or from the other, so that at whatever angle they may be fixed the edges of the mirrors can be made to touch each other, thus preventing the pattern or design from being broken in the center. The apparatus can be closed up in a portable form, similar to an ordinary pocket-book. Patterns having any number of angles or sides may be produced by varying the mirrors. The above has some resemblance to the kaleidoscope. — *Hatton*, Br.

Pol'y-graph. One of the names given to the gelatine copying pad. See GELATINE PROCESS; HECTOGRAPH; COPYGRAPH, *supra.*

In one modification of the process, instead of the gelatine compound in a tray, paper is coated with the material. Sized or unsized paper is coated on one side with a composition consisting of glue, or gelatine, glycerine, soap, and water, approximately in the following proportions, which have been found to give good results in practice: 80 animal glue or gelatine, 20 glycerine, 20 soap, 200 water.

The writing is made in aniline ink.

Then take a sheet of the polygraphic paper, lay it on a damp flannel, sponge with water containing a little alum, lay the writing thereon, ink to the gelatine, back with a sheet of paper, and put the pile in the ordinary copying press. — *Alisoff.*

Pol'y-mi'cro-scope. An adaptation of the principle of the revolving stereoscopic camera to microscopic purposes; the objects mounted on plates attached to a band are successively presented to the instrument.

Prof. Von Lenhossek, Buda-Pesth, * "*Scientific American Supplement*," 2267.

Po-lym'e-ter. An apparatus used for testing the distance between railway rails, and detecting inequalities of elevation.

An improved apparatus by M. Coutourier is mentioned in a paper in "*Bimensuel de la Société d'Encouragement*," 1878, p. 385, and republished in the proceedings of the "*Institute of Civil Engineers*," London.

It consists of an iron triangular ruler 6½" in length, having the long side for its base, furnished with a movable arm which is pressed against the rail by a spring. The arm communicates with a pointer, which stands at the zero of a finely divided scale when the rails are at their normal width apart (4′ 8½″ = 1.447 meters). Any deviation from this, more or less, is indicated on the scale.

At the side, a pendulum is attached to the ruler, which, when vertical, points to the zero of a circular scale; any change in the inclination of the ruler is communicated to an index sufficiently long to reproduce on the scale the actual amount of the super-elevation — or otherwise — of the rail. This communication can be made either by a toothed wheel or by a series of links from the pendulum to the index. See DYNAGRAPH, *supra*.

Pol′y-phote Reg′u-la′tor. (*Electricity.*) An order of voltaic arc regulators, also known as a *many-light* or *division* regulator, which allows several or many lights on one circuit.

Of this order are several forms, which see —
Differential.
Derivation.
Fixed interval (Regulators *à écart fixé*).

Po-lyp′tome. (*Surgical.*) A hook or écraseur for cutting loose a polypus in uterus, ovary, nasal cavity, etc.

Pol′y-pus For′ceps. (*Surgical.*) For removal of polypi by grasping and wrenching.

Allen's, Politzer's, Bumstead's, Avery's, Noyes', Hinton's, Pomeroy's, Tiemann's, and Wilde's ear forceps, pp. 45-47, Part II., *Tiemann's "Armamentarium Chirurgicum."*

Blake's polypus snares, *Ibid.*, p. 45.

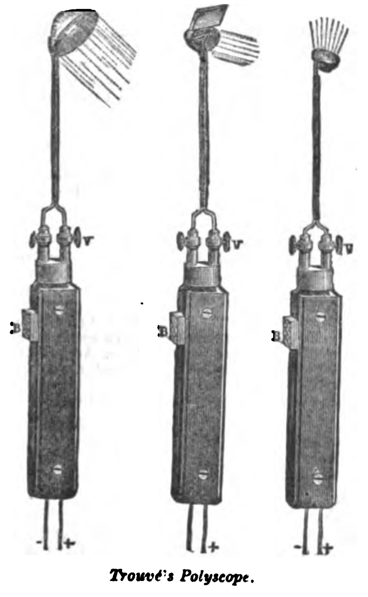
Simrock's, Gross's, and other nasal polypus forceps, *Ibid.*, p. 57.

Écraseurs and ligators, pedicle forceps and clamps, clamp and sac forceps, tumor forceps, tenacula, vulsellum forceps, etc., for uterine and ovarian tumors, *Ibid.*, Part III., pp. 92-99.

Pol′y-pus In′stru-ments. (*Surgical.*) Prehensile instruments for removing polypi from the nose, ear, uterus, etc.

They are forceps, snares, écraseurs, etc., for grasping, cutting, or tearing loose the sac or tumor, severing the pedicle, etc.

Fig. 1994.



Trouvé's Polyscope.

Pol′y-scope. Invention of M. Trouvé. Designed to illuminate cavities of the human body.

It consists of a secondary Planté battery, with rheostat for regulating the flow of the current, and a galvanometer with two circuits, in which the electro-motive force of the reservoir and that of the Trouvé-Callaud battery, intended to charge it, are opposed.

The instrument has a platinum coil and reflector fitted to a handle, and wire connecting it to the reservoir.

Edison has proposed a small electric light in a glass bolus to be swallowed, in order to illuminate the stomach interiorly.

" *Telegraphic Journal* " . . . . * vi. 313.
" *Scientific American* " . . . . * xxxix. 182.

An instrument to illuminate the cavities of the body has also been invented by Dr. Nitze, in Saxony. It consists of a platinum wire kept red hot by an electric current, and inclosed in a glass bulb.

One form is made by Coxeter & Sons, England.

Pol-y-zo′nal Lens. 1. A lens having several zones, as in the Dioptric arrangement for lamps and lighthouses.

See circular zones in Fig. 1096, p. 357, *supra;* and cylindrical zones in Fig. 1657, p. 704, "*Mech. Dict.*"

See also * "*Scientific American*, xli. 53.

2. A combination of a number of segmental lenses arranged in zones. Fig. 1376, p. 1763, "*Mech. Dict.*"

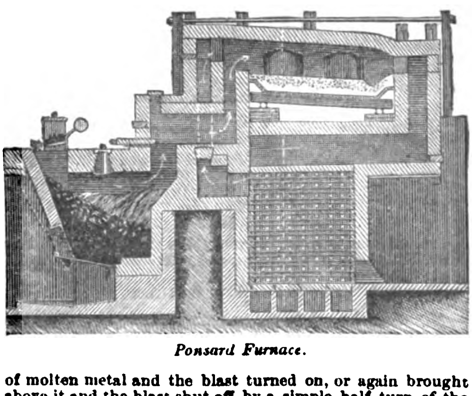
Pon′ci Bat′te-ry. Invention of Prof. Ponci. It consists of a glass jar and porous pot, the former containing a solution of ferric-chloride, in which is immersed a carbon-plate, and the latter containing a solution of ferrous-chloride, in which is immersed an iron plate. Each solution 35° B. "*Telegraphic Journal*," vi. 425.

Pon′sard Fur′nace. An open hearth furnace with a circular inclined and movable hearth, and considered to occupy an intermediate position between the Bessemer and Siemens in the range of its application to the raw materials.

The regenerator, shown beneath, is still more clearly indicated in Figs. 1161, 1162, p. 387, *supra*, where the *Ponsard* regenerator is shown as applied to gas works, and where the distinction between the *Ponsard* and *Siemens* regenerators is pointed out, the latter being shown in Figs. 1159, 1160, on p. 386, *supra*.

The open, circular, inclined and movable hearth of the *Ponsard* furnace is fitted with a pneumatic attachment, so arranged that the tuyeres can be plunged beneath the bath

Fig. 1995.

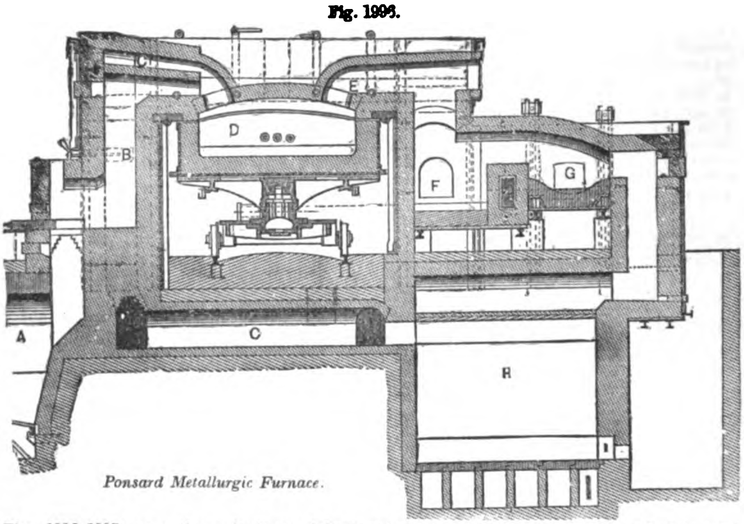


Ponsard Furnace.

of molten metal and the blast turned on, or again brought above it and the blast shut off by a simple half turn of the hearth, allowing the operation to be prolonged or shortened, or repeated at pleasure, without shutting off the heat or retarding the manufacture.

The hearth of the furnace can be readily detached and run out from beneath and away from the heat, affording facilities for repairing or renewing the lining as often as may be required. As the roof will generally outlast five or six hearth linings, the advantage of being able to have a second hearth ready to be run in without letting down the heat is great, particularly in the treatment of highly phosphoric pig by the new methods, in which the basic lining is rapidly destroyed by the reaction.

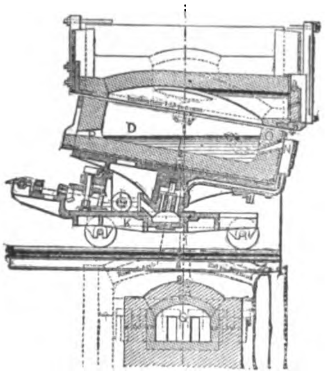
Fig. 1996.



Ponsard Metallurgic Furnace.

Figs. 1996, 1997, are sections of a Ponsard furnace in which the hearth is on a carriage and is run in and out of furnace, and is capable of rotation on its inclined axis. *A* is the producer; *B*, gas flue leading to hearth *D*; *E*, chimney; *R*, regenerator, *C F X*, flues; *G*, heater furnace.

Fig. 1997.



Ponsard Metallurgic Furnace.

Ponsard furnace . . . * "*Engineer*," xlvi. 281.
"*Van Nostrand's Mag.*," xxi. 252.
* "*Iron Age*," xx., July 19, p. 5; xxii., Sept. 16; Oct. 17; Oct. 31; * Dec. 12.
Its work . . . . . . "*Iron Age*," xxiv., Sept. 4, p. 8; Sept. 11, p. 15.

See also Regenerator Furnace; Gas Generating Furnace, Figs. 1161, 1162, p. 887, *supra*, and references *passim*.

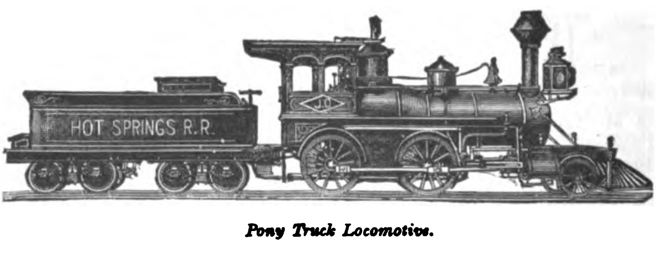
Pon'ty. The glass-blowers' tube.

M. Clémandot, of France, recommends nickel plating pontils and glass molds, to prevent coloration of the glass by oxidation of the iron. It is adopted in several French factories, the plan being to put the objects in a plating bath of a sulphate of nickel and ammonia for several hours.

Pony Truck. A truck with a single pair of wheels. Shown in Fig. 1998 as in advance of the drivers and just behind the pilot.

In Fig. 168, p. 65 *supra*, it is shown beneath the rear of the locomotive.

Fig. 1998.



Pony Truck Locomotive.

Po-poff'ka. A circular ironclad, the invention of Admiral Popoff, of the Russian navy.

The "Novgorod" and "Adm. Popoff," described in "*Iron Age*," vol. xix., June 7, p. 26.

See also references under "*Iron Clad*."

Por'ce-lain. (*Ceramics.*) A hard, partially vitrified, form of pottery, divided into two classes known as *hard* and *soft*, which names indicate the comparative hardness of the wares, due largely to the different quantities of silica in the composition. The porcelain of China (see p. 1765, "*Mech. Dict.*") is composed of *kaolin* and *petuntze*, one a peculiar clay and the other a feldspar. Silex (flint) is a form of silica commonly used in English porcelain, and entering as it does into some of the better forms of stone-ware and queen's-ware, they partake largely of the porcelain character.

Porcelain is translucent and breaks with a vitreous fracture, bright and clean, differing from the softer forms of pottery of which faïence forms the most attractive example.

Brogniart's classification, under the general head of "*Poteries à Pâte Translucent*," enumerates three kinds of porcelain: —

1. Hard porcelain: *porcelaine dure.*
2. Natural soft porcelain: *porcelaine tendre naturelle.*
3. Artificial soft porcelain: *porcelaine tendre artificielle.*

1. Hard Porcelain is distinguished by a fine, hard, translucid paste; it has a hard earthy glaze and a more vitreous character than other pottery, which accounts for its glassy fracture, and its sonority.

The elements which enter into the composition of hard porcelain are kaolin, feldspar, chalk, and sometimes silicious sand, plastic clay, and powder of broken porcelain.

Following in the description the practice at the manufactory at Sèvres: —

The kaolin of St. Yrieix yields both the argillaceous, flinty varieties. The feldspar is taken from a rock of pegmatite at St. Yrieix. The silicious sand is from Aumont, near Creil. The chalk is from Bougival. The plastic clay from Abondant, near the forest of Dreux.

The following is the composition at Sèvres: —

Silex	0.580
Alumina	0.345
Chalk	0.045
Potash	0.030
	1.000

The preparation of the paste is by means of careful grinding, levigation, sifting, incorporation, dilution, straining, ripening, and the subsequent operations upon the paste are by means of throwing or molding, or the two united much as in other species of pottery but with greater exactness and delicacy in proportion as the work is of a more delicate or elaborate description.

Owing, however, to the less plastic and tough character of the porcelain paste great care is necessary, and processes for condensing the paste by pressure in bags or wire cloth vessels have been employed, and are described by Brogniart and others as the invention of MM. Honoré, Grouvelle, Alluand, de Caen and others. See under "*Poterie*," Laboulaye, vol. iii.

The paste for articles of statuary which are not to be glazed but remain in biscuit form is composed of: —

Clay of the flinty kaolin	0.64
Feldspar	0.16
Sand of Aumont	0.16
Chalk	0.04
	1.00

The largest pieces are made of a much more plastic composition by M. Regnier: —

Clay of flinty kaolin	0.43 to 0.44
Pipe clay of Abondant	0.21 to 0.25
Feldspar	0.16 to 0.17
Quartzose sand of Aumont	0.16 to 0.09
Chalk	0.04 to 0.05
	1.00 1.00

The mode of fashioning is by throwing-wheel or mold, which see.

After a slight drying in the air, the pieces are baked in the waste-heat chamber at the upper part of the porcelain kiln, (see PORCELAIN KILN), where they are carefully preserved from soot by encasing in *casettes*, which are boxes of refractory clay like seggars, which see.

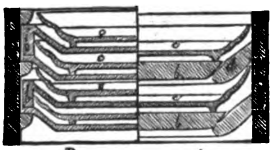
The glaze (Fr. *couverte*), is of the pegmatite of Saint Yrieix, the mean composition of which is: —

Silex	0.74
Alumina	0.18
Potash	0.07
Chalk and manganese	0.01
	1.00

The articles are dipped in the slip, which is the result of the most careful grinding and straining, and the quality is judged by the rate at which it will descend in still water in a cylindrical graduated glass vessel, in which it has been agitated so as to be in a state of suspension.

The firing of the ware is done at a high temperature so as to soften the compound, which is partially fused by the heat, giving it the vitreous and translucent character which belongs to porcelain. See PORCELAIN KILN.

Fig. 1999.



B A

Seggars for Sèvres Porcelain.

The encasing of the pieces in the kiln is a carefully arranged matter, and the accompanying figure shows two forms, one half of each being represented. In each case the rings *a* have spurs projecting inwardly on which are laid rondeaux, *b*, which serve to support the plates or dishes *c c*. The seggars (*casettes*) are of a special size and height for each description of ware. See PORCELAIN KILN.

2. NATURAL SOFT PORCELAIN. This is an English invention of which the Worcester porcelain may be considered the representative. The works at that city were started about 1751. The paste is a grade between fine faïence and hard porcelain. It is distinguished by having a base of kaolin and a large proportion of phosphate of lime obtained by the calcination of bones.

The following recipes show that great latitude of proportion is practiced: —

	Saint-Amans.		Aikin.
Argillaceous kaolin, washed	0.11	0.41	0.310
Flinty kaolin, crude and ground	–	–	0.260
Pipe-clay	0.19	–	–
Calcined flint	0.21	0.16	0.025
Phosphate of lime	0.49	0.43	0.405
	1.00	1.00	1.000

The paste is very plastic and is fashioned after the manner usual with fine faïence, yielding readily to the throwing-wheel or mold. The kiln is the same as that used for fine faïence (see FAIENCE) having fires *à alandier*. The glaze is lead and boracic acid glass, harder than that for faïence, but not so hard as the *couverte* of hard porcelain. It is laid on by immersion in the slip glaze.

The following is one example of glaze: —

	Saint-Amans.
Feldspar	0.48
Silex or quartzose sand	0.09
Borax, crude	0.22
Flint glass	0.21
	1.00

The glazing materials are fritted, and after grinding 10 to 12 per cent. of minium is added.

The firing of the glazed and decorated ware is at a moderate heat.

3. ARTIFICIAL TENDER PORCELAIN. — The porcelain made at Sèvres until 1804, when the difficulty of working in so little plastic a material caused it to be discarded.

The paste is marly, fine, dense, almost vitreous, hard, translucid, and fusible at a high temperature. The paste has but little adherence, and was always molded. After having acquired some little tenacity by the addition of a certain quantity of gum adragante, the dry pieces were finished on the lathe. The setting of the ware in the kiln or muffle was accompanied with great difficulty, as the objects required to be stayed and supported by pieces made in the same paste in order that they might exactly follow the contraction.

The composition was eminently vitreous. A frit was made as follows: —

Niter	0.220
Grey marine salt	0.072
Alum	0.036
Soda of Alicante	0.036
Gypsum of Montmatre	0.036
Sand of Fontainbleau	0.600
	1.000

The composition of the paste was: —

The frit, as above	0.75
Chalk	0.17
Calcarean marl of Argenteuil	0.08
	1.00

The glaze was put on by sprinkling. It was composed: —

Sand of Fontainbleau, calcined	0.27
Calcined flint	0.11
Litharge	0.38
Carbonate of soda	0.09
Carbonate of potash	0.15
	1.00

The materials are mixed, melted in a crucible, crushed, and again melted and crushed. The firing is at a lower temperature than that required for the biscuit. Care is taken to treat the interior surface of the seggars (*cazettes*) with the same glaze in order that they may not absorb that of the objects contained in them.

History and development of the ceramic art, report of *Hector Tyndale*, "*Centennial Exhibition Reports*," Group II., vol. iii., p. 2.

Chemistry and composition of Japanese porcelains and porcelain rocks, by *Wurtz*, *Ibid.*, 114.

Prof. Wurtz, report on Japanese	"*Eng. & Min. Jour.*," xxiii. 199.
Painting, *Joclet*	"*Scientific American Sup.*," 2895.
	* "*Man. & Builder*," viii. 182.
	"*Scientific American Sup.*," 2706.

Brogniart's "*Arts Céramiques*."
Marryatt's "*History of Pottery and Porcelain*."
Birch's "*History of Ancient Pottery*."

Por'ce-lain Ce-ment'. For mending china or glass ware.

Gelatine	5
Chromate of lime	1

Anoint the edges, press together, and expose in the sunlight.

Por'ce-lain Col'ors. (*Ceramics.*) Colored glasses which fuse upon the biscuit surface in firing. Fluxes with metallic colors; oxides generally.

Cobalt	Blue.
Chromium	Green.
Oxide of iron	Brown.
Oxide of uranium	Black.
Oxide of titanium	Yellow.
Chromate of lead	Yellow.
Chromate of baryta	Yellow.
Oxide of manganese	Black, violet, brown.
Sesqui-oxide of iridium	Black.
Oxide of cobalt	Black, blue-grey.
Proto-chromate of iron	Brown.
Purple of cassius	Purple.
Sub-oxide of copper	Red.
Oxide of copper	Green.
Oxide of chromium	Green.

Por'ce-lain E-lec'tro-pla-ting. Sulphur is dissolved in oil of lavender spike to a sirupy consistence; then chloride of gold or chloride of platinum is dissolved in sulphuric ether, and the two solutions mixed under a gentle heat. The compound is next evaporated until of the thickness of ordinary paint, in which condition it is applied with a brush to such portions of the china, glass, or other fabric as it is desired to cover, according to the design or pattern, with the electro-metallic deposit. The objects are baked in the usual way before they are immersed in the bath.

Por'ce-lain Kiln. The porcelain kiln is a high cylindrical tower with a dome, built of refractory bricks. It has two or three vaulted stages and is flanked at its base by several furnaces, from which the flame reaches the lower kiln chamber by horizontal passages, thence the upper chamber by vertical canals, and eventually the chimney at the summit.

See Plate XXXV. which is a representation of the porcelain kiln of Sèvres, France.

The upper chamber is for the baking of the green ware, bringing it to the biscuit stage, after which the objects receive the glaze (*couverte*) and then take their final firing in the lower story. The pieces are placed in refractory clay boxes termed (*cazettes*) seggars (which see), which are piled in the furnace forming high columns which reach almost to the vaulted ceiling. The door of the kiln (*laboratoire*) is then closed and luted, and the fires lighted in the furnace. The fires burn about 36 hours.

The chambers of the kiln are entered by arched openings which are bricked up when full and the kiln is ready to fire. The furnaces are 6 in number, around the base of the kiln, and the fire is direct, the air to support combustion entering by way of the ash-pot as usual.

The *couleurs de grand feu* are required to support an equal temperature with the paste but they are not so numerous as the other class of colors, *couleurs des moufles*, which are fired in muffles divided into stories and celles. See PORCELAIN MUFFLE.

Another form of porcelain kiln at Sèvres has furnaces *à alandier*, with a diving draft. Fig. 36, p. 20, *supra*, shows a three-story kiln with furnaces around them, but the section cuts through only one at each stage. The two lower ones are *a alandier*.

Por'ce-lain Mold'ing. (*Ceramics.*) In molding porcelain, if the hollow object is to have two exterior faces, the mold is in two parts, which, when joined, present an interior surface corresponding to the relief of the object; the paste is applied in each portion and smoothed on the exposed surface, which forms the interior of the vase (for instance). The parts of the mold are then brought together and the joint made by the hand, a spatula, or a smooth shell introduced into the interior.

A hollow shallow object such as a dish or tureen, is made by another method, termed *moulage à la croute*, the paste is rolled upon a marble table, in the manner of a pie-crust, hence the name, and is laid upon the mold, applying to the surface a sponge dipped in thin slip. See Plate XXXVI.

For thin hollow objects, the *moulage par coulage* is adopted, the thin paste being poured into the mold, which has a plug at the bottom, which is opened after a time to allow the superfluous slip to run out; the mold is porous, and the plug is withdrawn after a time determined by experience, when a sufficient thickness of the slip shall have adhered to the mold. The operation may be repeated for a greater thickness.

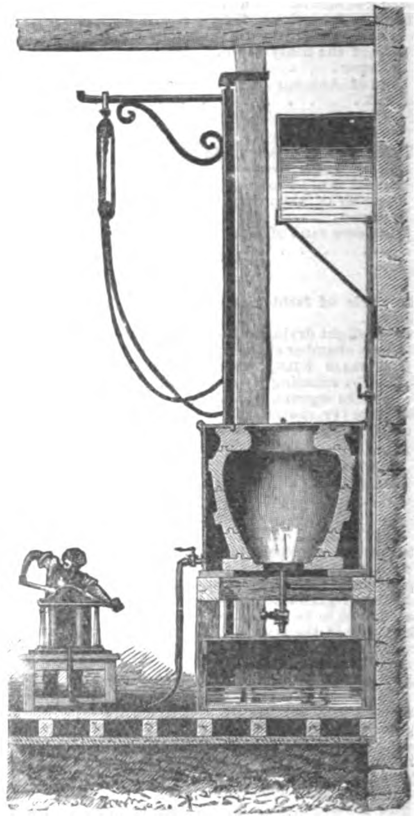
For a cup it needs but to pour a thin slip into a cavity of the right shape in a block of plaster. The water passing through the pores of the plaster allows the paste to gather on the sides of the mold, and the superfluous paste is poured out. This is the way in which very thin ware is made.

In making thin objects of large size by *coulage*, the aid of an air-pump is called for: either to compress the air inside the mold, or to remove the natural pressure of the air from the exterior of the hollow mold. See Plate XXXVI.

In the former case (compression) the slip is projected into the interior of the hermetically closed mold by a tube of caoutchouc, and the superfluous slip withdrawn by a faucet below; the compressed air introduced into the mold by another tube holds against the interior of the mold the paste which would be disposed to slip down.

In the latter case (exhaustion), the upper part of the mold is open to give access to the atmosphere and all the remainder of the mold is covered by a box of sheet-iron, as in Fig. 2000. The slip is injected and the excess drawn off by the

Fig. 2000.



Regnault's Apparatus for Molding with Air Exhaust (*Section*).

faucet below. The air inside the box around the porous mold is withdrawn by means of the air-pump, and the atmospheric pressure upon the paste adhering to the mold keeps the paste from slipping down, as mentioned in the previous case.

The molding completed, by means stated, the object is allowed to dry in position, by absorption of its moisture by the mold and the action of the air; the shrinkage renders it easily withdrawn and it is then finished. This may be upon the wheel, by scraping, by adding to or mending portions, hollowing out, stamping, adding molded portions, carving, and ornamenting in various ways with colors, designs, and what not.

To resume at the point of withdrawing the green ware from the mold, — the objects are dried in the air for several days, and then those which were fashioned upon the wheel are returned to it, and by means of sharp tools, of shapes and sizes, called *tournassins*, which have some resemblance to metal-turning tools, — the object is retouched, the angles sharpened, hollows deepened, the protuberances and moldings smoothed, the foliation repaired, and the whole object brought to the detail and thickness required. This operation is the *tournassage*.

Scraping (*grattage*) is adopted with objects not fashioned on the wheel.

The repairing or refilling (*remplissage*) which follows, consists in stopping up with paste defects in the molding, or holes produced in the subsequent *tournassage*.

The *evidage*, *estampage*, and *moletage* which follow, refer to the engraving, recessing, stamping, molding, and attaching molded ornaments, after which come the artistic sculpturing and the *garnissage*, which last refers to the surface artistic ornamentation. The next operation is firing. See PORCELAIN KILN.

Certain kinds of articles required in large numbers and of exactly equal size are molded by revolving wheel and templet, as in Fig. 7201, p. 2770. "*Mech. Dict.*"

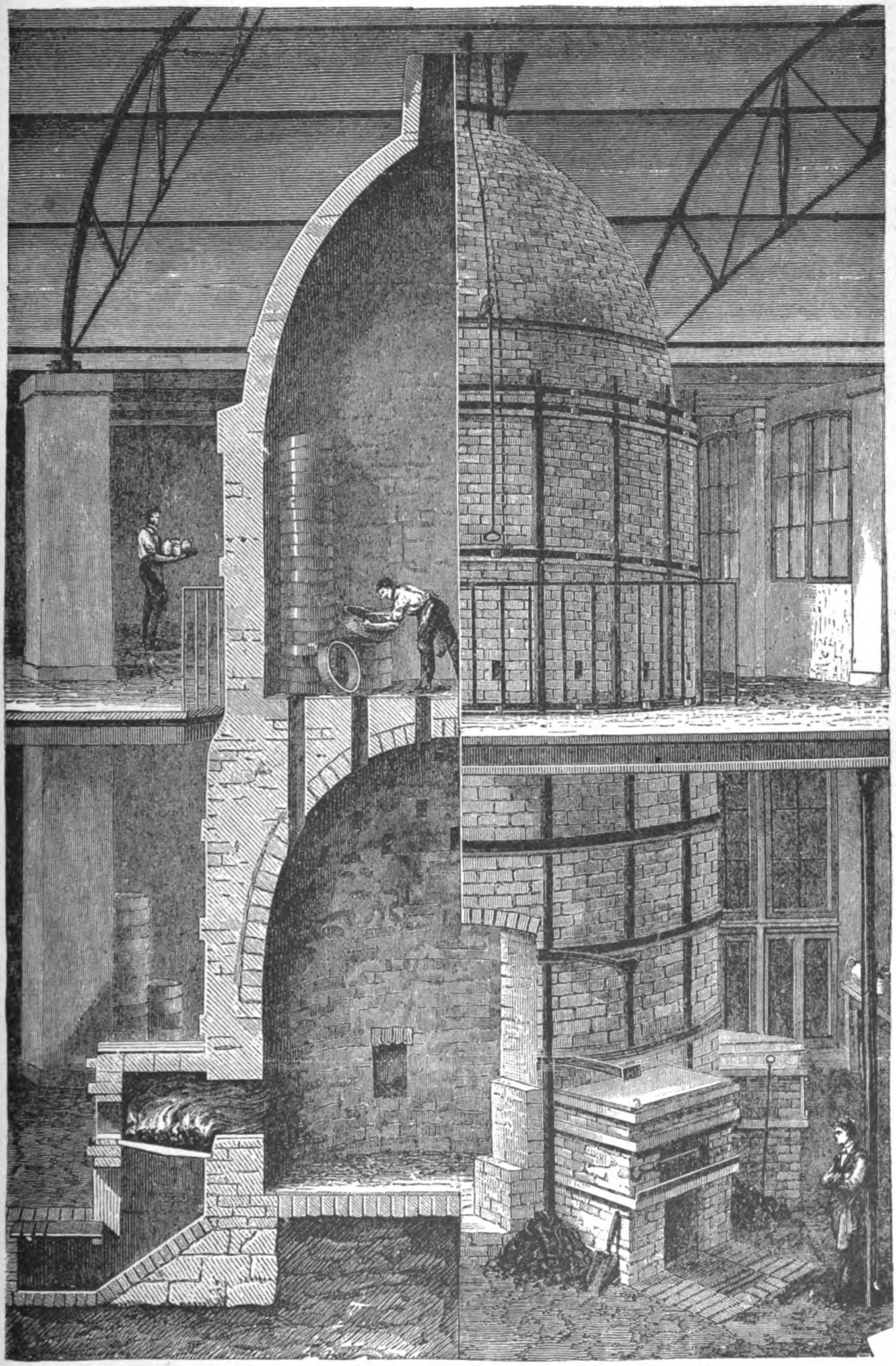


PLATE XXXV. PORCELAIN KILN, SÈVRES. (*Section and Elevation.*) See page 704.

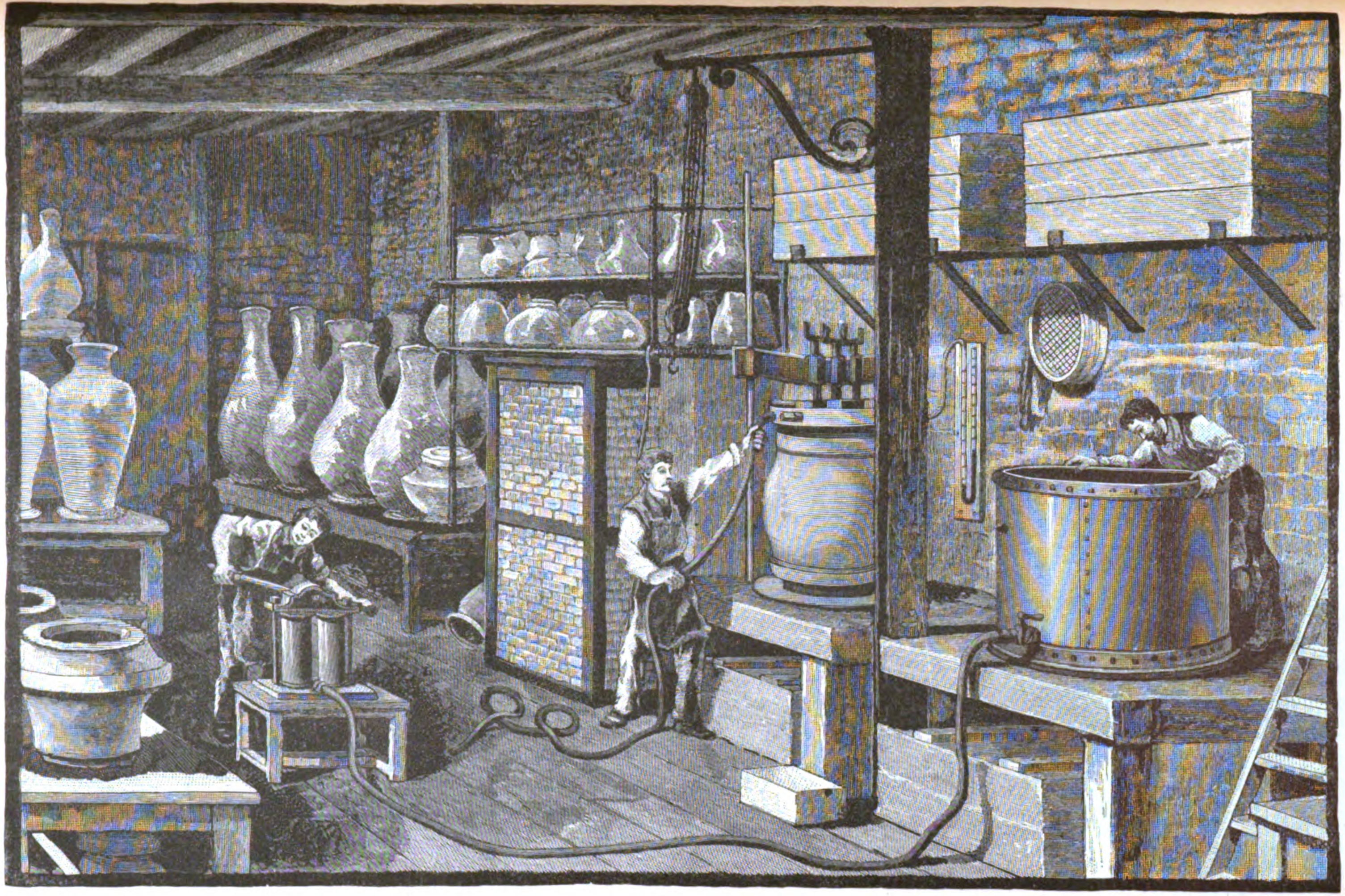


PLATE XXXVI.

MOLDING ROOM, SÈVRES.
WITH AIR COMPRESSION AND EXHAUSTION APPARATUS.

See page 704.

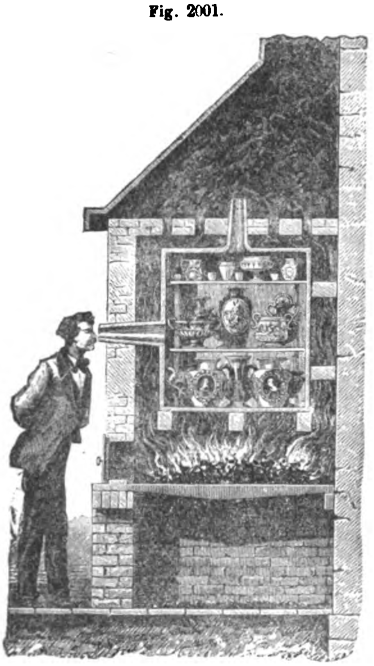
The templet, having at its working edge the exact half figure of one face of the object, is attached to a plate which is adjustable on an arm which has a center of motion to permit adjustment.

The plate is adjustable vertically and longitudinally on the arm, and a plate beneath the arm, secured by set screws, limits the downward drop of the arm, the latter is held down at the required distance by a set nut. By means of all these adjustments the required thickness is given to the plate, saucer, or other object, the top of the turning wheel giving the conformation to the interior surface of the article. The distance between the templet and wheel is the thickness of the article. Templets, for each different article required to be fashioned, are kept in stock, and are placed at pleasure on the arm; a suitable wheel-head also being attached to the vertical spindle to correspond with said templet.

Por'ce-lain Muf'fle. A kiln in which porcelain is fired to fix the colors which will not bear the great heat of the porcelain kiln. The colors are divided on this line into *couleurs de grand feu* and *couleurs des moufles.*

The muffle is a box of refractory clay, divided into stories and cells to contain painted porcelain, and is enveloped in the flames of the furnace, which, however, do not reach the interior, as the effect of contact of flame and smoke would

Fig. 2001.



Muffle for Firing Decorated Porcelain. (*Sèvres.*)

deface the objects. The inclosed ware is examined by means of peep-holes (*visières*), which are closed by a removable plug of baked clay. The condition of the ware is ascertained by the color and by the effect of the heat on slips which can be withdrawn for accurate examination.

Por'ce-lain Pâte Ten'dre. (*Ceramics.*) Soft paste porcelain. *Vieux Sèvres:* made there till 1804.

Por'ce-lain Plate Ma-chine'. The machines shown in Figs. 2002, 2003, 2004, are those used in the making of porcelain plates by M. Faure, of Limoges, France.

The hand process may be first described in brief:

"To produce the plate, three distinct operations are necessary — the forming, the molding, and the turning. The forming (*ébauchage*) consists in giving to the soft paste an approximate form. The workman taking a ball of the plastic mass places it on a wooden disk, the center of which coincides with that of his wheel. He then flattens the mass until it assumes a lenticular shape, the molecules being pressed to follow a spiral from the center outward. This is then put in a dry place for a short period. Molding consists in forcing the mass formed as above into a mold, which imparts to it the exterior form of the plate. By means of a dampened sponge the workman presses on the paste until it takes the imprint, working always from center outward, and leaving enough material wherewith to form the base portion. With a knife he removes the excess of material and then places the plate in a drying chamber, where it becomes sufficiently solid to be removed from the mold. It is then about twice the thickness to which it ultimately must be reduced.

"The turning operation brings the object to its proper dimensions. A cutting tool is used to remove the excess, and

Fig. 2002.

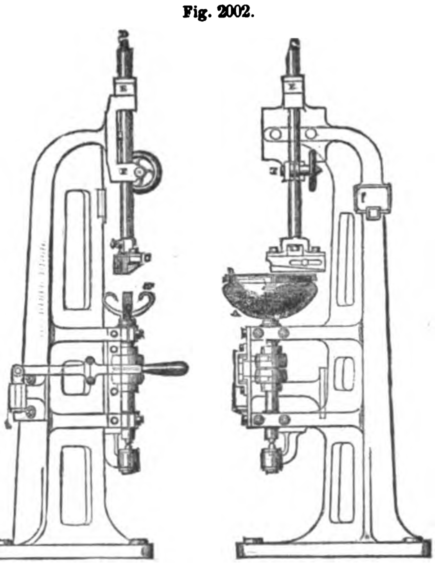


Plate-making Machine. Limoges (*Croûte Making.*)

the diameter of the plate being traced with a compass, it is removed and finished by thinning the edges. The plate is then ready for baking.

"The difficulty in the above is that peculiar to all handwork — variability.

Fig. 2003.

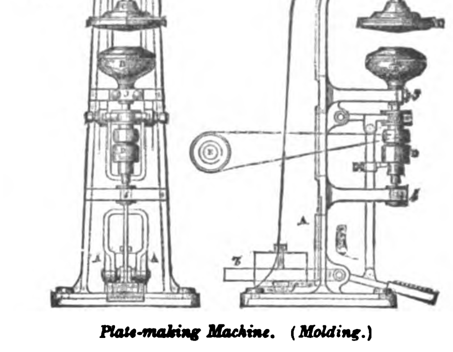


Plate-making Machine. (*Molding.*)

"Fig. 2002 exhibits side and front views of the apparatus for making *croûtes*, or thin flat disks of paste. *A* is the lathe head made of plaster mortar, formed on the iron armature *a*. *B* is a piece of sheepskin extended on a copper circle. *C* is the calibrating tool which spreads the paste. *D* is the tool arbor. This is lifted by a cord and pedal, and descends by its own weight. *E* is a stop limiting the descent, which is also adjusted by the device at *F*. The plastic material is placed in ball-shape on *B*, and the lathe set in motion by pressing a pedal. A second pedal-pressed tool descends vertically, with an accelerated velocity at the beginning, stops a few seconds for the operator to center the ball with the palm of the hand and hold it so as to resist the centrifugal force, and then continues its travel with slackened speed. At the end of its movement the tool has reduced the paste into a cake, of a surface and volume conforming to that which the plate ultimately is to possess. As soon as one *croûte* is prepared the tool rises, and a second ball of paste is inserted, and so on.

"The second apparatus, as shown in the front and side views in Fig. 2003, serves to replace the *croûte* in the axis of the lathe without deviation of the center, when turned over to be brought in contact with the mold. *A* is a cast-iron frame carrying four collars, 1, 2, 3, 4, the axes of which coincide. The pair above guide the tool arbor; those below, the lathe spindle. *B* is the lathe head surmounted by the mold. *C* is a platform to which is secured the sheepskin circle to which the *croûte* is attached. By carrying this platform down, the *croûte* is brought in contact with the mold. When the *croûte* is detached the platform and sheepskin is lifted by the counter weight *a*. *D* is a friction gear thrown into action by the counterweighted pedal *b*. This serves to throw the lathe into or out of motion at will. *E* is the motor.

"The third apparatus, of which a front view is given in Fig. 2004, consists of a vertical frame carrying the lathe below, a calibrating tool in the center, and the molding tool above. The *croûte A* coming from the second machine is secured to the lathe head. *B* is the molding tool moved by the handle *C*. *D* is an adjustable collar. *E* a carriage regulating the movement of the tool effected by the handle *F*. *G* is a gage for regulating the form of the plate. *H* is the calibrating tool. The *croûte* being on the lathe head the tool is caused to descend, and this meets the paste at the center, determining its thickness. Being restricted in its motion by the guide or gage *G* which represents the profile of the plate, and being submitted to a horizontal movement, it necessarily works the object according to the desired exterior form indicated by the gage.

Fig. 2004.

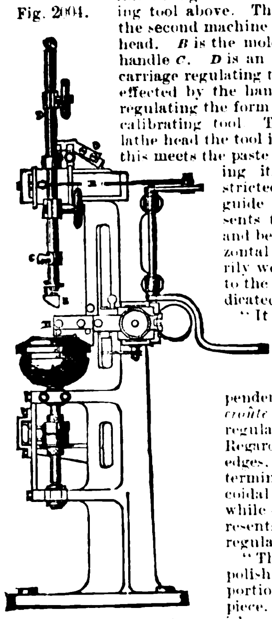


Plate-making Machine. (*Turning.*)

"It is evident that the tool should exercise, on the bottom and rim, certain relative pressures. These are, however, dependent on the section of the *croûte*: and this is perfectly regulated by the first machine. Regarding the shaping of the edges, the tool acting at a determined angle and with helicoidal faces cuts the paste while compressing it, and represents the work of the hand regulated and perfected.

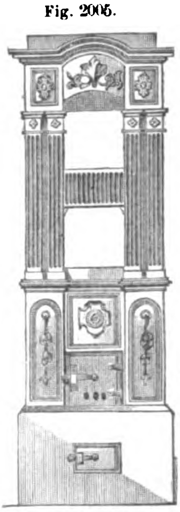
"The calibrating gives the polish, and produces the raised portions which decorate the piece. The tool merely polishes without pressing, and this terminated, a special tool removes the material which extends over the edges of the mold. The workman then lightly lifts the extreme edge so as to facilitate withdrawal, and removes the mold to a warm place for drying, as already explained.

"With regard to production, by hand work alone about 100 plates per day can be made. A single workman, aided by two children, can by the above machine average 450 per day." — "*Bulletin de la Société d'Encouragement pour l'Industrie Nationale.*"

Por'ce-lain Stove. The use of porcelain for stoves is very common in Germany, Austria, and Sweden. A number of such were shown in Paris, 1878. Figs. 2005, 2006, show two made by Joseph de Ceute, of Vienna.

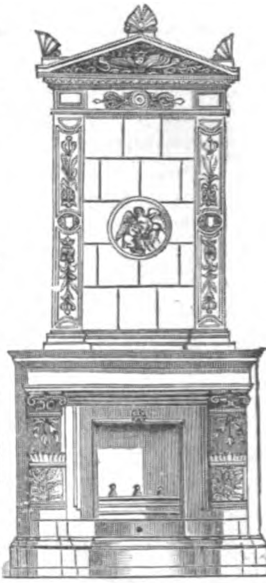
They are the artistic development of the Tartar *kang* and the Russian brick stove, each of which, however, is bedstead as well as stove. The former is heated by fermenting dung, and is a true hot-bed, while the Russian, one step, and a large one, in advance, is heated by burning wood.

Fig. 2005.



Porcelain Stove. (*De Ceute, Vienna.*)

Fig. 2006.



German Porcelain Stove. (*De Ceute, Vienna.*)

The advantages of the ceramic over the metallic material are several.

1. Not being good conductors of heat, they radiate it slowly and without sudden changes.
2. Being bulky, they hold heat equally and for a long time, even after the fire has burned out.
3. They do not scorch or "burn the air," or the floating particles of dust in it.
4. They have many of the advantages of the open grate.

"The mateɹial is earthenware molded into tiles or hollow bricks, about 6″ or 8″ square and several inches thick. They are made in a great variety of ornamental forms, and are generally glazed on the outer or exposed face, either white — which is most common — or brown, red, green, or black. Besides the ordinary flat-faced tiles, they are made with incised or raised designs, or are molded in high relief, so that when combined they form recessed panels or projecting fillets and moldings, in a variety of architectural patterns.

"The back portion of the tile exposed to the fire or heated gases rising from it is perforated and peculiarly shaped, so as to expose a large surface and make a series of tubular openings favorable to the absorption of the heat into the body of the tile.

"The shape of the stove formed of these tiles varies with the taste of the fabricant and the demands of the consumer. They are generally from 6 to 8 or 10 feet high, with a breadth of 3 or 4 feet. Usually there is a deep recess above the fire-space, or an opening quite through, the stove being divided in that portion into the parts united above by an entablature and cornice. Cylindrical or columnar stoves are also made; indeed, the modifications are numerous, to conform to the varying taste or fashion of the time. Lower and broader stoves are now coming into use with large openings in front, so that the fire may be seen and enjoyed as in an open fire-place, while the heat is much better utilized." — PROF. BLAKE.

Po'ro-type. A method of copying engravings. It depends upon the fact that the portion of the face of the print occupied by ink is non-porous.

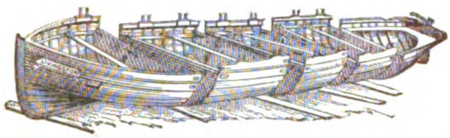
A gas which acts upon a certain chemical agent, and either bleaches or discolors it, is permitted to penetrate a copper-plate engraving or woodcut where possible, and, coming into contact, as it permeates, with paper which has been suitably prepared, brings about a reaction, — that is to say, wherever the gas has found means to penetrate, the color of the prepared paper alters, and a copy of the engraving is in this way produced. — "*Photographisches Archiv.*"

Po'rous Cup. An unglazed biscuit ware, used in batteries to prevent the mixing of two liquids, and yet not oppose the passage of the electric current.

Por'ta-ble Boat. One capable of transportation by land; over portages; sometimes sectional.

Fig. 2007 shows the sectional boat of the African traveler, H. M. Stanley, which he transported overland for the navigation of any rivers and lakes encountered during his researches.

Fig. 2007.

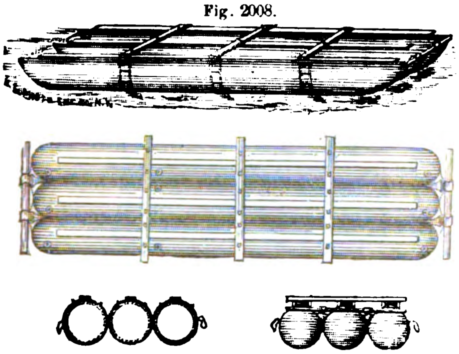


Stanley's Portable Boat.

The boat is, when put together, 40′ long and 6′ 4″ wide. It is composed of 5 water-proof sections, which may be firmly united by means of bolts and clamps. This craft, the "Livingstone," is the largest that has yet floated in the rivers of interior Africa.

Fig. 2008 is a boat, or rather *raft*, made of a number of inflated pontons bound together and braced with bars.

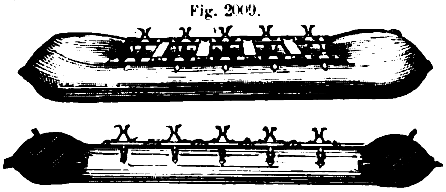
Fig. 2008.



Ponton Portable Boat.

Fig. 2009 is an inflated mattress with gunwale, rowlocks, and thwarts.

Fig. 2009.



Inflatable Portable Boat.

The United States Museum of Fisheries has models of portable and folding boats.

Colvin's. *Hegeman's.*
Fenner's.

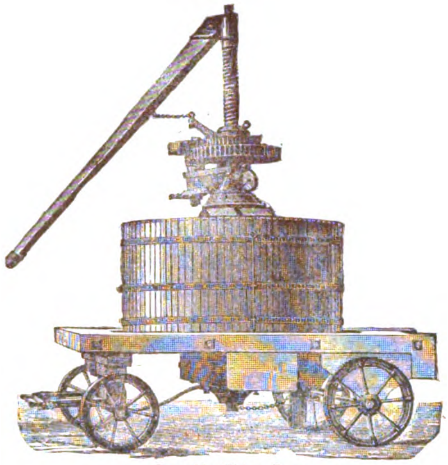
Also of canoes, fishing-boats, coracles, etc.
See list of references under Boat, p. 114, *supra*, to *collapsing*, *folding*, and *sectional* boats.
Also Fig. 2057, p. 899, "*Mech. Dict.*"

Ponton and rigging cutter, "Grosser Kerfurst"	* "*Engineer*," xlviii. 375.
Ponton steamer, *Olsen*	* "*Scientific Amer.*," xliii. 86.
List of boats	* p. 114, *supra*.
Folding boat	* Fig. 2057, p. 899, "*Mech. Dict.*"

Port'a-ble Ci'der Press. A press on wheels; much used in Normandy, where the apples are ground and pressed by machines taken from farm to farm, much as threshing is done in this country, and steam-plowing in Britain.

The press shown in Fig. 2010 is one made by Samain, of Blois (*Loir et Cher*). A horse is hitched to the end of the sweep, and the press has three powers of gradually increasing force, being shifted from to each in succession as the pomace becomes more compacted. A dynamometer is attached to indicate the pressure.

Fig. 2010.



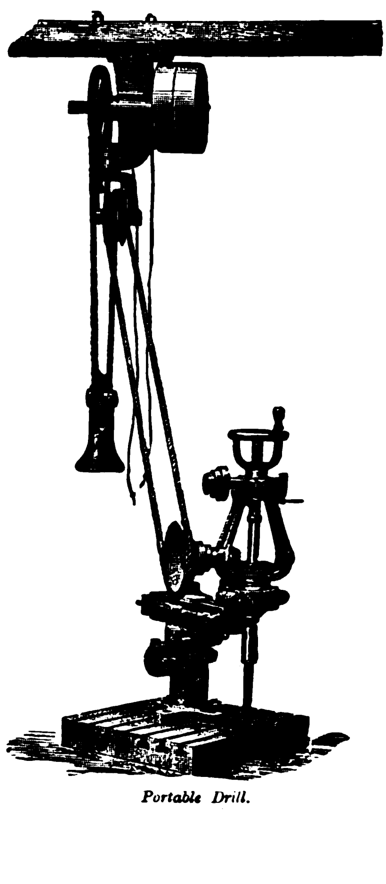
Portable Cider Press.

Port'a-ble Crane. One which is transportable upon its base. The traversing crane and overhead crane move on their bases.

See Railway Crane, *infra*; Balance Crane, Fig. 176, p. 66, *supra*; Portable Steam-crane, *infra*; Portable Hand-crane, *Ibid.*

Contractor's hoist, *Chapman & Sutton*, Br.	* "*Engineering*," xxiv. 304.
Derrick, *Lyons*	* "*Man. & Build.*," xi. 33.
Hoist, *Pennypacker*	* "*Iron Age*," xix., Feb. 1, p. 1.

Fig. 2011.



Portable Drill.

Port'a-ble Drill. A drill capable of being moved to its work, instead of the converse. See Bench Drill, Fig. 287, p. 95, *supra*. Also list under Drill, pp. 750–752, "*Mech. Dict.*," and references under Drill, p. 275, *supra*.

The portable drill shown in Fig. 2011 can be placed as easily as a rachet brace, and will drill at any angle in any position, at any distance, and in any direction from the power. The driving apparatus is so arranged that the round belt which drives the machine passes through the center of a hollow stud, enabling the power to be taken off in any direction, while the weighted idler keeps the belt tight at whatever distance the machine is worked.

The machine is intended to be bolted or clamped by its base to the piece being drilled. It can be adjusted in height by drawing the post out of the socket, and radially by screw and handle on the arm. The arm can be swung on the pillar as a center by means of a worm and tangent wheel, thus providing delicate adjustments in every direction. The spindle-frame swings in a ball and socket bearing to any angle up to 30° from the base, and is also provided with means of fixing it in a vertical position. The whole of the machine, including the post, can be drawn out of the socket, and the post passed into the horizontal hole in the socket for drilling in a direction parallel with the base.

The feed motion is self-acting and variable.

See also Flexible Shaft, Fig. 1060, p. 347, *supra*.

Thorne, De Haven & Co. * "*Engineer*," xli. 485.
* "*Engineering*," xxii. 110.
* "*Iron Age*," xx., July 19, p. 1.

Port'a-ble En'gine. One upon wheels, either to be hauled from place to place or self-driven. See Portable Steam Engine.

Among the portable engines may be classed —

Agricultural engines.	Traction engines.
Steam fire engines.	Portable steam pump.
Steam road rollers.	Portable steam hoists.
Steam plowing engines.	Portable steam cranes.
Railway crane.	(Which see.)

Port'a-ble En'gine and Pump. The portable engine pump for irrigating purposes is shown in Fig. 2012, as used upon the Nile. It is the modern substitute for the shadûf, mental, picotah, noria, wheel with pots, etc.

The pump is fixed on a staging over a stream, and is driven by a portable engine. The boiler has a fire-box considerably larger than the ordinary portable engines, and where coal is expensive, as in Egypt, and there is an abundant supply of cotton stalks, maize, etc., great economy is obtained by feeding this vegetable matter into the fire-box by the straw-burning apparatus, driven by a strap from the crank-shaft, as shown in the engraving. The traveling wheels are made entirely of iron, and are not affected by excessive heat or the attack of insects. The pump shown in the engraving has double suction pipes. The pipes are made entirely of wrought iron, with a view of saving weight, and avoiding the inconvenience caused if a pipe is broken. The disk is accessible for examination without disturbing any of the joints.

The apparatus has, however, various other uses, such as in drainage, sheep-washing, emptying docks and dams, etc.

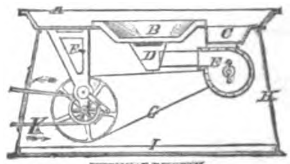
See also Noria, Fig. 1819, p. 636, *supra*.

See also Centrifugal Pumping Engine, Fig. 1218, p. 516, "*Mech. Dict.*"

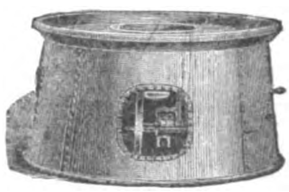
Port'a-ble Forge. A movable forge to be used in the field, on the march by pioneers, in the vicinity of temporary works, etc.

Two forms are shown in Figs. 2013, 2014. They are adapted to be driven by hand or power, having the necessary

Fig. 2013.



SECTIONAL DIAGRAM.



"*Keystone*" *Portable Forge.*

hand-wheels and power connections. The sectional view, Fig. 2013, shows the relation of the band-wheel *K*, band *G*, fan *E*, tuyere *D*, hearth *B*, quenching trough *C*, and table *A*. *F* is the hanger of the band-wheel. The functions are similar, but the parts somewhat modified.

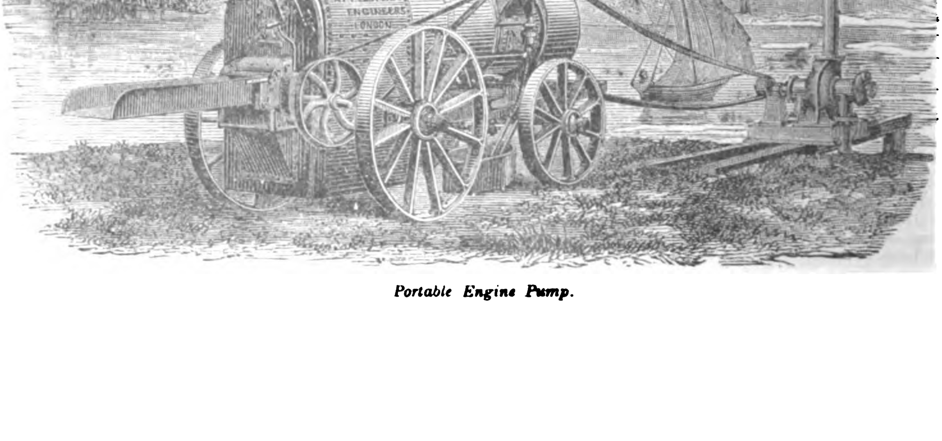
Fig. 2070, p. 905, "*Mech. Dict.*"

Battery Forge, Fig. 597, p. 249, *Ibid.*

Forge, Figs. 1084, 1085, p. 354, *supra*, and references *passim*.

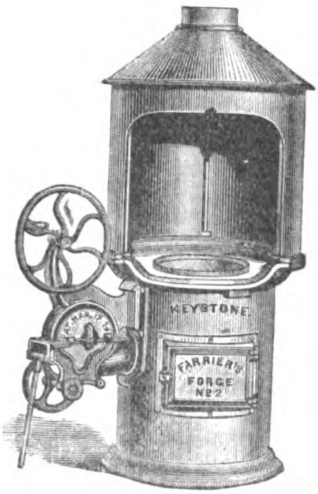
Port'a-ble Fur'nace. One which is transportable, as in the case of charcoal furnaces for domestic or plumbing purposes.

Fig. 2012.



Portable Engine Pump.

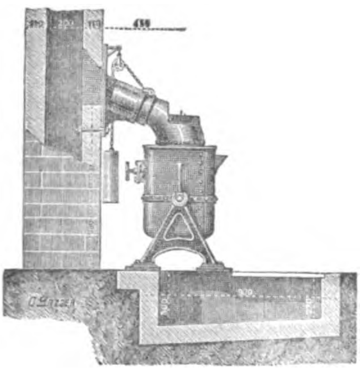
Fig. 2014.



Portable Forge.

A more important example, however, is the oscillating crucible furnace of M. Piat.

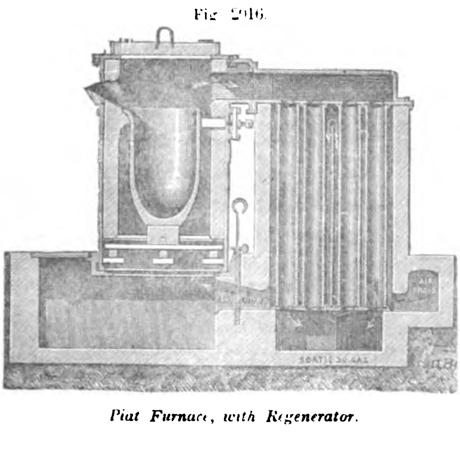
Fig. 2015.



Piat Portable Furnace.

It is shown in partial elevation and section in Fig. 2015, and in perspective under CRUCIBLE FURNACE, Fig. 737, p. 233, *supra*.

Fig. 2016.



Piat Furnace, with Regenerator.

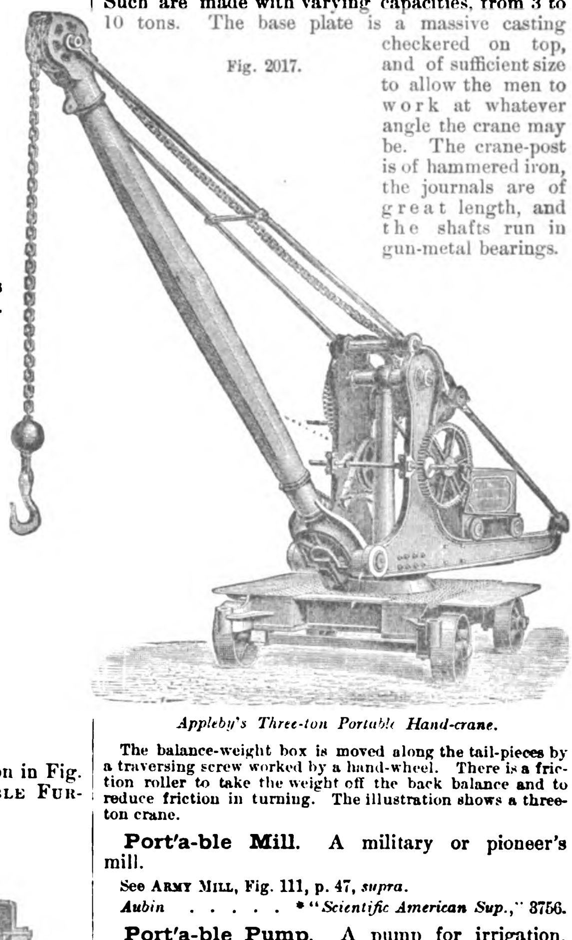
The crucible is permanently inclosed within the furnace wall, and the two are moved together, whether to the furnace and chimney, or to the molds on the floor of the foundry. The mode of heating is either by combustible placed between the crucible and the furnace wall, the ashes from which fall through holes in the furnace when the crucible is over the draft, or the heated gases from a gas producer are led to the furnace (Fig. 2016), passing through the regenerator which is heated by the gases escaping from the furnace in the direction of the upper arrow.

The furnace containing the crucible is moved on wheels, as in Fig. 735, p. 233, *supra*, or is slung from a crane.

Piat, Fr. . . . . * "*Engineer*," xlix. 260.
* "*Engineering*," xxviii. 397.

Port'a-ble Hand'-crane. A crane on a truck. Such are made with varying capacities, from 3 to 10 tons. The base plate is a massive casting checkered on top, and of sufficient size to allow the men to work at whatever angle the crane may be. The crane-post is of hammered iron, the journals are of great length, and the shafts run in gun-metal bearings.

Fig. 2017.



Appleby's Three-ton Portable Hand-crane.

The balance-weight box is moved along the tail-pieces by a traversing screw worked by a hand-wheel. There is a friction roller to take the weight off the back balance and to reduce friction in turning. The illustration shows a three-ton crane.

Port'a-ble Mill. A military or pioneer's mill.

See ARMY MILL, Fig. 111, p. 47, *supra*.

Aubin . . . . . * "*Scientific American Sup.*," 3756.

Port'a-ble Pump. A pump for irrigation, extinguishing fires, for green-house purposes, watering lawns, etc.

See under various titles. Such as HYDRONETTE, AQUAPULT, etc.

In a smaller form a STOMACH PUMP, INJECTOR, SYRINGE DOUCHE, etc., which see.
In one sense, a FIRE ENGINE, which see.
Fig. 2018 shows a French portable pump and tank.
See IRRIGATION PUMP. Figs. 1473-1475, p. 508, *supra*.
See NORIA; PORTABLE ENGINE AND PUMP, *supra*.
Also Fig. 1218, p. 516, "*Mech. Dict.*"

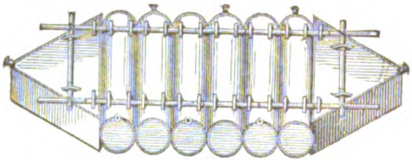
Port'a-ble Raft. One capable of transportation on a journey as distinct from one simply hove overboard from a ship, or made in an emergency from masts, casks, and other floating material. See Figs. 4105–4108, pp. 1854, 1855, "*Mech. Dict.*"

Fig. 2018.

French Portable Pump.

The life-raft, as shown in Fig. 2019, is of a form that might wisely be adopted for use nearer home. Stanley's portable raft was composed of six caoutchouc ponton tubes, which were inflated at pleasure by means of bellows. These tubes rest transversely on three keels, to which are lashed the poles shown above. The bow and stern consist of triangular compartments, and the whole during transportation may be

Fig. 2019.



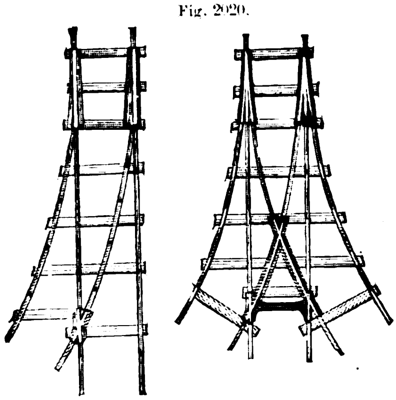
Stanley's Raft.

packed in a convenient form. Its whole weight is 300 pounds, which can be divided into five loads of 60 pounds each.

See also RAFT, "*Mech. Dict.*," *et infra ;* LIFE BOAT, Fig. 1588, p. 542, *supra ;* PORTABLE BOAT, *supra*.

Port'a-ble Rail'way. A system having tracks in section laid down on plantations, in wine caves, or in manufacturing establisements, for conveyance of crops, heavy articles, packages, and what not.

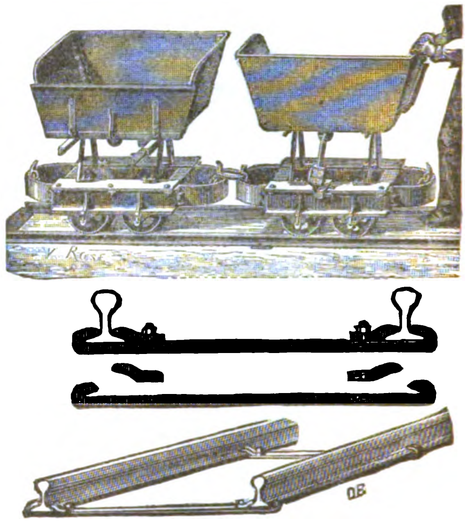
Fig. 2020.



Decauville's Portable Railway.

The system shown in Figs. 2020–2022 is that of *M. Decauville*, of Petit-Bourg, near Paris. The rails have iron ties laid

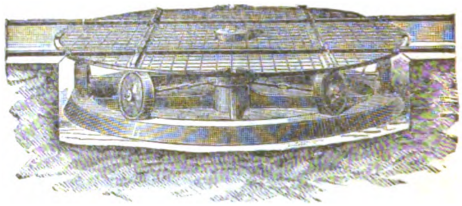
Fig. 2021.



Portable Railway Trucks, Rails, and Track.

in sections of track 5 meters long, more or less, with switches, turn-outs, and turntables, according to the requirements of the special case. It is evident that while in field-railways a curve may be admissible, it will frequently be necessary to substitute a turntable in the passages of a yard or building.

Fig. 2022.



Turntable.

The trucks shown are dumping cars used in plantation use for conveying beets especially from the field to the sucrerie or distillery. Other forms are used in wine caves and in factories and for cane plantations.

Fowler, Br. . . . . . . * "*Engineer*," xlviii. 34.

Port'a-ble Steam Crane. A locomotive steam crane. Used in factories and many public and private works of the larger class.

The crane shown in Fig. 2023 was used in dismounting heavy freight from flat cars at the Paris Exposition, 1878.

The Aveling & Porter portable steam crane is a modification of their traction engine, having the same locomotive power with the addition of the winding drum and crane. The foot of the jib is rigged in front, resting upon the front base-piece of the boiler, and the top is supported by iron rods which are attached to the side plate brackets. The sides of the fire-box are extended upward to form the crank shaft brackets.

See, also, RAILWAY CRANE, *infra ;* STEAM CRANE, "*Mech. Dict.*"

Port'a-ble Steam En'gine. One capable of moving or being moved from place to place. They are known by various specific names, according to purpose, usually. See various captions under PORTABLE ENGINE.

See also PORTABLE STEAM ENGINE, Figs. 3895–3899, pp. 1769, 1770, "*Mech. Dict.*"

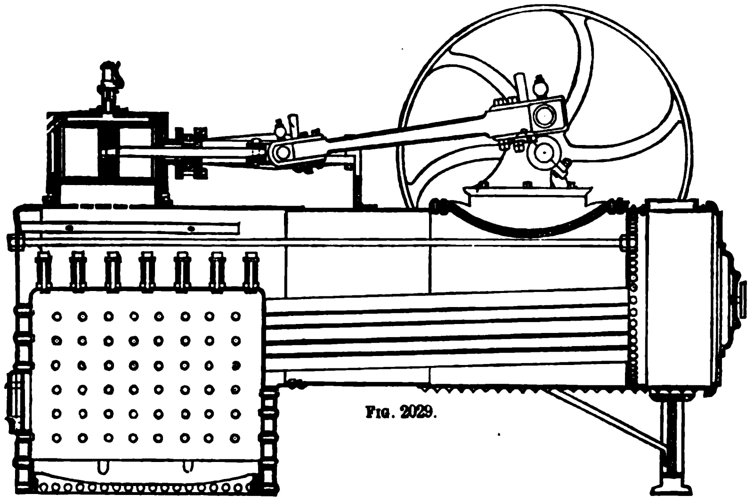


Fig. 2029.

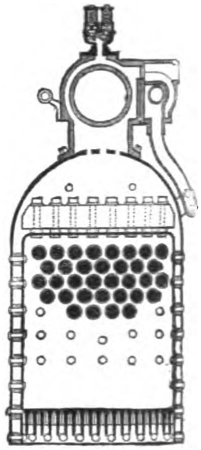


Fig. 2030.

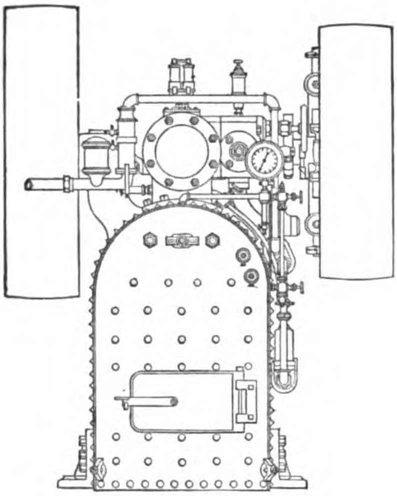


Fig. 2026.

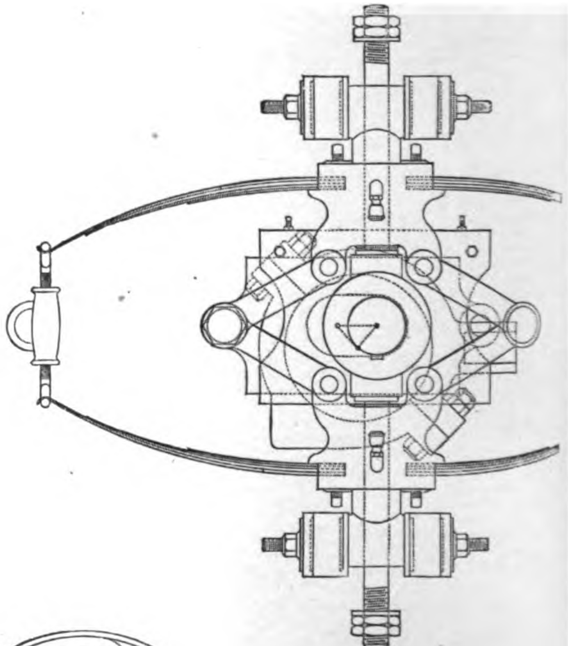


Fig. 2028.

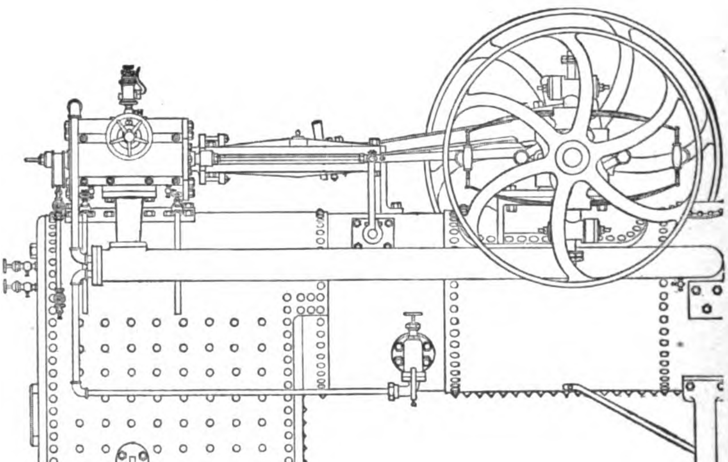


Fig. 2025.

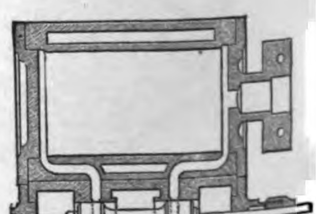


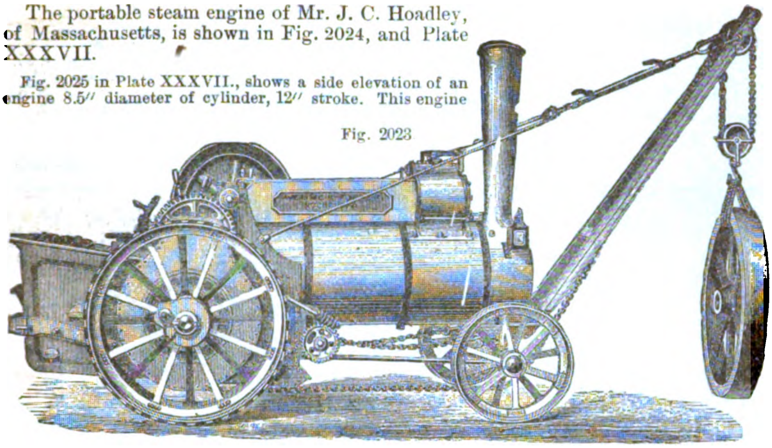
Fig. 2027.

 See page 711.

The portable steam engine of Mr. J. C. Hoadley, of Massachusetts, is shown in Fig. 2024, and Plate XXXVII.

Fig. 2025 in Plate XXXVII., shows a side elevation of an engine 8.5″ diameter of cylinder, 12″ stroke. This engine gives 20 indicated horse-power with 100 pounds per square inch steam gage pressure in the boiler, and four-fold expansion. The boiler easily supplies steam for 25 indicated horse-power.

Fig. 2023



Aveling & Porter's Portable Steam Crane.

Fig. 2026 shows the fire-box end of an engine 8.5″ diameter of cylinder, 12″ stroke, in end elevation.

Fig. 2027 is a horizontal section on the axis of cylinder and steam chest of an engine 8.5″ diameter of cylinder, 12″ stroke.

Fig. 2028 is a side elevation on the larger scale of the governor of an engine 3.5″ diameter of cylinder, 12″ stroke. The leaf springs are straight when unconfined by the links at their extremities. The centrifugal force of the springs, of the sliding heads which confine their thicker ends, and of the adjustable weights attached to these sliding heads, causes the heads to slide outward, toward the binding-nuts at the upper and lower ends of these rods, thereby increasing the tension of the springs, and shifting the eccentric, by means of the toggle-joint at the left-hand, and the sliding-plate to which the eccentric is fast, cast solid with it.

The sliding-plate and eccentric are slotted, as shown by dotted lines. The slot is long enough to admit of shifting the sliding-plate to the other toggle-joint, at the right, which reverses the engine.

Fig. 2029 is a vertical, longitudinal section, on the axis of a similar boiler and engine.

A spray-plate, indicated above the tie-rod, over the fire box, prevents the direct admission of entrained water to the jacket around the cylinder.

Fig. 2030 is a vertical cross section through fire-box and cylinder of an engine 8.5″ diameter of cylinder, 12″ stroke.

An engine of the class represented in the accompanying cuts, and of the same arrangement and construction, was tested at the International Exhibition in Philadelphia, Sept. 7, 1876, under the direction of John S. Albert, Chief of Bureau of Machinery, by Charles T. Porter, Charles E. Emery, and Joseph Belknap, Judges.

An ordinary, commercial engine, made and subsequently used to drive a saw-mill, it was destitute of all the refined appliances for saving heat and for obtaining unusual duty almost universal in trials of this kind. The boiler was entirely naked, and exposed a radiating surface equal to 40 per cent. of its heating surface, to a draft of cool, damp air. The loss caused by this radiation has been found experimentally to be at least 12 per cent.; and about 7-12 of this loss might have been saved by a simple boiler clothing.

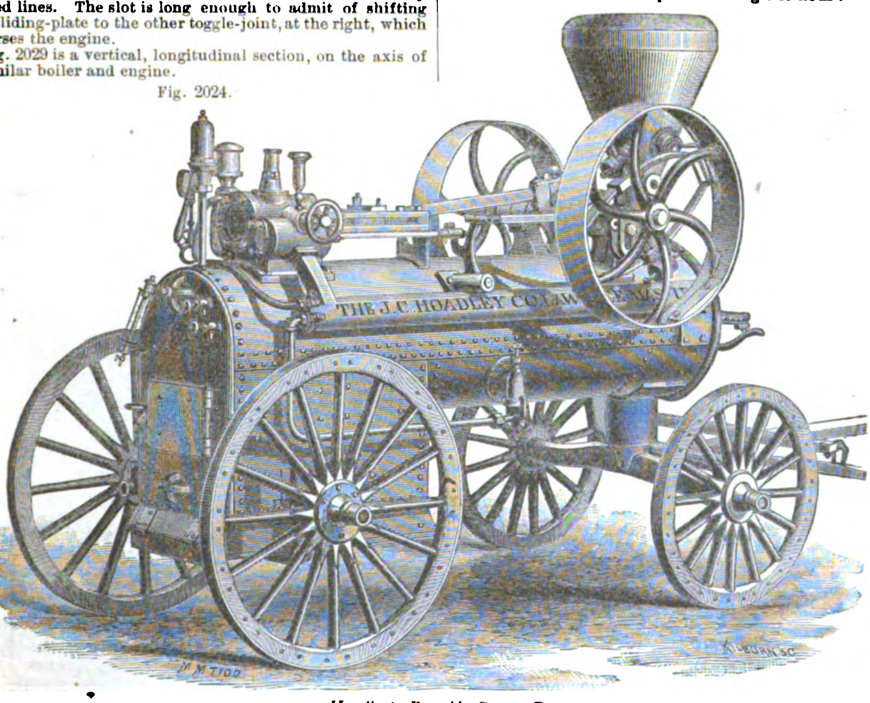
The ordinary anthracite used was wet by rain in transit to the engine, and was fired without special skill by a man who never before saw the engine.

All the conditions were arranged so as to represent the ordinary practice of men commonly using this class of engines. All these circumstances should be borne in mind in comparing results with those obtained by exceptional skill and care from "racing engines."

CONSUMPTION.

For each indicated horse-power during one hour: —

Fig. 2024.



Hoadley's Portable Steam Engine

25.61 pounds of feed-water, by weight.
19.38 pounds of visible steam, by diagram.
3.35 pounds of anthracite coal.
2.95 pounds of combustible.

GENERAL DIMENSIONS.

Engine.

Diameter of cylinder	14.56″
Diameter of piston-rod	2.375″
Length of stroke	1.66′
Capacity of clearances and passages in terms of stroke	.091

Boiler.

Length of shell	16′
Diameter of shell, inside	40″
Length of fire-box, inside	54″
Width of fire-box, inside	34″
Height of fire-box, above grates (whole height, 48″)	44″
Number of tubes	80
Diameter of tubes, outside	2.25″
Length of tubes (between tube-sheets)	113″
Heating surface in fire-box above top of grates, square feet	60.5
Heating surface, tubes, inside, square feet	394.5
Heating surface, smoke-box, square feet	6.5
Heating surface, aggregate, square feet	461.5
Area of fire-grate, 54″ by 34″, square feet	12.75
Ratio of heating surface to fire-grate area	36.2

SUMMARY OF RESULTS OF TRIAL.

Kind of Quantities.	*Pounds.*
Feed-water per dynamometer horse-power, per hour	28.27
Feed-water per indicated horse-power, per hour	25.61
Visible steam per dynamometer horse-power, per hour	21.40
Visible steam per indicated horse-power, per hour	13.38
Coal burned per dynamometer horse-power, per hour	3.69
Coal burned per indicated horse-power, per hour	3.35
Combustible burned per dynamometer horse-power, per hour	3.26
Combustible burned per indicated horse-power, per hour	2.95
Water evaporated per pound of coal burned	7.65
Water evaporated per pound of combustible burned	8.68

EFFICIENCY.

The indicated horse-power is obtained from 300 to 350 pounds of engine and boiler.

The portable horizontal trade engine of Marshall, Graves & Co., is shown in Plate XXXVIII.

The parts are plainly visible, and scarcely need description. The boiler is of the locomotive pattern, with arched crown sheet braced and stayed. The water front extends around the fire-box and ash-pit. The boiler and engine are so far independent of each other that the expansion of the former in heating up brings no strain on the latter. The valve has variable expansion arrangement. The spark arrester has a steam spray. The wheels are of iron, and turn under the boiler. The bed plate forms the heater, and is bolted to the boiler on the cylinder end. The pump is worked directly from the cross-head.

The portable and traction engine of Hooven, Owens, Reutschler & Co., is shown in Plate XXXVIII.

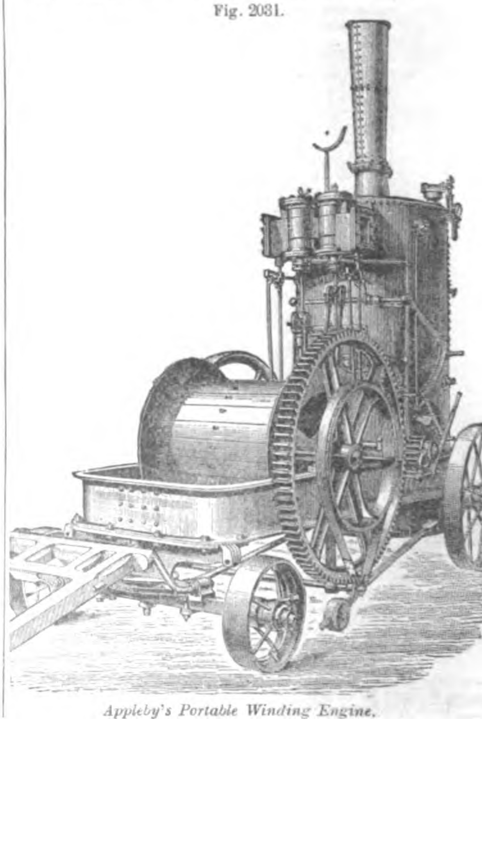
The engineer stands upon the rear plate, and has the starting and reversing levers, and the steering wheel immediately in front. The train by which the relatively rapid piston motion is geared down to the propulsion movement is principally upon the other side of the machine, as shown in the cut; but parts of it are visible above and below the boiler, and the pinion which actuates the spur wheel of the driver is on the side presented. When the engine is in place, the locomotive portion is thrown out of gear, and the force of the engine applied to the band wheel.

Several forms of portable steam engines, locomotive (self-moving), and otherwise, are shown on p. 1770, "*Mech. Dict.*:" also semi-portable at Fig. 3895, p. 1769. The smaller class of engines, such as the Baxter, Fig. 3898, p. 1770, are light in weight, and, in a sense, portable, but not according to the proper meaning of the word as applied in this connection.

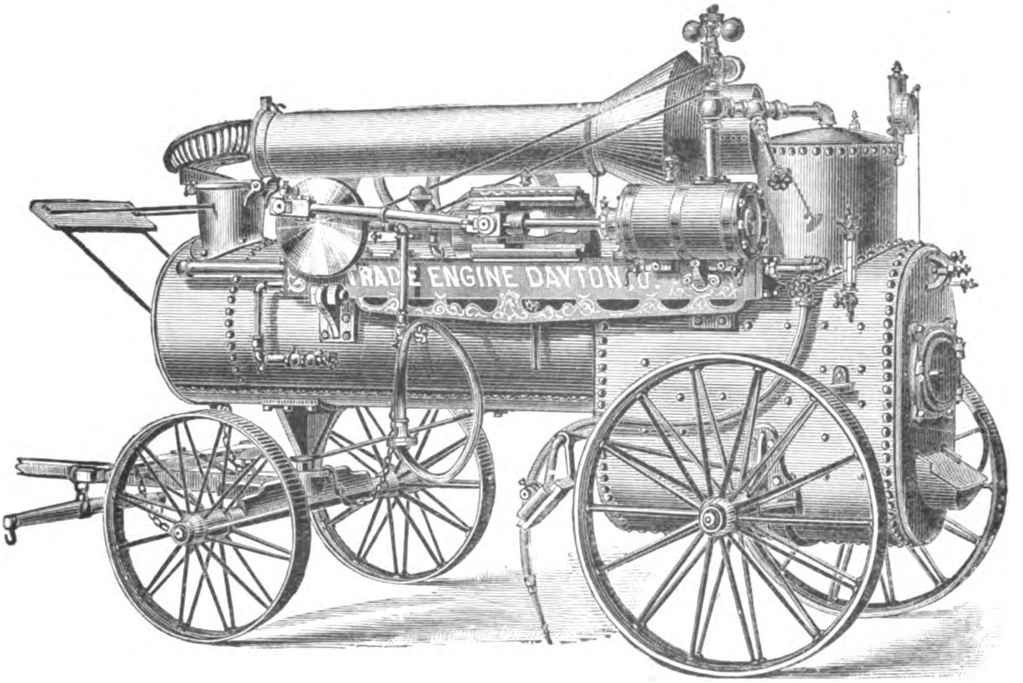
See the following references: —

Ransome, Br.	* "*Engineer*," xlvi. 407.
Marshall, Br.	* "*Engineering*," xxii. 463.
"Eclipse," *Frick*	* "*Scientific American*," xxxvi. 96.
Westinghouse	* "*Scientific American*." xlii. 115.
Wallis & Steevens	* "*Scientific American Sup.*," 1475.
Portable, *Ames*	* "*Min. & Sc. Press*," xxxiv. 112.
	* "*Engineer*," xlii. 6.
	* "*Iron Age*," xix., March 22, p. 1.
	* "*Iron Age*," xx., July 12, p. 1; Aug. 2, p. 1.
Armitage & Ruster, Br.	* "*Engineer*," xlii. 203.
Baxter	"*Scientific Amer.*," xxxviii. 70.
Boiler, *Belleville*	* "*Engineering*," xxv. 387.
Blake, Br.	* "*Engineer*," xlviii. 181.
Brake, *Garrett*, Br.	* "*Engineering*," xxx. 44.
Engine, *Brown & May*, Br.	* "*Engineering*," xxiii. 448.
Cambridge	* "*Engineer*," xlvii. 466.
"Clipper,"	* "*Iron Age*," xviii., Dec. 21, p. 1.
Cochran, Br.	* "*Engineering*," xxx. 9.
	* "*Engineer*," l. 39; xlviii. 45.
Demenge, Fr.	* "*Engineering*," xxviii. 338.
Erie Iron Works	* "*Iron Age*," xix., April 26, p. 1.
Boiler, *Garrett*, Br.	* "*Engineer*," xlvi. 226.
Engine, *Gibbons*, Br.	* "*Engineer*," xlviii. 434.
Hornsby (1849), Br.	* "*Engineer*," xlvii. 459.
King	* "*Min. & Sc. Press*," xxxvi. 81.
Longrove	* "*Iron Age*," xix., March 1, p. 1.
Mills	* "*Scientific Amer.*," xxxvi. 303.
Mud plug for portable engines, *Clayton & Shuttleworth*, Br.	* "*Engineer*," xlix. 53.
	* "*Engineering*," xxx. 233.
At Paris, 1867	* "*Engineer*," xlviii. 16.
"Peerless," *Landis*	* "*Iron Age*," xxi., May 16, p. 1.
	* "*Scientific American*," xlii. 68.
	* "*Scientific Amer.*," xxxviii. 190.
Ransome, Br.	*Thurston's* "*Vienna Rept.*," ii. 102
Ransome (1841)	* "*Engineer*," xlvii. 459.
Self-moving	* "*Engineer*," xlvii. 459.
Skinner & Wood	* "*Scientific American*," xlii. 82.
Talbot, Br.	* "*Engineer*," xlvii. 416.
Utica St. E. Co.	"*Iron Age*," xvii., Jan. 6, p. 3.
Wallis & Steevens, Br.	* "*Engineering*," xxii. 467.
	* "*Engineer*," xlii. 382.
Wallis & Steevens, Engl.	* "*Scientific American Sup.*," 950.
Wheeler & Mellick	* "*Am. Man.*," July 16, 1880, p. 13.
Compound, *Fowler*, Br.	"*Iron Age*," xxiv., July 31, p. 13.
Engine of the future	"*Scientific American Sup.*," 1555.
Expansion gear.	
Marshall, Br.	* "*Engineering*," xxviii. 4.

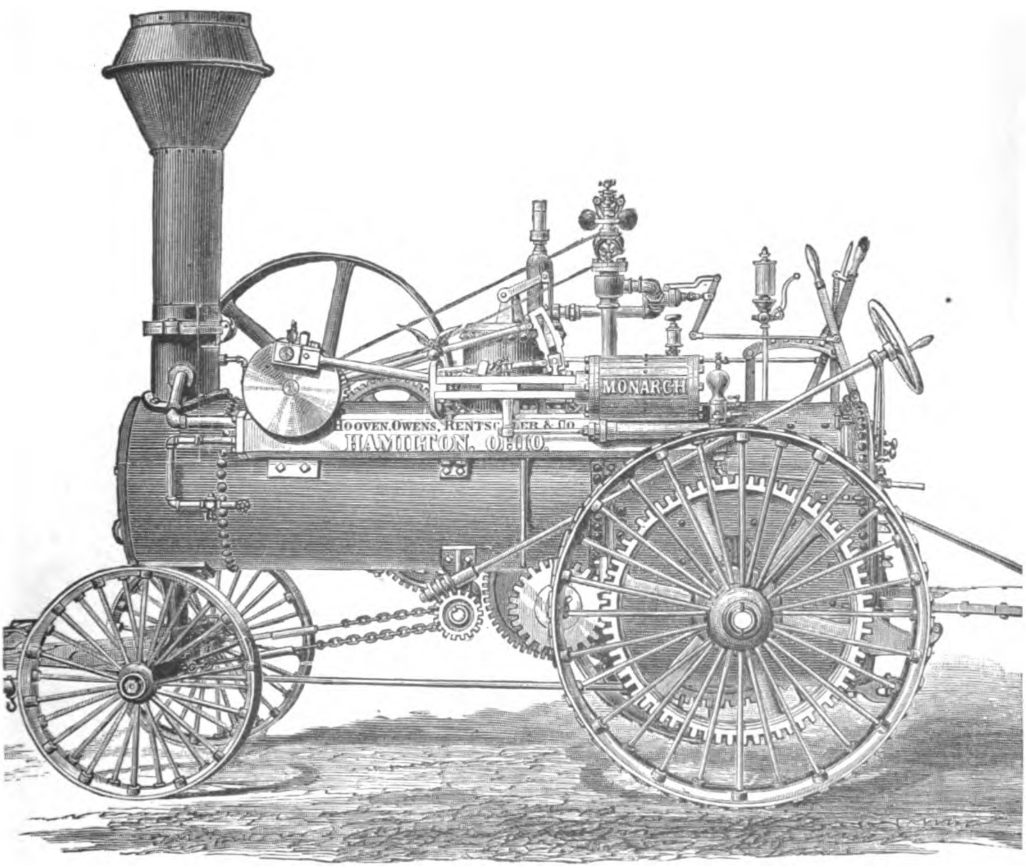
Fig. 2031.



Appleby's Portable Winding Engine.



MARSHALL & GRAVES' PORTABLE STEAM ENGINE.



HOOVEN, OWENS, RENTSCHLER & CO.'S PORTABLE AND TRACTION ENGINE.

See page 712.

Garrett, Br. . . . * "*Engineering*," xxviii. 25.
Straw-burning, *Clayton & Shuttleworth*, Br. . * "*Engineering*," xxvii. 572.
Garrett, Br. . . * "*Engineering*," xxvii. 573.
* "*Engineering*," xxiv. 36.
Vertical, *Baxter* . . * "*Iron Age*," xxi., May 2, p. 5.
Blymm Co. . . . * "*Iron Age*," xxi., Feb. 14, p. 9.
* "*Iron Age*," xx., Dec. 27, p. 1.
Ervien . . . . . * "*Iron Age*," xxi., May 9, p. 39.
Farquhar . . . . . * "*Iron Age*," xxii., Dec. 12, p. 5.
Shapley . . . . . * "*Iron Age*," xxii., July 25, p. 1.

Por'ta-ble Wind'ing En'gine. A movable hoisting engine used in many temporary works, either buildings or excavations.

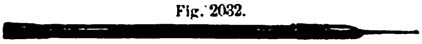
The forms vary with the purpose and the power required.

The instance given in Fig. 2031 is a 12 horse-power, used in railway works. It is mounted on wrought-iron wheels, and fitted with shafts and locking plate. The engine is fitted with link reversing gear, so that an up or downcast cast or double rope can be worked, or lowering may be performed by steam or by the brake. The drum and gear can be readily removed when the engine is to be used for driving machinery.

Porte-ac'id Glass. (*Surgical.*) A small burette to carry a caustic, for application in a deep-seated part.

Porte Ai-guille'. A needle holder.

Fig. 2032.

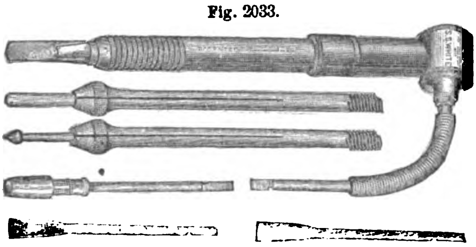


Porte Aiguille.

See Needle Forceps, Needle Holder, *supra*; and Fig. 3306, p. 1518, "*Mech. Dict.*"

Porte Pol'ish-er. An instrument for use with the Dental Engine, Fig. 795, p. 250, *supra*. It

Fig. 2033.



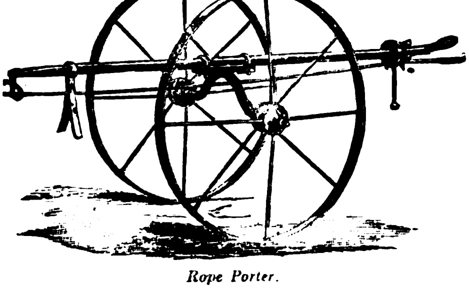
Porte Polisher and File Carrier.

may be considered a kind of chuck; a split screw, which allows the use of different sized points, and their retention by a turn of the sheath. — *Klump.*

Por'ter. Porters are wheeled supports placed along the line of the rope at intervals of 40 yards, to keep the rope off the ground in steam plowing. In another form they are mounted on three wheels, so as to allow them to be moved sideways by the rope.

The *Aveling and Porter's* traveling rope porters are fastened to the rope at intervals behind the plow or cultivator, as it leaves either headland; they travel across the field with the rope, and are taken off as they return. Their release from the rope is instantaneous. They are much less trouble than porters on any other principle, and they save the boys the fatigue of running with the implement across the field. The one which immediately follows the plow or cultivator is provided with a steerage, to prevent those behind from running on the plowed ground, and to keep the back rope clear of the furrow.

Fig. 2034.



Rope Porter.

See Installation of Steam Plow, pp. 2354, 2355, "*Mech. Dict.*"

Port'land Ce-ment'. A favorite hydraulic mortar made from the quarries of the hill of Portland, South Britain.

See Hydraulic Cement, p. 508 and 1144, "*Mech. Dict.*" Also Cement Tester, p. 184, *supra.*

Tests of, *Mann* . . . "*Van Nostrand's Mag.*," xvii. 17.
"*Sc. American Sup.*," 1333, 1427.
"*Scientific Amer.*," xxxvi. 227.

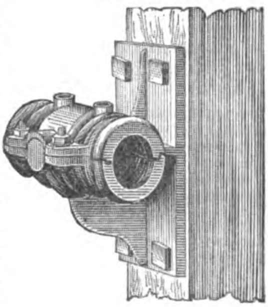
Por'trait Lathe. A lathe adapted to copying busts. It is a species of lathe for turning irregular forms, and depends principally upon the primary suggestion first embodied in useful service by Brunel in his block-making machinery in 1804, and Blanchard's spoke lathe, 1828.

See some data, pp. 1263, 1264, "*Mech. Dict.*," and discussion under article "*Sculpture par procédés Mécaniques*," vol. iii., *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," ed. 1877. Also *Ibid.*, iv., "*Tours Composés.*"

Pos'i-tive. (*Electricity.*) In the battery, the zinc plate or element.

Post Box. A shafting box attached to a post, instead of to hanging or standing pedestal.

Fig. 2035.



Post Box.

Post Drill. One supported on a standard. See Lever Drill, Fig. 1584, p. 541; Pillar Drill, Fig. 1931, p. 681, *supra.*

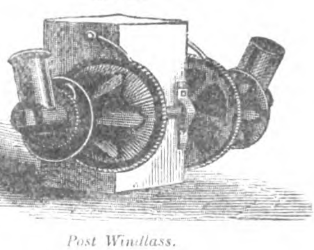
Post Mor'tem Table. One for autopsy, dissections, etc.

A table about 6½' × 2½' and slightly dishing towards a perforated plate in the center, at which water and blood are carried off by a trapped pipe to the sewer. The same pipe carries off fetid air. The table revolves, also raises and lowers, and rests upon a scales in the pedestal which has beams reading to pounds and ounces. — *McIlroy.*

Post Pumps. A form of donkey pump, attached to a port. See Pendulum Pump, *supra.*

Post Wind'lass. A winding machine which is actuated with breaks or handspikes by a reciprocating movement. In the special case it is a windlass of small size and the mode of mounting accounts for the name.

Fig. 2036



Post Windlass.

Pot. 1. (*Glass.*) The crucible in which *frit* is melted to form glass.

Glass pots are open or closed, the latter to protect fine qualities of glass, such as flint, from impurities.

In France and Belgium pots for cylinder glass usually contain 1,000 to 1,200 pounds of glass; in England sometimes as much as 5,000 pounds.

Furnaces usually hold 8 pots. It is a common European practice, and not unknown in America, to make pots thin and replace them regularly at the end of the week; instead of making them thicker to give them a longer lease of life.

The batch is put into the pots in three lots, allowing each to melt before adding another. The allowance of melting time, with a class of large pots, is —

For the first charge	7
For the second charge	4
For the third charge	3

2. (*Fishing.*) The *bowl*, *pound*, or *crib* of a *pound-net*, which see.

Po-tas'si-um-chlo'rate Bat'te-ry. (*Electricity.*) One in which potassium-chlorate with sulphuric acid is used as the depolarizer.

	"*Niaudet*," American translation, 210.
Potassimeter	"*Potassimètre*," *Laboulaye's* "*Dict.*," iii.
Potassa, industry	"*Scientific American*," xxxiv. 260.

Po-ta'to Bug De-stroy'er. A device for sprinkling or dusting poison upon the beetles, or sweeping them off the plants into trays.

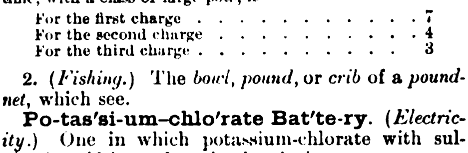
See list, where the devices of this nature are described, COTTON-WORM DESTROYER, p. 226, *supra*.

Po-ta'to Cov'er-er. A one-horse machine with flanged expanding sides that draw the soil from both sides and cover the potatoes, or other ridge crop.

Po-ta'to Dig'ger. Three forms of machines for digging potatoes are shown on pp. 1775, 1776, "*Mech. Dict.*"

Those given in the accompanying Figs. 2037-2039, are respectively French (double effet.), American (*Speer*), British (*Permey*).

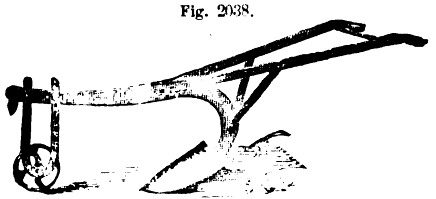
Fig. 2037.



French Potato Digger.

Their action is essentially different. One acts as a plow with lifting prongs to separate the tubers from the soil; an-

Fig. 2038.



American Potato Digger.

other plows up the tubers and soil and separates them by a dancing grating: the third has revolving forks which throw up soil and tubers against a dependant screen.

The "Empire" potato-digger, *Allen & Co.*, is a machine in which a plow is succeeded by bent revolving forks which work through the furrow slice and sort out the potatoes from the soil.

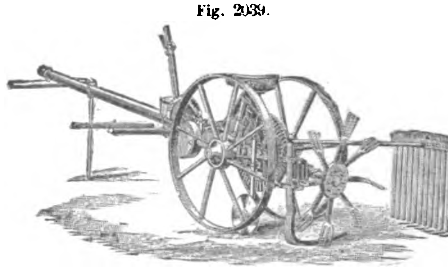
Avery's is a shovel plow with prongs extending behind the share.

Siedersleben, Ger.	"*Scientific American*," xli. 66.

Po-ta'to Ma-chin'er-y.

Beetle destroyer, *Badona*	* "*Scientific American Sup.*," 57.
Iske	* "*Scientific American Sup.*," 446.
Digger, Engl.	* "*Scientific Amer.*," xxxix. 182.
Fr. & Am., Paris, 1878	* "*Scientific Amer.*," xxxix. 165.
Liedersleben, Ger.	* "*Scientific American*," xli. 66.
Strait	* "*Scientific American*," xl. 67.
Taylor	* "*Scientific American*," xlii. 166.
Planter, *Murray*, Br.	* "*Engineer*," l. 61.

Fig. 2039.



British Potato Digger.

Po'tent. (*Horology.*) A journal plate or bearing in a watch.

Po'ten-tite. An explosive used in the Cumberland and Furness mines, England.

Pot'te-ry. (*Ceramics.*) Pottery is an inclusive term, and comprehends all the varieties of baked clay ware.

Ceramics and *ceramic art* are the scientific terms which include the whole art of making and ornamenting objects of clay.

Even bricks are a class of pottery and are only distinguished from tiles of a common order by their shape. Of the many millions of bricks of which the major part of ancient Rome was built, a large proportion would be termed tiles, if classed according to their shape.

The saying of Augustus that he "found Rome brick and left it marble," has its comment in the fact that the hordes who captured Rome "found it marble and left it brick," for the marble was generally but a covering of slabs which have generally disappeared. The baths of Caracalla and the basilica of Constantine, as examples, are enormous masses of brick walls, from which the white and colored marble veneering has disappeared.

Pottery takes two grand divisions: *soft* and *hard*.

Soft pottery may be divided into four kinds: —

1. *Unglazed*; simply made of baked clay, porous and without lustrous surface.

2. *Lustrous*, or semi-glazed, but imperfectly resisting water.

3. *Glazed*, having a shining surface which is proof against water and uncorrosive liquids.

4. *Enameled*, or having a vitreous and more incorrodible and impermeable surface.

While the archaic and technical interest of the first-named three varieties is very great, the latter includes the principal objects of interest in modern soft pottery manufacture and embellishment.

Soft pottery embraces *faïence* and *majolica*, from Faenza (in Italy) and Majorca, two localities where the art of decorating pottery flourished in times past; in the former, notably in the sixteenth century, and in the latter during the Saracenic occupation of the island.

Almost every nation in Europe is now struggling to lead in the making of faïence, and the influence of the works of Asia, from China, Japan, India, Arabia, and Persia have suggested compositions, designs, forms, colors, and objects which have greatly increased the variety and beauty of European productions.

Hard pottery, or porcelain, is of a more vitreous character than *soft* pottery. Its composition is materially different, and it approaches glass in its character. Porcelain, in breaking, shows a vitreous character, usually white, though the color depends upon the material. Soft pottery has a rough fracture, exposing the porous clay body. Porcelain has a much sharper ring when struck, its material being hard and homogeneous. Pottery is translucent; soft pottery opaque.

Porcelain is divided into *hard* and *soft* paste, indicative of the relative compactness of the material. This may be stated in a general way to be due to the proportions of silica. See PORCELAIN, *supra*.

Stone ware is practically a grade between porcelain and earthenware.

See list under CERAMICS, p. 186, *supra*.

Brogniart divides pottery into 3 classes and 9 orders: —

I. Tender paste; sandy clay, calcareous; generally fusible in a porcelain fire.	1. Terra-cotta: bricks, tiles, and coarse earthenware. Sandy-clay ware, with dead surface, without glaze. 2. Lustrous pottery: thin silico-alkaline glaze. 3. Glazed pottery: lead glaze. 4. Enameled pottery (common faïence): tin glaze.
II. Hard paste. Argilo-silicious. Infusible.	5. Fine faïence: uncolored paste; lead, glass glaze. 6. Stone ware: colored paste, without glaze, or with silico-alkaline glaze.
III. Hard paste. Translucent; argilo-silicious; alkaline.	7. Hard porcelain: k aolinpaste, with feldspathic glaze. 8. Natural tender porcelain: paste argilo-saline, phosphatic, kaolinic; lead, glass, or boracic acid glaze. 9. Artificial tender porcelain: fritted marlaceous saline paste; lead-glass glaze.

I. 1. Fr. *Terre Cuite.* The ordinary and coarser kinds of pottery are made of plastic clay or argillaceous marl tramped, or ground in a pug-mill, and mixed with sand, lime, or cinders, according to the quality of the clay. The drying of bricks is usually in the open air, but of other objects sometimes in ovens.

The produce is an article open and porous, usually not very hard, and the objects are unglazed.

This class of pottery comprises: —

a. Bricks for building, not including *fire bricks* (which see).

b. Tiles for roofing and paving, not including glazed, enameled, and decorated. See TILE.

c. Stove and furnace pots; though these are often of refractory material, and not of the material cited above.

d. Drain tiles, water pipes, and hollow bricks.

e. Common household pottery not glazed, such as the chafing dishes used in Europe.

f. Flower pots and horticultural vases.

g. Sugar molds.

h. *Alcarazzas*, or cooling jars for water; *hydrocérames.*

I. 2. Fr. *Poteries tendres lustrées.* The paste is fine, homogeneous, opaque, and of a red or yellow color; the surface covered with a luster or peculiar alkaline-silicious glaze, now of a reddish or a black color, very thin and resisting. The ware has a dull fracture, and was baked at a low temperature. The Greek, and some other ancient pottery, belongs to this class, and it is not made now-a-days.

I. 3. Fr. *Poteries tendres vernissées.* This class includes the ordinary pottery before the making of *faïence*, and is still common in many countries. The paste is of plastic clay or argillaceous marl and sand, with the addition of lime, when it is not present with the clay. The materials are ground, the objects baked under protecting hoods, the biscuit ware dipped in a slip of lead glaze colored with oxides of manganese or copper.

I. 4. Fr. *Poteries émaillés.* Common *faïence.* Probably invented in Persia; introduced by the Saracens into Spain and Majorca (*majolica*); rediscovered in Italy by Luca della Robbia, born at Florence 1388 (*faïence*); and again by Palissy in the middle of the 16th century (Palissy ware).

The material of the paste is plastic clay, or argillaceous marl and sand. The clay is washed. The material is carefully mixed and milled, the ware baked at two operations; one for the biscuit, and the other for firing after glazing. This is frequently done in the same kiln, the crude being above, and the enameled ware below. The heat of the latter is a few degrees the hotter; the upper from a cherry to a dark red.

The enamel consists of a slip containing red lead, the oxides of lead and tin, sand, salt, soda, and coloring materials, and the ware is completed in a second fire. See FAÏENCE.

II. 5. Fr. *Faïence fine.* Invented by Wedgwood, in Staffordshire, England. The paste is white, opaque, of fine texture, dense, and the ware is sonorous. The glaze is a lead-glass. The material is essentially a washed plastic clay and calcined flints, or quartz finely ground, sometimes with a little chalk. The material of the glaze is fritted, and is composed of silex, soda, oxide of lead, and sometimes the addition of a little boracic acid.

Three principal kinds are distinguished, named from the notable quantities of chalk, silex, and feldspar in their respective compositions; though some chalk always accompanies the plastic clay, which varies from 62 to 87 per cent. in the various pastes of fine faïence.

The clay or kaolin is washed, the silex broken and ground fine, the matters brought to a thin batter with water, strained, and consolidated by evaporation. The paste is placed in damp cellars to ripen.

The baking and firing are at two operations; the biscuit being glazed by dipping or sprinkling with a slip embracing more or less of the following: feldspar, sand, kaolin, chalk, soda, boracic acid, ground glass, red lead, niter, and a little cobalt to connect yellow color. See FAÏENCE.

II. 6. Fr. *Grès-cérame* or *poteries de grès.* Stone ware. Stone ware is solid, very hard, sonorous, and opaque, with a paste more or less fine, and is distinguished as *common* or *fine.*

a. The paste, of coarse stone ware, is of unwashed plastic clay and quartzose sand. The articles are molded or made on the wheel, according to the character of their shape. They are glazed by throwing marine salt into the kiln and into the fire at the period of great heat, and the decomposition of the salt covers the objects with a thin scale of silico-aluminate of soda.

In some cases the unglazed articles are plunged in a bath of yellow ochre and fired; the resulting color is a brown-yellow glaze.

b. The composition and glazing of fine stone ware are essentially different. A feldspathic flux is added to the paste which makes it more vitreous, shown by its brilliant fracture. Kaolin, plastic clay, silex, pegmatite, sulphates of lime and baryta are used in the various pastes for stone ware. The glaze is sometimes by salt, potash, and red lead, placed in the seggars and volatilized in the kiln; or the biscuit is dipped in a lead-glass slip.

The articles are often ornamented by transfer-printing, or painting with metallic colors. See STONE WARE; PIPE.

III. 7. Fr. *Porcelaine dure.* Hard porcelain has a fine paste, is hard, translucent, sonorous, semi-vitreous, with a hard, earthy glaze. It is the most beautiful and resisting of all kinds of pottery.

The paste is composed of kaolin, feldspar, and sometimes of sand, plastic clay, and ground powder of pottery. The utmost care in preparing and compounding the materials is exercised. The mode of fashioning is according to character, the wheel, mold, and, in many cases, the art of the statuary.

After a slight drying in the air, the pieces are baked in the upper chamber of the kiln, inclosed in seggars to prevent soiling by the combustion of the fuel. The glaze is of silex, alumina, potash, and chalk, made into a fine slip in which the article is plunged.

The ware, after ornamenting in the biscuit stage, is burned at high temperature (*grand feu*) to vitrify the materials, giving the translucency and sonority. See PORCELAIN.

III. 8. Fr. *Porcelaine tendre naturelle.* English soft porcelain. This paste occupies a position between fine *faïence* and hard porcelain, differing from the latter in having a large proportion of phosphate of lime. The paste is more plastic than that of the hard porcelain, and is fashioned like fine faïence.

It is baked, and the biscuit glazed, ornamented, and fired in seggars. The glaze is lead-glass, with boracic acid. See PORCELAIN.

III. 9. Fr. *Porcelaine tendre artificielle.* French soft porcelain. This was made at Sèvres until 1804, and then the manufacture abandoned.

The paste is fine, dense, almost vitreous, hard, translucid, and fusible at high temperatures. A peculiar glass, fritted, forms three parts, to one part of marl and chalk, making a composition of little plasticity, which was molded. The difficulty of working it was extreme. The glaze was a glass: of sand, silex, litharge, potash, and soda. See PORCELAIN.

CERAMICS.

See: "*Wedgwood and his Works.*" *Meteyard:* London, 1878.
"*History of the Ceramic Art.*" New York, 1875.
"*Ceramic Art at the Vienna Exposition.*" *Blake:* New York, 1875.
"*Report of Ceramics at Paris Exposition*, 1878." *Blake*, United States Report, 1880.
"*Two Centuries of Ceramic Art in Bristol.*" *Champion:* London, 1873.
"*History of the Ceramic Art.*" *Jacquenard:* New York, 1873.
"*Keramic Art of Japan.*" *Audsley & Bowes:* 1875.
"*Pottery and Porcelain.*" *Prime.*

History, Development, etc., of the Ceramic Art, by *Hector Tyndale*, "*Centennial Exhibition Report*," vol. iii., Group II., p. 2.

On the Chemistry and Composition of the Porcelains and Porcelain Rocks of Japan, by *Henry Wurtz*, *Ibid.*, 114.

See: Alhambra . . .	* "*Scientific American*," xl. 137.
American	"*Scientific American*," xl. 57.
Ancient Roman . . .	"*Iron Age*," xx., Aug. 9, p. 3.
Gray pottery	* "*Scientific American*," xl. 264.
Greek ancient	* "*Scientific American*," xl. 199.
Japanese potters at work	"*Scientific American Sup.*," 1830.
Turkish pottery . . .	"*Scientific American*," xl. 361.
Potter's wheels . . .	* "*Scientific American*," xl. 226.
Pottery and porcelain .	"*Scientific Amer.*," xxxiv. 403.

Pou'dre Bru'tale. Coarse, or *cube powder.* Slow burning powder in blocks of determinate size, consisting, in some cases, of cubes 1.5″ thick.

See PEBBLE POWDER; PELLET POWDER, *supra.*

Poul'try Feed'er. A revolving cylinder with coops in stories and in circuit, holding fowls which are successively presented to the attendant, who crams each in turn. A French device. See EPINETTE, Fig. 974, p. 315, *supra*.

Poun'cing Ma-chine'. (*Hat Making.*) A machine for shaving or rubbing the surface of a hat or hat-body to rid it of shaggy fibres. The abradant is usually sand paper.

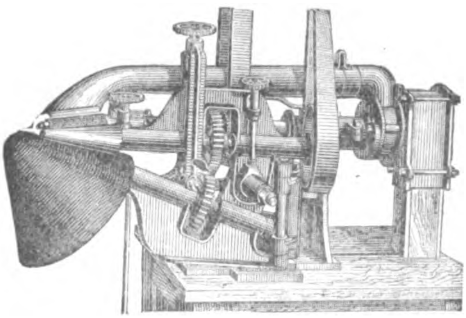
These machines may be considered as next in importance, in hat making, to the hat-blocking machine, and are constructed on two principles.

1. A rapidly revolving rubbing or cutting cylinder which operates on the object while it is fed along upon a yielding bed. This form is used on wool hats and the lower grades of fur hats.

2. A reciprocating motion is given to the rubbing surface or to the hat-body, to rub in two directions.

Fig. 2040 represents Eickemeyer's machine, which is used in both fur and wool-hat factories to sand-paper — or, as it is called in the trade, to *pounce* — hat-bodies when in the conical form, or, when the hat has been blocked, to pounce the brim. It consists of a rotary cutting roller of conical shape which is driven from a countershaft above. This roller is covered with sand or emery paper, and on the opposite end of the roller-shaft is a fan, connected by a pipe which has a mouth-piece corresponding in shape with the cutting roller and directly over it, to carry off the fur or wool pounced off the surface during the operation. Under the cutting roller is a pouncing bed which is adjustable in two ways, namely, so as to set that part of its upper surface exactly parallel with the face of the roller and to vary its position when desired; and also to prevent its upward motion beyond a given point.

Fig. 2040.



Eickemeyer's Hat Shaving and Pouncing Machine.

The bed is pivoted in the rear part of the frame and is operated by a treadle, to facilitate the introduction and removal of the hat. A pair of conical feed rollers, supported in an adjustable swinging frame, which are also driven from the countershaft, furnish the feeding mechanism. The pouncing bed is raised by the treadle, after the hat has been introduced and grasped by the feeding rollers, until the hat-body is in contact with the cutting roller, after which the hat is guided by the operator until its surface is properly pounced.

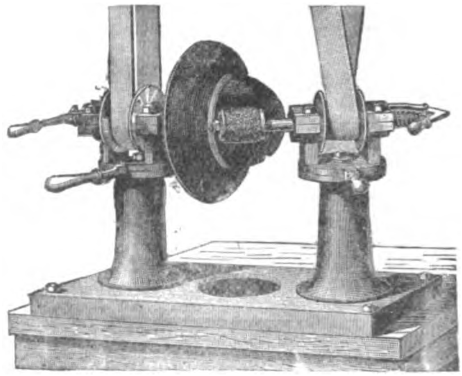
To pounce hat-bodies of different shapes, the position of the feed rollers has to be varied, and for this purpose a swinging frame is introduced which admits of an adjustment closer to or farther from the cutting roller as also in a direction parallel with the axis of the roller. An india-rubber spring presses the two rollers together, while the position of the feed-rollers relative to each other can be adjusted by a set-screw on the hinge joint of that part of the swinging frame which carries the upper feed-roller.

The cutting rollers are usually made of metal, and, in this case, have a spline to hold the sand-paper, but when of india-rubber the sand-paper is glued in the shape of a conical ring which is held on the roller by the expansion of the rubber by means of a nut on the outer end of the spindle.

In wool-hat factories this machine is the only pouncing machine used, as all hats, even such as have been previously blocked, can be pounced, all but a very small piece on the tip, which is pounced when the hat is completed on the finishing lathe.

In the crown-pouncing machine of Wheeler & Manley, the hat is drawn upon a block which is rotated upon a lathe-spindle. This cutting roller has its bearings upon the outer end of a long lever which is pivoted upon a countershaft with a gimbal joint which allows a free motion of the lever in all directions, and enables the operator to bring the cutting-roller in contact with all parts of the crown. In the illustration the cutting-roller is shown as working upon the side-crown, and it is from that position slowly carried over the round edge and brought to bear upon the tip.

Fig. 2041.



Hat-crown Pouncing Machine.

Fig. 2041 represents the Labeaux hat-crown pouncing machine. It has two lathe spindles, supported upon two columns, in bearings which can be turned upon the center of the columns in a horizontal plane. The spindle which carries the hat-block has a slow motion while the roller spindle revolves rapidly. Both spindles can slide longitudinally in their bearings.

The hat is held upon the block by an india-rubber band, and, as both the spindles can be turned in a horizontal plane, and also brought nearer together and farther apart, the operator can bring the cutting roller to bear upon all parts of the side-crown and the tip.

These machines, as previously stated, are used for wool hats and for only the coarser grades of fur hats, and do not produce the fine surface required on the better grades of fur hat; for these, machines having a reciprocating motion are required.

In the *Eickemeyer-Rosecrans* machine the hat is placed upon an upright spindle having a reciprocating rotative motion. The spindle has its bearings in the frame of the machine, and at its lower part is enlarged, forming a roller of sufficient length and diameter to receive two bolts which are each fastened to one end of the roller and one end to a cross-head which is supported in two slides, also fastened to the frame. The slide receives a horizontal reciprocating motion from a crank on the main shaft of the machine. Every revolution of the crank causes the cross-head to wind up and unwind the belts alternately upon and from the roller, and thus causes the block to make a revolution in one direction and then in the other.

While thus in motion, sand-paper is held by the operator against the surface of the hat until the proper degree of finish is attained. Cutting first in one and then in the other direction produces a very short nap, which cannot be obtained when the cutting is done in one direction, as on a machine with a continuously rotating cutting roller.

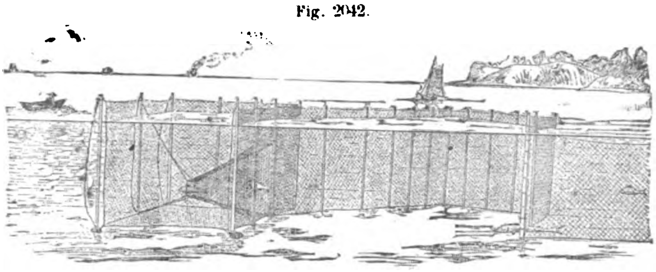
The brim-pouncing machine consists of a pair of rubbing plates, to which sand-paper is attached. These plates are made to vibrate in a horizontal plane in opposite directions to each other, by two cranks on the upright shaft which receives motion from the main shaft of the machine by a half-twist belt. The roller and the upper rubbing plate are raised to allow the introduction of the hat-brim. While the feed-rollers carry the hat around, one plate pounces the under side and the other plate the upper side of the brim. The result is a very smooth surface, and although but one fifth the number of hats can be pounced on this machine that can be pounced on the rotary cutter machine, it is by the manufacturers of fine hats preferred to the former.

The machine is provided with all the adjustments necessary to take up the wear of the working parts, and the upper plate and feed roller can be held up while in motion, so that it is not necessary to stop the machine to introduce and remove the hats.

Pound. (*Fishing.*) A wire or net inclosure into which fish are directed by a leader which intercepts their course along shore and conducts them to the first inclosure, known as the heart, from whence they pass through the tunnel to the more remote inclosure, the *pound* or *bowl*.

In emptying the pound the bottom stay-ropes are cast loose, the tunnel guys pulled up, closing the tunnel, the

Fig. 2042.

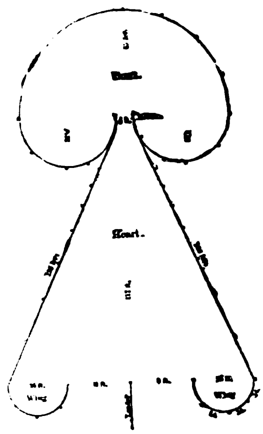


Pound.

bottom raised, driving the fish into one corner, when they are thrown into the boat by a scoop net.

Pound Net. (*Fishing.*) The *heart net* or *pound* consists of three parts, the *leader*, *heart*, and *bowl*, or *pound*, and is variously constructed.

Fig. 2043.



Pound Net, Wood's Holl, Mass.

The leader (of which a portion only is shown) is 265 yards long, reaches from the shore to the mouth, and directs fish passing along shore into the heart, whence they pass into the *bowl*.

The bowl is emptied once or twice a day.

For list of U. S. Patents, see FISHING NETS.

See other forms in "*Report of U. S. Fish Commission*," Part I., 1873, pp. 263, 264.

Pow'der Blow'er. (*Surgical.*) An instrument for blowing a powder upon a part. They are specially —

Aural.	Urethral.
Laryngeal.	Uterine.
Nasal.	

See AUTO-INSUFFLATOR, Fig. 131, p. 57, *supra*; INSUFFLATOR, p. 501, *supra*.

Pow'der Dust'ing Ma-chine'. Gunpowder, whether pebble or granulated, is required to be clean, and the dusting operation intervenes between the pebbling or granulating and the glazing.

Dusting is performed in revolving cylindrical reels, with clothing of canvas or wire cloth of a fineness to suit the grade of powder. A reel 8′ long and 30″ diameter will have 40 revolutions per minute.

In Russia, the powder is dusted in bags. Fig. 26, accompanying Appendix I., "*Ordnance Report*," 1877.

See also "*Ordnance Report*," 1879, Appendix I., Plate IV., Fig. 9, and description on pp. 106, 107.

Pow'der-ing Ma-chine'. 1. A bronzing machine.

2. A pulverizer — which see.

Pow'der Pa'per. A substitute for gunpowder, invented in England.

Paper impregnated with a mixture of potassic chlorate, nitrate, prussiate, and chromate, powdered wood charcoal, and a little starch. It leaves no greasy residue on the gun, produces less smoke and less recoil, and is less impaired by humidity, and it is 5-16 stronger than gunpowder.

For a paper with fulminate, see Fig. 1151, p. 380, *supra*.

Pow'der Press'ing Ma-chine'. A machine in which the powder meal from the breaking-down machine is made into cakes. It is a hydraulic press, the box of which is 30″ × 14″, lined with oaken boards.

The powder has a thickness of 1¼″ between each of the consecutive plates, and is pressed to the determined extent. Pressed cakes, for breaking into pebble powder, are ⅜″ thick.

For ordinary powder, the cakes are broken with wooden mallets, and pass to the granulating machine.

Details of the pressing machine are given in Col. Laidley's report, "*Ordnance Report*," 1877, p. 441.

See also *Ibid.*, 1879, Appendix I., Plate III., Fig. 7; and description on p. 103.

In the St. Petersburg arsenal, the incorporated mixture is pressed into cake in two ways: —

1. By hydrostatic pressure.

2. By passing the mixture between two heavy iron rolls, while spread to a uniform thickness on an endless band of cloth. This is known as the Prussian method.

Pow'der Spoon. A small paddle with which a modicum of powder is applied to a deep-seated part, the uterus especially.

Pow'der Test'ing. In Britain, the chronograph is used to determine the velocity of the flight of the projectile, a given quantity of the powder under test being used in a service gun with a given ball.

In France, the test is in firing to extremity a cast-iron gun of a given model, made of a particular iron, and treated in a given manner, with charges of a fixed weight of the powder to be tested. A new gun of exactly similar character is used for each powder.

In Russia, the French *densimetre à mercure* is employed to test the gravity of powder. See DENSIMETER.

The subject is considered, *supra*, under INTERNAL PRESSURE GAGE; PIEZOMETER; CUTTER; DYNAMOMETER, etc.

In "*Mech. Dict.*," under EPROUVETTE; BALLISTIC PENDULUM; ELECTRO-BALLISTA; CHRONOSCOPE, etc.

Drying stove for testing samples, "*Ordnance Report*," 1879, Appendix I., Plate X *a*.

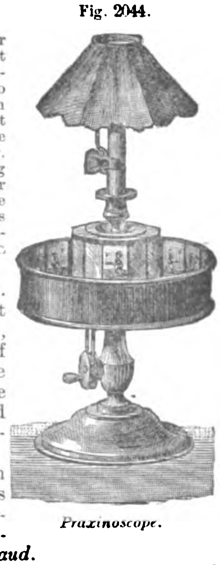
HYGROSCOPE, *Ibid.*, Plate X *b*.

Pow'er. As applied to a machine, signifies that it is moved by power, and not by hand: as *power press*, *power shears*, etc.

Prai'rie Plow. (*Agric.*) A plow with a broad, sharp share and long mold-board, for cutting a wide, shallow furrow, and completely inverting the furrow slice. A prairie breaker. See Fig. 422, p. 130, *supra*.

A California plow designed for work in the tules, which will cut a furrow 38″ wide. The mold-board is 8′ long from the point to the end, sweeping upward with a curve of about 4′ radius. At the end it stands 2′ above the ground. The land side is 7′ long. At the rear a horizontal cutting plate is arranged to cut under the sod on the land side a distance of 10″. The furrow depth is from 3″ to 4″. The plow is attached to a sulky, and requires a team of 12 horses.

Fig. 2044.



Praxinoscope.

Prai'rie Ren'o-va-tor. (*Agric.*) An implement with tearing harrow teeth, drawn over the surface of grass land to loosen the roots and the soil, dislodge moss, uproot weeds, and break up the matted vegetation.

Prax-in'o-scope. An instrument which depends for its effects upon the persistence of visual impressions on the retina. — *Reynaud*.

It however, differs structurally from a number of other instruments which depend also upon persistent impressions. These are the **Anorthoscope, Phenakistoscope, Stroboscope, Thaumatrope, Zoetrope.** See under these titles in the "*Mech. Dict.*"

In the praxinoscope of M. Reynaud the pictures are placed on the inner perimeter of a polygonal box. These pictures represent the consecutive positions of a moving body and substitute each other incessantly, the series in the circle representing a cycle of movements. Turning around a common center there is a concentric polygonal prism formed of mirror plates, and having a diameter equal to the radius of the exterior polygon. The box carrying the pictures and the reflecting prism is revolved at a moderate speed by means of a crank, pulley, and cord.

In the evening the apparatus may be lighted by a lamp or gas flame, the light being reflected downward by a shade. The optical principle involved is explained by *G. Fussandier*, in "*La Nature.*"

Pre'puce In'stru-ments. (*Surgical.*) See Phimosis Instruments.

Press'es. See under the following heads: —

Arch screw press.
Baling press.
Blacking-box press.
Calendering machine.
Cane press.
Cheese press.
Cider press.
Compound cotton press.
Cork press.
Cotton press.
Cutting, drawing, and stamping press.
Double-tub press.
Drawing press.
Embossing press.
Forage press.
Fruit press.
Grape press.
Hay press.
Herbarium press.
Horn press.
Inclined press.
Jelly press.
Lever press.
Mangle.
Olive press.
Pebble powder machine.
Pellet powder machine.
Pendulum press.
Portable cider press.
Powder pressing machine.
Pressing machine.
Reducing press.
Screw press.
Shirt press.
Stamping press.
Tan press.
Tan-yard press.
Tincture press.
Tobacco press.
Toggle press.
Wire press.
Wiring press.

Dr. Knight's report on agricultural instruments at the Paris Exposition of 1878, gives descriptions and views of the following. See "*Paris Exposition* (1878) *Reports*," vol. v., pp. 223, 238. The list includes various kinds: —

Grape mill, *Mabille Frères*	France.
Cider or oil press, *Mabille Frères*	France.
Constant movement for agricultural presses, *Bodin*	France.
Three-speed mechanism of apple-press, *Marmonier Fils*	France.
Lever differential press, *Marmonier Fils* . .	France.
Wine and cider press, *David*	France.
Hydraulic press, *Mannequin*	France.
Hydraulic oil-press, *Mannequin*	France.
Combined screw and hydraulic press, *Cassan Fils*	France.
Wine and cider press, *Quillet*	France.
Wine and cider hand-press, *Quillet*	France.
Toggle-press, *Samain*	France.
Toggle-press, caisson, tampon, and barrel, *Samain*	France.
Trussing-press, *Guilhem*	France.
Forage press, *Guitton*	France.
Ration press, *Guitton*	France.

Press Drill. A drilling machine largely used in gun and sewing machine work.

In the form shown in Fig. 2045, it runs by belts, avoiding the noise of gears. The sizes of spindle pulleys give a variety of speeds for drilling holes from 1-16″ to ¾″ diameter, and the driving cross pulley has 4 speeds. The work is elevated by vertical motion of the table; lever and treadle arrangements being provided for the purpose.

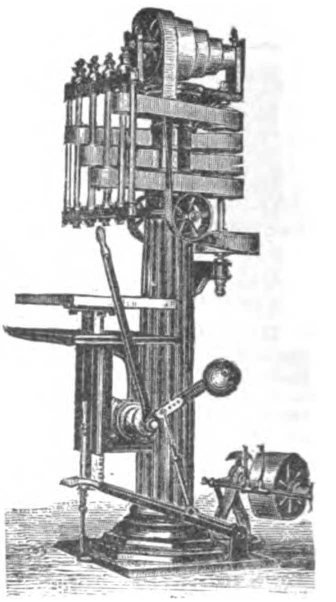
Pressed Fuel. See Fuel, Artificial, "*Mech. Dict.*," *et supra.*

Loiseau; Newton: Anthracite Fuel Co.; Prince's Report in Group I., "*Centennial Reports,*" vol. iii., p. 54.

Loiseau. . . . . "*Van Nostrand's Mag.*," xxiii. 41.

Pressed Glass. (*Glass.*) Glass made in a mold by pressure. This may be solid or with knobs, insulators, etc.; or hollow, as with bottles, which are blown and pressed in a mold; and some other things pressed hollow without blowing.

Fig. 2045.



Press Drill.

Iron molds are generally used, but wooden molds are very common in France.

Press'ing I'ron. A Smoothing Iron; Flat Iron, etc.

See Fluting Iron; Gauffering; Ironing Machine; Smoothing Iron, etc. See also Laundry.

Pres'sure Bar. A device in a planing machine for holding down lumber to be planed.

The long suits of the Woodworth and the Woodbury Patents were upon pressure bars and pressure rollers.

Horton's. . . . . "*Iron Age,*" xvii., April 20, p. 11.

The Pressure Block or Pressure Roller have the same duty.

Pres'sure Gage. An instrument used for indicating the pressure of an elastic material; steam, air, gas, etc. See various forms in Figs. 3939-3942, pp. 1736, 1737, *Mech. Dict.;*" Steam Gage, Figs. 5674-5677, p. 2345, *Ibid.* Also Gages, Figs. 5678-5683, pp. 2345, 2346, *Ibid.*

1. The gas pressure and vacuum gage is shown in Fig. 2046. It has a cast-iron case containing two brass tubes or wells; in one of them is a float, to which is attached a small cord passing over a pulley; this carries a pointer over the range of a dial. Such instruments are generally used near the hydraulic main, or in the exhauster room to indicate the pressure at any time. The pressure gage shows from 0″ to 18″ pressure, and the pressure and vacuum gage ranges from 9″ pressure to 9″ vacuum.

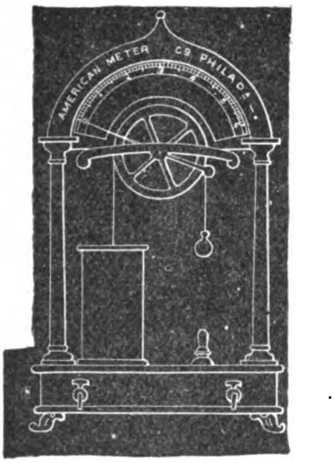
See also *A*, Fig. 3939, p. 1786, "*Mech. Dict.*"

2. An instrument used to detect the pressure in a cannon or fire-arm at the instant of explosion of the charge. See also Crusher Gage; Piezometer.

Fig. 2047 shows Rodman's pressure gage as adapted to the Springfield service gun and cartridge.

"The usual breech arrangement of the gun should have added a projecting frame, *A*, specially made for strength and accommodation of the piston *D*, knife *E*, and copper and steel plates *F* and *G*. A gas check *B* is used to prevent the escape of gas at the piston *D*. The cartridge *C* has a hole in its side the same size as the piston *D* (area 1-10 square inch); the edges of the hole in case are required to be made thin by a special operation, and lay snugly to the side of chamber to

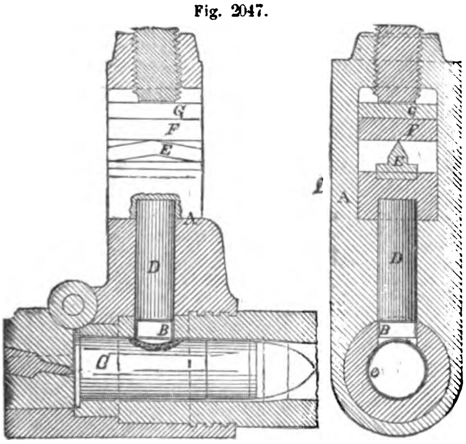
Fig. 2046.



Gas Pressure and Vacuum Gage.

prevent the escape of gas. No reliable results can be obtained if the gas is allowed to escape at this point. A slip of paper is inserted into the case to prevent the powder from falling out; the charge is ignited in the usual manner; the gas forces the piston *D* against the knife *E* into the copper plate *F*, making a cut; the knife and copper are removed to a weighing machine, and a corresponding cut of equal length is made in the same copper. A record of 50 shots gave a maximum of 14,000 lbs., and a minimum of 12,000 lbs. Mean 13,000 lbs. per square inch for the service cartridge — 70 grains powder, 450 grains ball."

Fig. 2047.



Rodman's Pressure Gun.

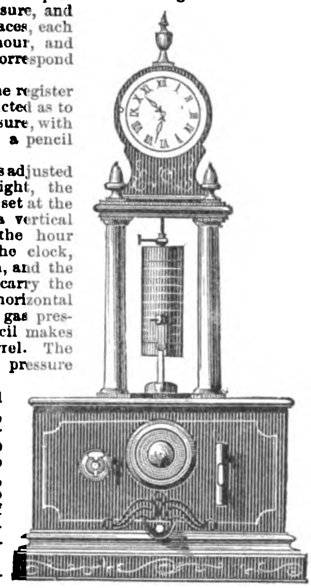
Apparatus, *Bouvet* . . * "*Eng. & Min. Jour.*," xxv. 129.
Pictet . . . . . . * "*Eng. & Min. Jour.*," xxv. 112.
Gage, *Allan*, Br. . . . * "*Engineer*," xliv. 193.
Allen, Engl. . . . . * "*Scientific Amer.*," xxxvii. 258.
Gage (theory), *Bourden* * "*Scientific American Sup.*," 1105.
Gage, *Shaw* . . . . * "*Mech. Dict.*," Fig. 3943, p. 1787.
Gage, steam . . . . * "*Iron Age*," xix., March 1, p. 11.
Gage, *Snyder* . . . . * "*Scientific American*," xxxvii. 6.
Indicator, electrical.
Shaw . . . . . . "*Scientific American*," xlii. 131.
Log . . . . "*Scientific American Sup.*," 1089.
Reducing valve, *Alley*, Br. * "*Engineer*," xlviii. 104.
For mains, *Barton & West* . . . . . * "*Engineer*," xlviii. 112.
Register . . . . . . "*Laboulaye's* "*Dict.*," iv., "*Graphiques*," Fig. 16.
Regulator, *Giroud* . . "*Iron Age*," xx., Dec 13, p. 7.
Holly . . . . . . * "*Scientific American*," xxxix. 95.

Pres'sure Reg'is-ter. An instrument elastic cording the fluctuations of pressure of an for re-body: steam, air, gas, etc. See Recording Steam Gage, Fig. 5083, p. 2346, "*Mech. Dict.*"

The gas pressure and vacuum register is an instrument used for recording the variations of pressure on street mains, at works, office, or any desired point of distribution, and is made with any required range of from 1″ to 6″ for 1″ working pressure, but is generally made for 5″ pressure to give a range of 12″.

Attached to the clock is a vertical barrel which makes 1 revolution every 24 hours; around this is a printed card divided horizontally, by lines, into 50 spaces, each representing 1-10″ pressure, and vertically into 24 spaces, each representing one hour, and so marked as to correspond with the clock.

Fig. 2048.



Pressure and Vacuum Register.

In the body of the register is a float, so constructed as to rise 12″ for 5″ pressure, with brass rod carrying a pencil holder.

When the water is adjusted to the proper height, the point of the pencil set at the zero line, and to a vertical line representing the hour corresponding to the clock, the gas is turned on, and the float will rise and carry the pencil up to the horizontal line indicating the gas pressure when the pencil makes its mark on the barrel. The tracing is thus a pressure and time line.

The pressure and vacuum register, Fig. 2048, is governed by the same principles as the pressure register, and is designed to keep record also of the degree of vacuum in the exhauster.

The card is divided the same, vertically, but in the horizontal divisions it differs, as it is divided into sixty spaces each representing 1-10″ pressure, the zero line being the twentieth from bottom, the space below the zero line representing 2″ vacuum, and the space above 4″ pressure.

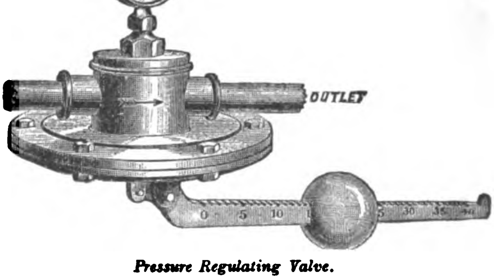
In adjusting the water line in this instrument, the point of the pencil is brought to zero line and to vertical line, corresponding to the hour of day shown by the clock. Gas then being turned on, any change of pressure or vacuum will be duly recorded, the cards to be changed daily and filed away as with Pressure Register.

See also Meter Prover, *supra*.

Pres'sure Reg'u-la'ting Valve. An apparatus to obtain a constant pressure of steam or air from a supply reservoir, wherein the pressure varies.

The form of apparatus shown in Figs. 2049, 2050, is specially intended for the abstraction of steam for heating purposes under pressure in a boiler much in excess of what is

Fig. 2049.

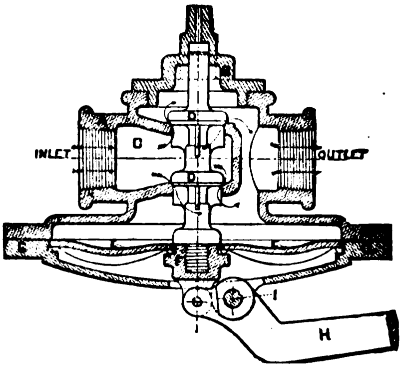


Pressure Regulating Valve.

demanded for the heating. The heating purposes referred to are for vacuum pans, heating apartments, drying rooms, bleacheries, paper machines, etc.

Fig. 2049 is an exterior view of the apparatus with a low pressure gage attached, and a lever beneath, with a weight

Fig. 2050.



Pressure Regulating Valve.

by which the pressure is regulated. The sectional view, Fig. 2050, shows the casing *A* with a screw-cap *B*. *C* is the inlet-chamber, and *D* is a balanced puppet valve, the raising of which allows steam to flow upwardly and downwardly into the main chamber of the valve, and thence to the outlet. The degree of opening of the valve is regulated by a large, flexible, thin, sheet-brass diaphragm *E*, clamped by the bottom-piece *G* to the base of the case *A*. The downward steam pressure on the diaphragm is opposed by the upward pressure of the weight on lever *H*, and this is so adjusted as to open the valve to such a degree as to admit the passage of such an amount of steam as may keep the pressure in the apparatus for which it is provided, at a given pressure, and consequent heat.

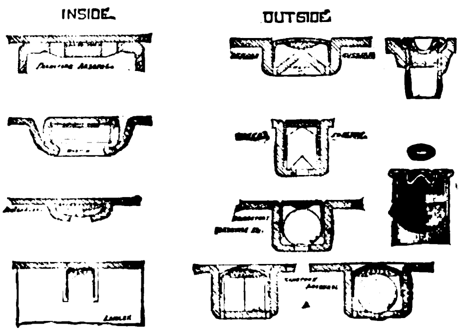
See: * "*Iron Age*" . . . . . . xxv., March 4, p. 9.
* "*Manuf. & Builder*" . . xi. 241.

Pri′ma-ry Coil. (*Electricity.*) The inner coil of the helix.

Pri′ma-ry Cur′rent. (*Electricity.*) That which passes through the primary coil.

Pri′mer. An exploder attached to a fire-arm, ordnance, or cartridge. See FRICTION PRIMER; PRIMER, "*Mech. Dict.*"

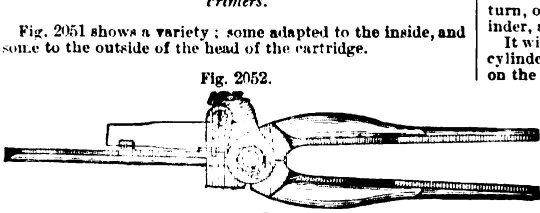
Fig. 2051.



Primers.

Fig. 2051 shows a variety; some adapted to the inside, and some to the outside of the head of the cartridge.

Fig. 2052.



Primer Extractor.

French friction primers, land artillery. *Laboulaye's* "*Dictionnaire*," "*Artifices de Guerre*," Fig. 166.
French friction primers, marine, *Ibid.*, *b*.

Pri′mer Ex-tract′or. A tool used to withdraw the spent primer capsule, in reloading metallic shells. See RELOADING TOOLS.

Pri′ming Ma-chine′. A machine to put the fulminate in the cap, which is to be attached to the cartridge shell.

One which places the fulminate in percussion caps.

Print′ing Press. Perfecting presses, *i. e.*, those which print both sides of the sheet at a single passage through the machine, usually work upon a continuous web of paper, the continuous sheet passing through the machine, passing between a type and impression cylinder, by which one side is printed and then between a similar pair of cylinders which print the reverse side; thence passing to the cutter which severs the sheets and thence to the folder.

Perfecting presses usually print from stereotype plates, some running as high as from 12,000 to 50,000 perfect papers per hour. The following are shown in the "*Mech. Dict.*," at the pages noted: —

Hoe & Tucker, Perfecting Web Press, Fig. 3640, p. 1666.

Walter Press, London "Times," Fig. 3641, p. 1667.

Bullock Press, Web Perfecting, Fig. 3642, p. 1667.

Victory Printing and Folding Machine, Plate XLIII., p. 1798.

Hoe's Web Perfecting Printing Machine, Fig. 7137, p. 2751.

Augsburg (German) Web Perfecting Press, Fig. 7138, p. 2752.

The preparing of stereotype plates involves a loss of at least 20 minutes after the forms have been set up by the compositor. The type revolving newspaper perfecting press of Hoe & Co., shown in Plate XXXIX., is made to print from type forms, from a roll of paper, at a rate of 12,000 per hour, and fold and deliver the perfected papers from one set of forms.

The type which is set up in the usual way in the composing room is placed in curved type beds, known as *turtles*, similer to those used in the multiple cylinder type-revolving machines, shown at page 670, and Plate XI., "*Mech. Dict.*" These beds, which contain the forms for the pages (say four) of the newspaper, are placed upon a large central cylinder around which at intervals are four plain cylinders with blankets on them and which take the impression.

The paper, which is in a large roll say 30′′ or more in diameter, is placed at the end of the machine, and the sheet — the "*web*" — passing through rollers and tapes is conducted around the first of the impression cylinders. As the central cylinder revolves against it the impression of the whole four pages is taken upon the paper. The sheet is then carried over a roller and introduced upon the second impression cylinder when the four pages are again printed upon it. The web of paper is then carried through rollers underneath the large type cylinder and by an arrangement of bars and rollers turned completely over. From the turning apparatus it is conveyed to the third impression cylinder, and again receives, opposite the side printed by the first impression cylinder, an imprint of the four pages of the paper. Again the paper is carried around a roller and introduced around the fourth impression cylinder, against which is printed in its turn, on the back of the impression made by the second cylinder, another of the whole four pages.

It will thus be seen that in one revolution of the large type cylinder four distinct papers or impressions have been printed on the web of paper.

The portion of the central cylinder which is not occupied by the type is used as a distributing surface for ink which is placed in fountains and conveyed by an arrangement of composition rollers to this distributing surface, which in turn carries it to the rollers inking the forms of type, and which are placed between each of the impression cylinders.

The paper, which now contains upon it four complete printed newspapers, is brought by tapes to two

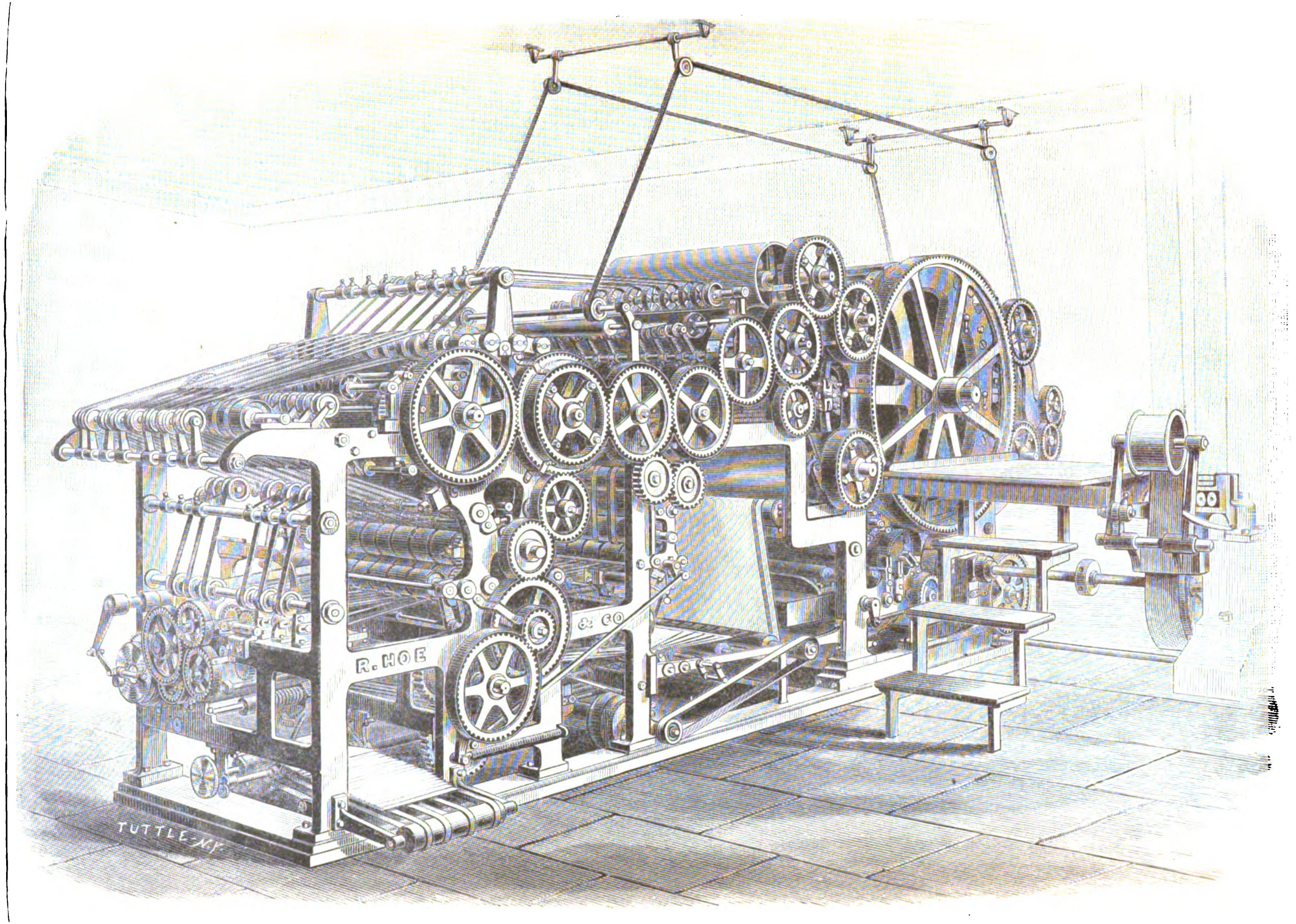


PLATE XXXIX. HOE'S TYPE REVOLVING NEWSPAPER PERFECTING PRESS. See page 720.

cylinders placed one upon the other. In one of these is a knife with a blade like a saw which at each revolution of the cylinders shoots out and cuts the paper apart.

The papers then, carried between tapes, enter the folding apparatus. This consists first of cylinders provided with grippers or fingers which seize the paper as fast as presented by the tapes. Within the circumference of these cylinders is a revolving blade so placed that its edge strikes the paper in the center margin between the pages driving it down between two rollers through which it is carried and given the first fold. As soon as the sheet is clear of the rollers, a knife placed upon an arm strikes it across the center of the page and drives it again between two other rollers which give it the second fold, and this operation is repeated until the required number of folds have been made, when the paper is deposited on a traveling belt or platform, which receives the papers and counts them in 10's, 20's, 50's, or 100's as required. If desired, the apparatus for giving last folds can be disconnected and the papers delivered folded twice for the carrier, the extra folds being intended for the mails.

Besides the foreman of the room only one attendant is required for the press, whose duty it is to watch the roll of paper, and a boy to remove the papers as delivered.

The series of patents to J. T. Hawkins (Campbell Printing Press Co.), Nos. 257,576-257,581, constitute the foundation of the system of printing presses now being built by the company.

The first of the series stated concerns the gearing of the cylinders continuously to the beds, insuring uniformity of surface velocity, and permitting the use of very small cylinders, so small as to make more than one revolution in each direction during the passage of the form or stone; this machine being specially for lithographic printing, and working but one side of the paper.

The next in series adds the perfecting feature, which adapts it to newspaper printing; working the sheet on both sides, taking the sheet, tail first, on the reverse revolution.

The third in series shows a delivery of the sheet, adapted to general book and job printing, where various-sized sheets are printed on the same machine on both sides, avoiding contact of the last-printed side with tapes or fly-fingers.

The fourth adapts the system to the double-cylinder form of press so much used on evening papers of moderate circulation, the speed of which presses is ordinarily limited by the methods employed to impart motion to and overcome the momentum of the bed, the cylinders revolving in one direction only. The equilibrating principle is the peculiar feature of this one of the series.

In the fifth in series the whole system, including the equilibrating principle, is adapted to a perfecting web press working from the original type forms.

The perfecting press of Cottrell & Babcock works sheets. Its foundation is the drum cylinder press, embracing the air-spring and governor.

The rotary attachment consists of two cylinders, — one for curved stereotype plates of the matter to be printed, the other to give the impression. These cylinders are supplied with a feed-board, and revolve in harmony by the instrumentality of the usual gear-wheel attachment, making two revolutions while the drum cylinder of the main press makes one, and yielding the sheet, when printed on one side from the curved stereotype plates, to a supplementary set of grippers on the drum cylinder, in perfect register, when it passes to the flat form on the bed of the main press, and is printed on the other side and piled in the usual manner.

The type cylinder is supplied with an ordinary distributing apparatus for four-form rollers; and as it revolves twice before printing, the form is necessarily rolled twice also, with a fresh supply of distributed ink each time.

At each alternate revolution of the impression cylinder the impression is thrown off by a simple mechanical device, by which means the complete rotary attachment (as it gives the impression on its second revolution) works in harmony with the drum cylinder of the main press.

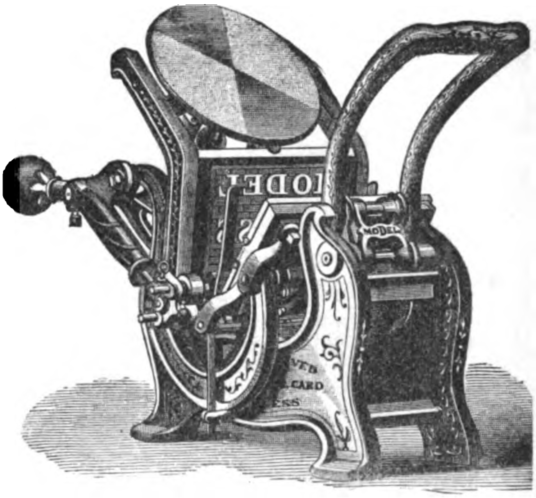
Chromo printing, *Greenwood & Kritch*, Br. As many forms are prepared as there are colors in the picture or lettering, and these occupy the bed in succession; the edition being run through in one color, the form is changed, the next color worked, and so on. It has an upright gang of three inking rollers. The platen vibrates in an arc, then moves horizontally to make the impression.

The small-size hand-presses have arrived at great rapidity and quality of work.

The Daughaday self-inking press is shown in Fig. 2053. The impression is produced by simply pressing upon the handle which acts upon the double toggle connected directly with the platen. The chase is held in place by a screw latch shown at top.

The curved arm shown at the side of the press operates

Fig. 2053.



"*Model*" *Hand-Press.*

the self-inking apparatus. A similar curved arm is on the other side, which insures an equal motion, free from side strain. The ink-roller journals are hinged, and the rollers are kept in contact with the type and distribution-disk by a simple spiral spring inside the arms, so that they not only adapt themselves to the size or irregularity of the type form, but to the curving track, as they approach the ink-disk. The ink-roller arms are very accurately balanced, and pivoted at the rear of the press, as shown, so that there can be no irregular motion. The ink-disk revolves slightly, after the rollers leave it, with each impression, giving a fresh surface for distribution of the ink. At the instant of taking the impression, the inking-rollers remain stationary on the disk, after which the surplus power is used in inking the form for a new impression. There is a *dwell* on the face of the type during the impression.

On stuffs. History in vol. ii., *Laboulaye's* "*Dict. des Arts et Manufactures*," article "*Impression sur Étoffes*."

Elaborate description in 52 pages, containing machines, processes, dyes, etc.

Ceramics. See TRANSFER PRINTING; BAT PRINTING, "*Mech. Dict.*"

Photogr. Direct ink printing from glass negatives. See "*Scientific American Sup.*," 2080.

Color printing, *Prang*, "*Scientific American*," xliii. 40.

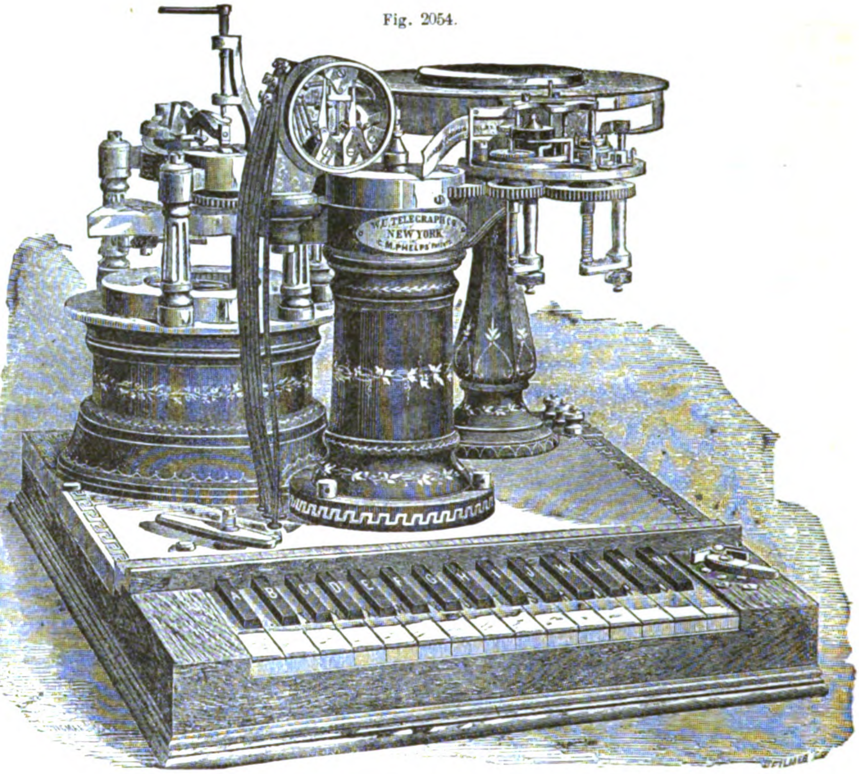
Improvements during the century, *Faxon*, "*Centennial Reports*," Group XIII., pp. 20–22.

Printing rollers for wall paper * "*Sc. Amer.*," xxxvii. 226.
Print-washing machines . . * "*Sc. Amer. Sup.*," 1543.

Ink factory, *Mathers* .	* "*Scientific American*," xlii. 223.
Perfecting, *Alauzet*, Fr.	* "*Scientific American Sup.*," 2475.
Campbell	* "*Scientific American*," xxxv. 47.
Derriey	* "*Scientific American Sup.*," 2617.
"Victory," *Duncan & Wilson*, Engl. . . .	* "*Scientific American Sup.*," 1199.
Web perfecting, *Hoe* .	* "*Engineering*," xxii. 412.
Web, *Hoe*	* "*Engineer*," xliii. 215, 218.
Perfecting, *Hoe* . .	* "*Min. & Sc. Press*," xxxiv. 113.
	* "*Scientific American Sup.*," 719.
Web, *Ingram*, Engl. .	* "*Scientific Amer.*," xxxvii. 303.
Ingram, Br. . . .	* "*Scientific American*," xxxix. 291.
	* "*Scientific Amer.*," xxxvii. 303.
	* "*Illus. Lon. News*," Oct. 6, 1877.
Web, *Ingram*, Br. . .	* "*Engineer*," xliv. 239.
	* "*L'Exposition de Paris*," 1878, p. 224.
Manufacture, *Cottrell & Babcock*	* "*Scientific American*," xlii. 191.
Hand, *Daughaday* . .	"*Scientific American Sup.*," 528.
	* "*Engineer*," xli. 412.
"Liberty," *Degener* .	* "*Scientific American Sup.*," 518.
"Excelsior" . . .	* "*Iron Age*," xviii., Nov. 16, p. 5.
Walter	"*N. Y. Tribune*," May 24, 1876.
	* "*Scientific American Sup.*," 374.
Water colors, mechanical, *Husnik*	* "*Scientific American Sup.*," 1008.

Print'ing Tel'e-graph. One which records the message in readable form. The term is gen-

Fig. 2054.



Phelps' Electro-motor Printing Telegraph.

erally restricted to those which use the common alphabet.

The *Vail, Bain, House, Hughes,* * *Phelps,* * *Anders,* * *Edison,* * *Van Hœvenberg* instruments are described on pp. 1800–1802, "*Mech. Dict.*" See, also, PRIVATE-LINE TELEGRAPH, *infra.*

The automatic printing telegraph of *Edison, Phelps,* * *Meyer* are described in *Lines'* "*Report of Vienna* (1873) *Exposition,*" p. 37 *et seq.*, vol. ii., Sec. I.

The autographic telegraphic is in a sense a printer. *Meyer's* * Fig. 130, p. 56, *supra; Caselli's,* p. 191, "*Mech. Dict.,*" * *D'Arlincourt, Lines'* Rept., above cited, p. 40, *Sawyer's,* * "*Scientific American Sup.,*" 302.

Gray's automatic printer (Western Electric Manufacturing Co.) is largely used on private stock-board and municipal lines.

The sending operator prints out his message in plain letters at the distant end of the line, whether the receiving operator is at the instrument or not. The message is also printed by the transmitting instrument. This printer is self-starting, self-stopping, and self-correcting. Any person who knows how to spell and to read can use it.

In the Phelps electro-motor printing telegraph, Fig. 2054, the type-wheel and printing mechanism is operated by a rotary electro-magnetic engine which is set in action by a local battery.

The apparatus consists of the following parts: —

The transmitting apparatus, consisting of the key-board and circuit-closing devices.

The receiving and printing mechanism.

The automatic unison mechanism.

The electro-motor and speed governor.

"The principle upon which the instrument acts may be described as a combination of the synchronous and step-by-step movement. Like the Hughes apparatus, the transmitting apparatus and the type-wheel of the receiving instrument are caused to revolve synchronously under control of a governor, and each separate letter is printed by a single pulsation of the electric current of a determinate and uniform length, transmitted at a determinate time, but, unlike the Hughes apparatus, the motion of the type-wheel is arrested while each letter is being printed, and is automatically released the instant the impression has been effected. Thus a speed of revolution may be given to the type-wheel in this instrument far greater than it would be possible to attain by means of a step-by-step movement, while at the same time letters which happen to come in direct sequence upon the key-board may be printed from during the same revolution." — "*Journal of the Telegraph.*"

The key-board is seen in front, its black and white keys being lettered, and behind it rises the hollow column of the transmitter, within which is a circular range of 28 slide rods corresponding to the keys of the board. It also contains the mechanism by which the circuit closer is actuated. In the center of the column is a vertical shaft which is rotated 240 times per minute by means of the electro-motor shown on the left, the speed being controlled by a governor. The circuit closing mechanism admits of either the single current or the double current system of transmission being employed by merely changing the connections. The printing mechanism is shown upon the right, and the tape drum at the rear.

The details of the ingenious and complex apparatus are to be found in the "*Journal of the Telegraph,*" *Prescott's* "*Electricity and Electric Telegraph,*" and reproduction of the same, * "*Scientific American Sup.,*" 831, 882.

Herring	* "*Telegraphic Journal,*" vi. 493.
	* "*Scientific American Sup.,*" 2611.
Higgins	* "*Telegraphic Journal,*" vi. 181.
Electro-motor, *Phelps* .	* "*Telegraphic Journal,*" v. 74.
	* "*Sc. American Sup.,*" 831, 882.

Prism. The subject is considered under PRISM, pp. 1802–1804, "*Mech. Dict.,*" and several forms are shown in Fig. 3963, p. 1803.

The following are forms used in microscopy: —

Amici's.	Right angle.
Nachet's.	Double image.
Nichol's.	Equilateral.
Diatom.	

Pris-mat'ic Glass. A glass prism used for showing the solar spectrum.

Pris-mat'ic Pow'der. Large grained gunpowder for slow burning in heavy ordnance. Also known as POUDRE BRUTALE, PEBBLE POWDER, PELLET POWDER.

Prismatic powder is molded under pressure into hexagonal prismatic form and pierced with 7 small holes made at the time of molding by tapered spindles. See Machine, Plate III. accompanying Col. Laidley's report, Appendix K., "*Ordnance Report*," 1877, * p. 448, and pp. 523, 525, with Figs. 16½ and 21, Appendix L.

The idea originated, it appears, with Col. Rodman about 1861, but the only machine for the purpose is that of Prof. Vichnegradski, copied into Prussia and Holland.

The prisms are 1″ thick, weigh 600 grains and have 7 holes, each .015″ diameter. Density, 1.65 to 1.75.

Of allied shapes are some of those, sphero-hexagonal, cubical, polyhedral, etc., the subject of trials and a report: "*Ordnance Report*," 1879, Appendix II, 7, * p. 85; and Appendix I., p. 124, and Plate VIII.

The manufacture of hexagonal powder at Du Pont's mill is described on pp. 124, 125, and Plate IX., "*Ordnance Report*," 1879, Appendix I.

"*Engineer*" . . Sept. 16, 1870; March 17, 1876, p. 186.

Prism Bat'te-ry. A form of Leclanché battery in which the usual porous cup is dispensed with, and a pair of compressed prisms containing all the materials formerly used in the porous cup are substituted for it.

These prisms are placed upon opposite sides of the carbon plate, and are kept in place by rubber bands. See Fig. 1574, p. 538, *supra*.

The negative pole is a pencil of amalgamated zinc, and the two poles are suspended from the cover in a solution of sal-ammoniac.

Pris'moid-al Rail'way. A wooden or iron beam is supported on posts, the cars are mounted saddle-fashion; the engine grips the rail. Used in South Africa.

Pris'on. *Cook & Heath's* "Perfected systems of Prisons," is the subject of a brochure published at Memphis, Tenn. Patents, 1874, 1875.

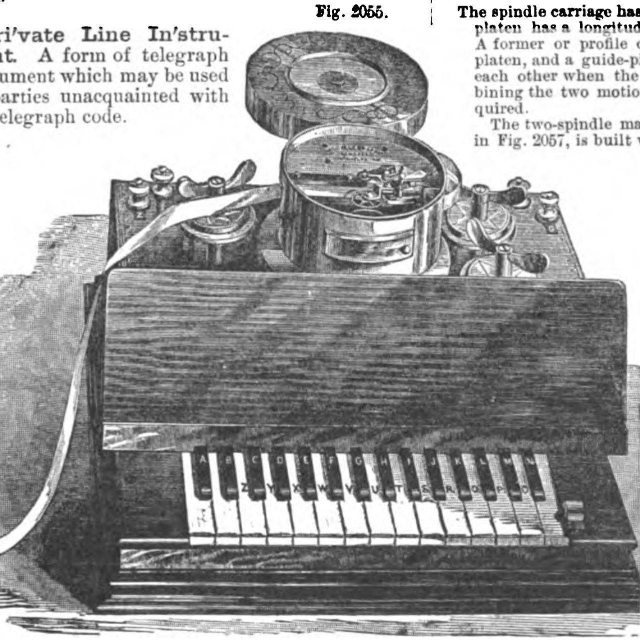
The points of value are the use of cast-iron for windows and doors and lining of cells. An outer wall being of brick or stone.

Between the walls is a mass of dry sand which issues into the cell when the wall is punctured.

The running of the sand actuates an alarm and rouses the guard.

Pri'vate Line In'stru-ment. A form of telegraph instrument which may be used by parties unacquainted with the telegraph code.

Fig. 2055.



Phelp's Private Line Printing Telegraph.

Such a one is shown in the *Auders* instrument, Fig. 3960, p. 1802, "*Mech. Dict.*"

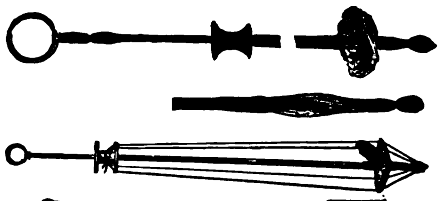
The dial telegraph, Fig. 806, p. 254, *supra*, is another form.

The machine of Phelps, shown in Fig. 2055, has the sending and receiving apparatus on the same stand: the former having a finger-board and the latter an automatic printer.

Pro'bang. An instrument to remove an obstruction from a passage. Several forms are shown in Fig. 3965, p. 1804, "*Mech. Dict.*"

Fig. 2056 shows a bristle probang for removing foreign substances from the throat and air passages.

Fig. 2056.



Probangs and Probe.

A contrivance for the same purpose, in which the disk is brought to a transverse position after the object is passed.

A porcelain bullet probe on a flexible staff.

Pro'cess Mil'ling. A term which, like *new process milling*, refers to the modes of high grinding, or of treating the middlings. See CYLINDER MILL; HIGH-GRINDING; MIDDLINGS; ROLLER MILL, and references *passim*.

Pro-du'cer. (*Metallurgy*.) The fuel chamber and gas producer of a Siemens' or similar furnace. See GAS PRODUCER; GAS GENERATING FURNACE; PONSARD FURNACE; SIEMENS' FURNACE, and references *passim*.

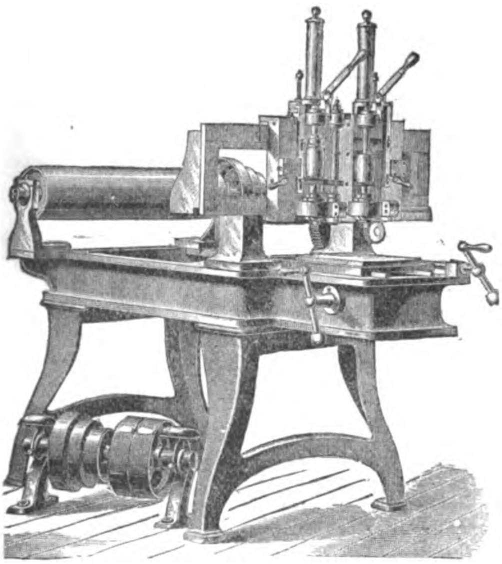
Pro-fil'ing Ma-chine'. The machine is shown in Fig. 3969, p. 1806, "*Mech. Dict.*" The purpose is there described. It is used for milling around the inside and outside edge of irregular shapes, and for surfacing and inside milling.

The spindle carriage has a side motion across the bed. The platen has a longitudinal motion under the cross-head. A former or profile of the shape required fixed to the platen, and a guide-pin fixed to the carriage, act upon each other when the machine is operated, and by combining the two motions give the cutter any direction required.

The two-spindle machine of Pratt & Whitney, shown in Fig. 2057, is built with Parkhurst's device for cutting formers without reversing the fixtures. To produce the forming pattern, the model piece is secured in the place and position afterward occupied by the work to be machined, and the piece to be cut for the forming pattern is placed in the position it will permanently retain. The guide-pin is put in the spindle which usually carries the cutter, and follows the outline of the model piece, while the cutter, in the spindle, which afterward holds the guide-pin, cuts the forming pattern in the exact position it will retain in use. After disconnecting the gearing upon the spindles, reversing the relative positions of the guide-pin and cutter, and smoothing the edge of the forming pattern (if this be necessary), the machine is ready for work. The gearing for moving the table and cross-slide is adjustable by means of double gears, set to prevent back-lash by two independent adjusting screws, and also by a double rack adjusted in the same manner.

The automatic edging machine is of a similar character to the profiling machine, but has an accurate automatic movement for cutting circles of 3″ and less diameter, with their tangents. These machines are made with one, two, or three spindles.

Fig. 2057.

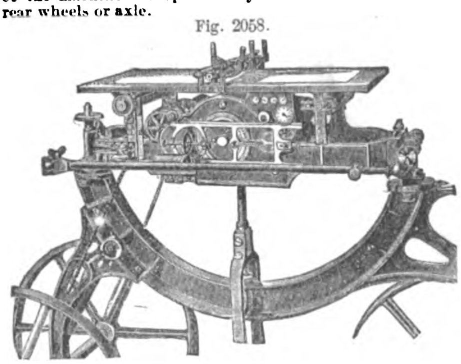


Profiling Machine.

Pro-fil′o-graph. A machine for tracing mechanically the outline of the surface of the ground over which it travels.

It is a small carriage on 4 wheels, and it is designed to make straight lines between stations. When it diverges the angle is taken and recorded on the profile paper. The carriage supports a small table on which is a flat sheet of paper traveling between an unrolling and a rolling drum beneath slits near the ends of the table. The profile is drawn by a pencil held perpendicularly above the table. All the motions of the machine are operated by an endless chain from the rear wheels or axle.

Fig. 2058.



Profilograph.

Underneath the machine hangs a pendulum which maintains a constant vertical position while the machine, and consequently the table, inclines in one direction or the other as it ascends or descends a slope. These angular oscillations are transmitted by proper devices producing reciprocating movements of the paper and the pencil, diverging from the zero which represents a level. The sheet of paper moves positively and the instrument records the distance passed — not the true base of the profile. The scale for the horizontal distance traversed is in the proportion of 1-1500 and the vertical dimensions 1-500.

In operation, each course is a record. A man draws the carriage along from one station to another. The surveyor at each stop notes the length on the distance indicator, draws a vertical line on the profile paper, notes the heights, then repeats the operation. — "*Nature.*"

Pro-jec′tiles. For illustrations and list see p. 1806, "*Mech. Dict.*"

For list of U. S. Patents on harpoons, lances, bomb harpoons, bomb lances, harpoon guns, etc., used in whaling, see HARPOON.

Effects of, Creusol . .	* "*Engineer*," xlv. 251.
Terre-Noire	* "*Engineer*," xlv. 251.
Whitunth	* "*Engineer*," xlv. 251.
Cammell	* "*Engineer*," xlv. 251.
Rice	* "*Scientific American*," xli. 395.
Winged for life line, *Hunt*	"*Scientific American*," xl. 376.

Pro-jec′tor. A camera with electric, magnesium, or oxyhydrogen light, for throwing an image upon a screen.

Proof Plane. (*Electricity.*) A metallic disk with insulating handle, employed for removing electricity from one object to another. — *Gordon.*

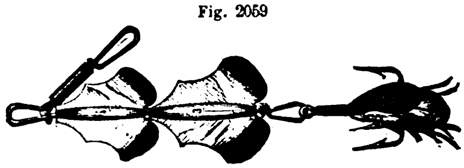
Pro-pel′ler. 1. A means for propulsion of vessels. A screw on a longitudinal shaft projecting at the stern. See figures, PROPELLER, pp. 1808–1810, "*Mech. Dict.*," and pp. 2070–2073, *Ibid.*

Hand, *Tangen*	* "*Scientific American*," xli. 38.
Adjustable	* "*Scientific American Sup.*," 1471.
Coupling	* *Laboulaye's* "*Dict.*," iv., "*Bateau a Vapeur*," Fig. 8118.
Mechanism	* *Ibid.* i. "*Bateau a Vapeur*," Figs. 23, 24.
Driving and steering	
Mallory	* "*Engineering*," xxvi. 90.
Collis-Browne . . .	* "*Scientific American Sup.*," 426.
Hydraulic, *Curtis* . .	* "*Scientific Amer.*," xxxviii. 182.
Light draft (Canadian) .	"*Scientific American*," xxxv. 255.
Marine	"*Scientific Amer. Sup.*," 190, 191.
Patterns, making . . .	* "*Scientific American Sup.*," 1461.
Screw, *Ben's*, Br. . .	* "*Engineer*," xliii. 427.
Position of screw, *Brooks*	* "*Scientific American Sup.*," 314.
Screw, *Deane*	* "*Scientific American*," xli. 130.
De Bay	* "*Scientific American Sup.*," 2700.
S. S. "Cora Maria" .	* "*Engineer*," l. 133, 136.
Screw, *De Bay*	* "*Scientific American Sup.*," 3975.
Mallory	* "*Engineer*," xlvi. 126.
Rankin	* "*Scientific American Sup.*," 455.
Sheriffs	* "*Boston Journal of Commerce*," Aug. 19, 1882.
Spartal	* "*Scientific American Sup.*," 250.
Shaft, "Thetis" . . .	* "*Scientific American Sup.*," 1281.
Propulsion, steam pump	"*Iron Age*," xix., June 21, p. 15.
Propeller pump . . .	* "*Iron Age*," xviii., Dec. 7, p. 1.
Trial of, *Thorneycroft & Griffith*	"*Scientific American Sup.*," 48.
Variety of forms and orders	* "*Scientific American Sup.*," 61.
Vertical shaft, "Alarm"	* "*Engineering*," xxv. 148.
Vliet	* "*Scientific American*," xlii. 147.
Propelling Vessels . .	"*Scientific American*," xxxvi. 81.
Wilson	* "*Scientific American Sup.*," 2.

Walker's "Screw Propulsion."

2. (*Fishing.*) A kind of trolling bait, having oblique wings which cause it to rotate in the water.

Fig. 2059



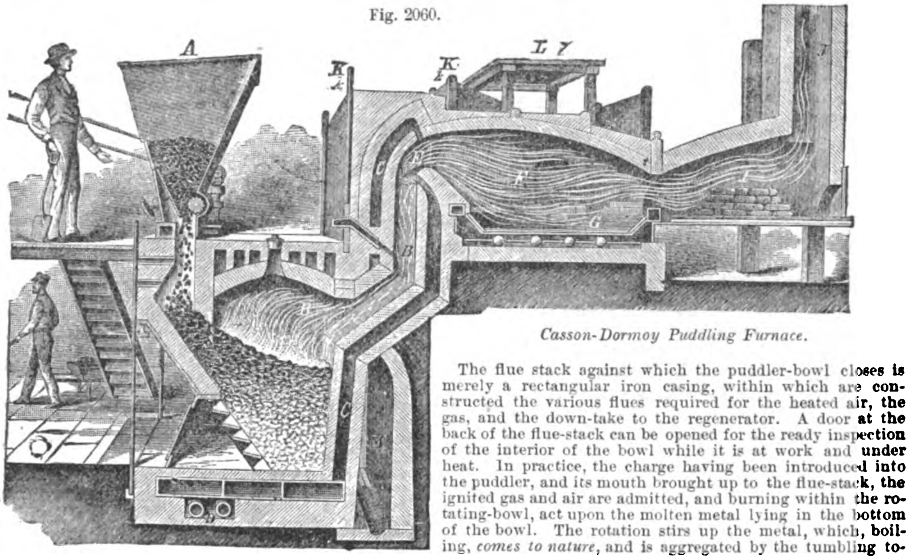
Chapman's Reversible Propeller.

Pro-stat′ic Guide. (*Surgical.*) A slight steel rod upon which is screwed a spiral ribbon; the whole being flexible and used as a guide for a soft rubber through an inflamed prostate gland. — *Dr. Otis.*

Pro-trac′tor. A three-armed circular protractor for plotting position determined by the three point problem, is shown in "*Eng. and Mining Journal*," * xxv. 425.

	* "*Scientific American*," xxxviii. 245, Fig 3.
Cook	* "*Scientific American*," xxxix. 262.
Proportional dividers	* "*Scientific American Sup.*," 2506.

Fig. 2060.



Casson-Dormoy Puddling Furnace.

Pro-vi'so-ry Hoop. A truss hoop. A French form is shown in Fig. 1363, p. 461, *supra.*

Pseu'do-phone. An instrument invented by Dr. S. P. Thompson for producing acoustical illusions and for investigating some of the phenomena connected with bi-aural audition.

It consists of two ear-pieces of tin-plate which are held in their places by adjustable straps, one passing over and the other behind the head. Hinged to each of the ear-pieces is a reflector which is capable of adjustment to any angle and thus the sound is directed into the ear, which, being deprived of the usual conditions by which it is enabled to judge of the the direction, is deceived as to the direction of the source.— * "*Engineering,*" xxviii. 195.

Psy'chro-phore. (*Surgical.*) A cold sound. See Fig. 659, p. 209, *supra.*

Pud'dling Fur'nace. One in which pig-iron is subjected to heat, stirring, and chemical treatment in order to refine it. See history and statement, with figures, on pp. 1815–1817, "*Mech. Dict.*"

The processes proceed upon various methods: —

1. The furnaces revolving in a horizontal axis.
2. The pan on vertical axis.
3. Mechanical rabble.

The *Casson-Dormoy* puddling furnace is shown in Fig. 2060 in connection with its adjuncts, the gas producer *B* and the pig-heating chamber *I*.

The gas producer is like the Siemens', but instead of using a regenerator, the incoming air is blown down the sides of the furnace so as to be heated to 800° Fah. when it reaches the bridge at *E*. By means of blast valves a reducing or oxidizing flame is obtained as the condition of the iron may require. The fuel is slack, fed mechanically from a hopper, *A*. The puddling basin *G* is circular and is supported on iron balls in a dish of water, and the contents are first heated in chamber *I*, thence transferred to pan *G* and then boiled, rabbled mechanically, and then balled.

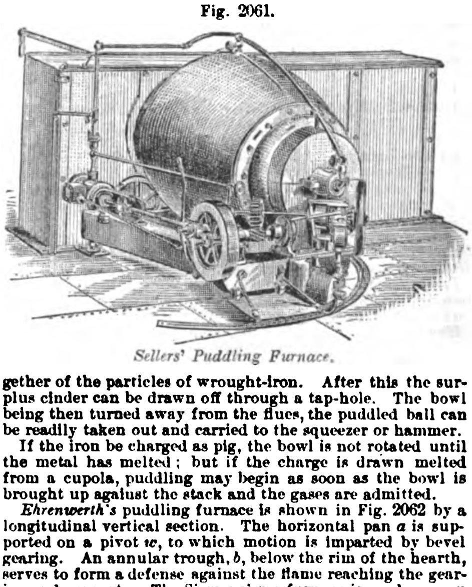
The *Sellers'* puddling furnace is heated from a gas producer. It is flask-shaped. The flame passes in, circulates, and passes out again at the same end by which it entered, on the opposite side of a horizontal partition which divides the opening. The puddler is so placed upon a frame that it can be swung away from the furnace to permit of charging from the front. The parts most exposed to the heat are protected on the outside by water-jackets. The furnace is supported by friction wheels at one end, and on a horizontal pivot at the other.

A small horizontal steam engine is mounted by the side of the furnace, on the same supporting-frame. The whole apparatus is carried by this frame, which is pivoted at the end nearest the open end of the furnace, the pivot-bolt being placed a little on one side and beneath the furnace-mouth.

The engine is so attached that it can be used either to revolve the furnace or to swing the whole machine about the pivot bolt.

The flue stack against which the puddler-bowl closes is merely a rectangular iron casing, within which are constructed the various flues required for the heated air, the gas, and the down-take to the regenerator. A door at the back of the flue-stack can be opened for the ready inspection of the interior of the bowl while it is at work and under heat. In practice, the charge having been introduced into the puddler, and its mouth brought up to the flue-stack, the ignited gas and air are admitted, and burning within the rotating-bowl, act upon the molten metal lying in the bottom of the bowl. The rotation stirs up the metal, which, boiling, *comes to nature*, and is aggregated by the tumbling to-

Fig. 2061.



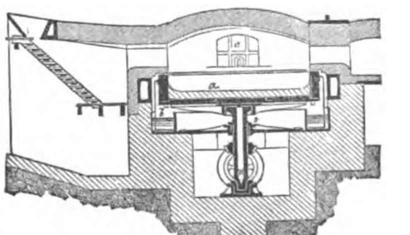
Sellers' Puddling Furnace.

gether of the particles of wrought-iron. After this the surplus cinder can be drawn off through a tap-hole. The bowl being then turned away from the flues, the puddled ball can be readily taken out and carried to the squeezer or hammer.

If the iron be charged as pig, the bowl is not rotated until the metal has melted; but if the charge is drawn melted from a cupola, puddling may begin as soon as the bowl is brought up against the stack and the gases are admitted.

Ehrenwerth's puddling furnace is shown in Fig. 2062 by a longitudinal vertical section. The horizontal pan *a* is supported on a pivot *w*, to which motion is imparted by bevel gearing. An annular trough, *b*, below the rim of the hearth, serves to form a defense against the flame reaching the gearing and supports. The Siemens' gas furnace is used, as seen

Fig. 2062.



Ehrenwerth's Puddling Furnace.

on the left. The special feature is the rotating hearth, *f* being the fort journal, and *l* the neck journal. The rabbles are introduced through holes in opposite doors; one only, *c*, appearing in the view. The rabbles move in right lines, and the motion of the hearth brings all its contents under their action. A plate depending from the periphery of the hearth dips into the water: the latter is continually replenished.

Walker & Warren. Diagonal barrel, horizontal axis flame passing through.

Mandslay. Cylinder revolving on diagonal horizontal axis. Reverting flame.

Tooth. Drum on horizontal axis. The piece removable, to allow the ball to be withdrawn at that end.

Tooth & Yates. Drum on vertical axis, with reverting flue.

Danks. Drum on horizontal shaft, revolving between fire-place, and movable flue-piece. "*Mech. Dict.*," p. 1815, Fig. 3992.

Siemens. Furnace on horizontal axis; reverting flue; regenerator. See SIEMENS' FURNACE.

Crampton. Horizontal axis, movable flue-piece, reverting flame.

Clough, Br. A reciprocating rabble passing through a side in the door of the metal chamber. * "*Scientific American*," xxxvi. 15. See also Figs. 3990, 3991, p. 1815, "*Mech. Dict.*"

Godfrey & Howson, Br. A rotary chamber on inclined axis, presenting its open mouth to the charger and to the chimney, and tilting to discharge its contents. * "*Scientific American*," xxxviii. 35.

Pernot. A horizontal pan on vertical axis. On a wheeled carriage moving in or out of battery. See PERNOT FURNACE; OPEN HEARTH FURNACE, *supra*.

See also PONSARD FURNACE, *supra*.

See list of PUDDLERS, MECHANICAL AND REVOLVING, p. 1816, "*Mech. Dict.*"

Furnaces, on . . .		"*Eng. & Min. Jour.*," xxii. 89.
		"*Iron Age*," xxi., May 6, p 24.
List of processes . . .		"*Iron Age*," xviii., Aug. 31, p. 3.
		"*Scientific American*," xxxix. 198.
Furnace, *Abbott*, Engl. .		"*Scientific American Sup.*," 2222.
Gas heated, Bethlehem .	*	"*Iron Age*," xxv., April 1, p. 1.
Oscillating		"*Bulletin du Comité des Forges de France*," No. 112, April 20, 1876.
Caddick	*	"*Iron Age*," xix., Feb. 8, p. 5.
Caddick & Maybery, Br.	*	"*Engineer*," xliv. 206.
	*	"*Am. Man.*," Sept. 5, 1879, p. 9.
	*	"*Scientific Amer.*," xxxvii. 271.
Casson-Dormoy . .		"*Van Nostrand's Mag.*," xv. 51.
	*	"*Am, Man.*," Sept. 26, 1879, p. 8.
	*	"*Iron Age*," xvii., June 8, p. 1.
		"*Engineering*," xxi. 255.
	*	"*Engineer*," xli. 340.
Crampton		"*Iron Age*," xviii., Sept. 7, p. 17.
Danks	*	"*Am. Man.*," Sept. 19, 1879, p. 8.
	*	"*Mech. Dict.*," Fig. 3992, p. 1815.
Epremworth	*	"*Am. Man.*," Sept. 19, 1879, p. 8.
Rocking, *Gedlow*, Br. .		"*Iron Age*," xxii., Aug. 15, p. 15.
Furnace, *Godfrey & Howson*, Br. . . .	*	"*Iron Age*," xix., Jan. 4, p. 1.
	*	"*Am. Man.*," Sept. 19, 1879, p. 8.
	*	"*Engineering*," xxiv. 242.
	*	"*Eng. & Min. Jour.*," xxv. 272.
	*	"*Engineering*," xxii. 85.
	*	"*Engineer*," xliv. 247.
Griffith	*	"*Am. Man.*," Sept. 26, 1879, p. 8.
Jones	*	"*Iron Age*," xvii., May 11, p. 5.
Lukens	*	"*Iron Age*," xxiv., Nov. 27, p. 1.
Middleton, Engl. . .	*	"*Iron Age*," xvii., April 13, p. 1.
Middleton	*	"*Scientific American Sup.*," 524.
Nair		"*Iron Age*," Aug. 2, p. 39.
Price, Woolwich, Br. .	*	"*Engineer*," xliv. 316.
	*	"*Scientific American Sup.*," 1712.
Reynolds & Thomas .	*	"*Iron Age*," xviii., Sept. 14, p. 5.
Rotary, *Roe*, Br. . . .	*	"*Engineering*," xxiv. 56.
Furnace, *Ryan* . . .	*	"*Iron Age*," xviii., July 20, p. 5.
Revolving, *Sellers* . .	*	"*Iron Age*," xvii., March 30, p. 5.
Furnace, *Swindell* . .		"*Iron Age*," xxii., Nov. 14, p. 15.
Furnace shield . . .	*	"*Iron Age*," xxiv., Dec. 25, p. 1.
Puddling, on		"*Iron Age*," xviii., Oct. 5, p. 15.
Art's invention . . .		"*Iron Age*," xix., March 8, p. 9.
Art of, *Howson* . . .		"*Van Nostrand's Mag.*," xxi. 520.
Past and present, *Roberts*		"*Iron Age*," xxv., Feb. 26, p. 9.
Sherman		"*Van Nostrand's Mag.*," xvi. 67.
		"*Iron Age*," xviii., Dec. 7, p. 24.
Mach., paper on, *Howson*		"*Scientific American Sup.*," 1109.
Mechanical		"*Iron Age*," xviii., Aug. 31, p. 3; Sept. 7, p. 17.
	*	"*Sc. American Sup.*," 393, 1122.
Griffiths		"*Iron Age*," Aug. 2, p. 28.
Howson		"*Iron Age*," xxiv., Sept. 11, p. 11.
Mackintire, Br. . . .	*	"*Engineer*," xli. 271.
Oestland	*	"*Eng. & Min. Jour.*," xxvi. 202.
Swedish	*	"*Scientific American*," xxxix. 82.
Rotary, *Ehrenworth* . .		"*Van Nostrand's Mag.*," xiv. 23.
Ehrenworth, Fr. . .		"*Iron Age*," xvii., Jan. 6, p. 15.
Pernot, Fr.	*	"*Iron Age*," xvii., Jan. 13, p. 5.
Danks		"*Iron Age*," xvii., Jan. 13, p. 15.
Puddling, on, *Crampton*, Br.		"*Engineering*," xxii. 61, 81, 85.
Howson, Br. . . .		"*Engineering*," xxiv. 255.
Mechanical stokers, paper on		"*Scientific Amer.*," xxxvii. 292.

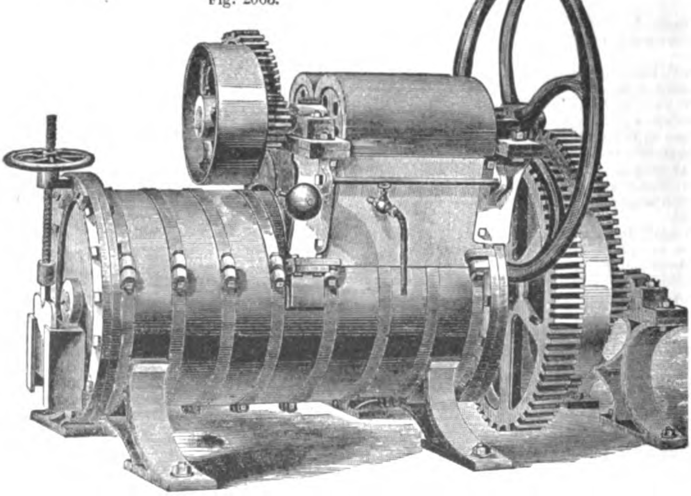
Report by *Holley*, Group I., "*Centennial Reports*," vol. iii., p. 41. Refers to

Danks.	*Schneider & Co.*
Graff, Bennett & Co.	*Sellers.*
Hopkins, Gilkes & Co.	*Crampton.*
Godfrey & Howson.	*Pernot.*

Pug Mill. A mill for working clay into plastic condition for brick-making.

The machine shown in Fig. 2063 is a Philadelphia mill, in which the rear end is elevated 12′′. The clay is thrown into a hopper (not shown), passes between rollers which crush the lumps, and thence into the interior of the drum, where it is masticated by blades, and tempered with water introduced through a pipe. The gate at the end governs the discharge.

Fig. 2063.



Carnell's Pug Mill.

Pul′ley. See 22 illustrations, p. 1819, "*Mech. Dict.*"

Made of paper and of raw-hide. — *Cooper*, "*Belting*," xv.
Of leathern disks. — *Cooper* "*Belting*," 77.

Grooved rim pulleys with round belts. — "*Newton's Journal*," 1857, N. S., vi., p. 163.

Leathern covered pulleys. — *Van Nostrand's* "*Eclec. Eng. Mag.*," July, 1869, 604.

Proportions, principles, etc., are carefully considered in *Cooper's* "*Treatise on Belting*," Philadelphia, 1878.

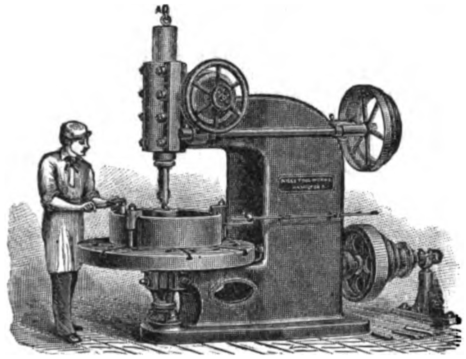
Consult also *Rankine's* "*Rules and Tables.*"

See: Rope-sustaining, *Williams*, Br.
* "*Engineer*," xliv. 446.
Self-stopping, *Wilke*.
* "*Sc. American Sup.*," 315.
Cover, *Sutton*.
* "*Sc. American*," xl. 388.
Driving, *Heer*.
* "*Sc. American*," xxxiv. 291.
Grinding mach., *Thomson, Sterne & Co.*, Br.
* "*Engineering*," xxv. 443.
Machine.
"*Sc. American Sup.*," 1617.
Steel rim.
* "*Scientific Amer.*," xl. 89

Pul′ley Bor′ing Ma-chine′. A special machine tool for boring the shaft-holes of pulleys, but applicable to other similar uses.

The machine, as shown, receives and bores pulleys 52″ diameter; the face plate is revolved by powerful gearing, driven by a cone, with four steps for a 4″ belt. The tool bar is fed automatically and is counterbalanced; it has quick

Fig. 2064.



Pulley Boring Machine. (*Niles' Tool Works.*)

return hand-motion. The feeds are thrown in instantly by friction; they are actuated by belt and worm gearing, rack and pinion (all cut); the feed-belt has three changes of speed, giving feeds of .0648″, .0441″, and .0279″ per revolution of chuck.

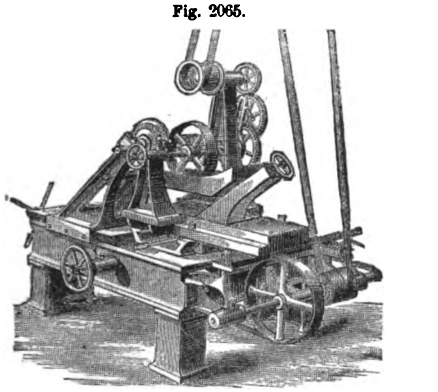
The countershaft is provided with tight and loose pulleys, 24″ diameter, for a belt 4″ wide, and should run 70 revolutions per minute, giving to the chuck-plate speeds as follows: 63, 43, 19, 10 revolutions per minute, thus adapting the machine to bore holes from 1″ to 7½″ diameter. When operating on the latter diameter, the power exerted at the cutting point is 1,800 pounds.

Pul′ley Grind′ing Ma-chine′. Fig. 2065 is a pulley grinding machine made by Thomson, Sterne & Co., of Glasgow, Scotland. It is used for the rims of pulleys, which may be made of the shape required: flat or crowning. The pulleys are cast as thin as may be desired, and the finishing is more thoroughly and rapidly done than by turning.

The machine has an automatic feed, and being self-acting in all its motions, one person can attend to a number of machines.

The different speeds of the work operated on are regulated

Fig. 2065.



Pulley Grinding Machine. (*Thomson, Sterne & Co.*)

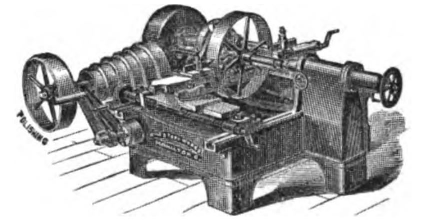
by change-wheels, so as to keep the surface speed somewhat uniform. By a simple arrangement of compound tables worked radially by a worm wheel and connecting rods, the rim of the pulley being ground, can be rounded to any radius.

The pulley being ground runs in a water-trough, which keeps it from heating, and also arrests the dust in grinding. The emery wheel is encased, so that the water and dust carried with it is taken away by the outlet pipe.

Pul′ley Turn′ing Ma-chine′. A special machine tool for turning pulleys, gears, rolls, etc.

It has a large cone pulley, with 6 steps for a belt 4″ wide, and transmits the power through tangent gearing to the main spindle. The carrier plate is of the equalizing type, obviating unequal and lateral strains. On each side of the solid bed-piece are rests which slide in and out on graduated surfaces to suit the diameter of the pulley to be turned;

Fig 2066.



Pulley Turning Machine. (*Niles' Tool Works.*)

these rests can be set angularly to get any desired degree of *crown*; tools are thus operated on both sides of the machine. The feeds are continuous, can be instantly engaged, disengaged, or changed. The spindle of cone pulley runs at so much higher velocity than the main spindle that its speed is suitable for polishing when the latter is turning; a steel mandrel and a suitable rest are provided for polishing.

* "*Iron Age*" . . . . xxi., May 30, p. 1.
* "*Scientific American*" . . . . . xxxix. 146.

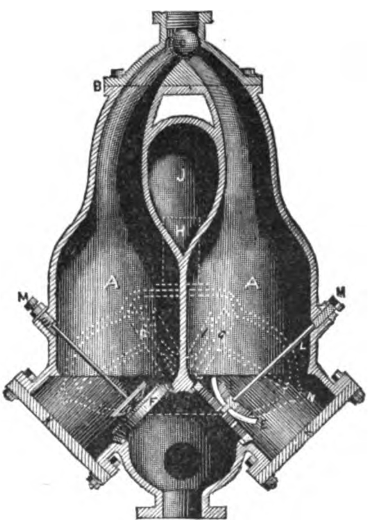
Pul′pit Spec′ta-cles. Spectacles with flat top to the bows to enable a reader to glance over them at an audience.

Pul′sa-tor. A name for the PULSOMETER, which see.

Pul-som′e-ter. A water-raising device, on the principle of the Savery Engine, Fig. 5657, p. 2337, "*Mech. Dict.*"

It consists principally of two bottle-shaped chambers, *A A*, joined together side by side, with tapering necks bent towards each other, to which is attached, by means of a flange

Fig. 2067.



Pulsometer.

joint, *B*, a continuous passage from each cylinder leading to one common upright passage, into which a small ball, *C*, is fitted so as to oscillate with a slight rolling motion between seats formed in the junction.

These chambers also connect by means of openings with the vertical induction passage, *D*, which openings are so formed that the vulcanite valves *E E* and their seats, *F F*, constructed so as to sustain the valves, may be easily inserted.

The delivery passage *H*, which is common to both chambers, is also constructed so that in the openings that communicate with each cylinder are placed valve-seats *G G*, fitted for the reception of the same style of valves as in the induction passage. *I I* are valve-guards to prevent the valves from opening too far.

J represents the vacuum chamber, cast with and between the necks of chambers *A A*, and connects only with the induction passage below the valves *E E*.

K K are flanges covering the openings to the respective chambers, which may be removed for the repair or renewal of valves and seats, when necessary. Vent plugs are inserted into these flanges, for the purpose of drawing off the water to prevent freezing.

L L are rods extending from the valve-guards to the set-screws *M M*, by which the suction seats, valves and guards are tightly pressed to place.

N N are brass socket-headed bolts by which the discharge seats, valves, and guards are drawn down to place.

A small brass air check-valve is screwed into the neck of each chamber *A A*, and one into the vacuum chamber *J*, so that their stems hang downward.

The check-valve in the neck of each chamber, *A A*, allows a small quantity of air to enter above the water, to prevent the steam from agitating it on its first entrance, and thus forms an air piston for preventing condensation.

The check-valve in the vacuum chamber *J*, serves to cushion the ramming action of the water consequent upon the filling of each chamber alternately

See also AQUAMETER, Figs. 105–107, p. 45; HYDROTROPHE, Fig. 1426, p. 486, *supra*; VACUUM STEAM PUMP, "*Mech. Dict.*"

Pulsometer	* "*Engineer*," xlii. 89.
Hall	* "*Engineer*," xlvii. 378.
	* "*Engineering*," xxii. 56.
	* "*Eng. & Min. Jour.*," xxii. 407.
At Normanton quarry .	* "*Engineering*," xxiii. 299.
	"*Technologiste*," xli. 207.
At work	* "*Engineering*," xxv. 501.
Hall	* "*Engineering*," xxviii. 413.
	* "*Manufact. & Builder*," xii. 208.
Factory	* "*Scientific American*," xliii. 63.
Poillon	* "*Technologiste*," xli. 736.

Pul'ver-i-zer. A word of very general application: —

For *soil*. See HARROW; DISK HARROW; ROLLER; CLOD CRUSHER, etc.

For *stone*. See STONE CRUSHER; STONE BREAKER; DISINTEGRATOR; ORE CRUSHER; ORE MILL; STAMPING MILL; CHILIAN MILL, etc.

For *grain*. See GRINDING MILL; CORN CRACKER; CORN MILL; OAT MILL, etc. See list under MILLS.

For *cement*, etc. See MORTAR MILL; CEMENT MILL, FERTILIZER MILL; PAINT MILL, etc.

Considered structurally, see the following heads, *supra*: —

		Figure.	Page.
Cage	Fertilizer	1020	832
Crusher	Grain	1234	411
	Feed	1005	327
Chilian	Cement	575	183
	Bone	378	119
Granulator . . .	Coffee	652	207
Grinder	Oil Cake	498	152
	Cacao	496	151
	Bone	377	119
	With balls	191	70
	Flour (roller)	1287	426
Eccentric	-	918	292
Disintegrator . .	Rock	828	260
Harrow	Soil	831	261
Rollers	Flour	767–770	243

See also list under MILLS; GRINDING, etc., in "*Mech. Dict.*" and *supra*.

Durand & Chapitel, Fr.	* "*Engineering*," xxviii. 97.
Hanctin	"*Technologiste*," xxxviii. 217.
	"*Scientific American Sup.*," 963.
Machine. *Jordan*, Br. .	* "*Engineering*," xxx. 542.
Mill	* "*Iron Age*," xxiv., Sept. 18. p. 1.
	* *Laboulaye's* "*Dict.*," ii. "*Fonderie de fer*," Fig. 928.
Barrel, *Paul*	* "*Min. & Sc. Press*," xxxv. 65.
Ryerson	* "*Eng. & Min. Jour.*," xxx. 397.
And sifting mill, centrifugal, *Thompson* . .	* "*Engineer*," xlviii. 61.

Pul'ver-ma-cher Bat'te-ry. A porous jar is surrounded by a silver wire which is rolled spirally, and is used as the negative pole of the element. The exciting fluid, dilute sulphuric acid, caustic potash or sal-ammoniac solution, is filled into the porous jar, through which it percolates by capillary attraction. The positive pole is a rod of zinc, the top of which is covered with caoutchouc in order to avoid accidental contacts which might short circuit the battery. The small spirals of silver wire must be far enough apart not to cause capillary attraction to take place between them.

Pumps, Wa'ter En'gines, and Wheels. See under the following heads: —

Accumulator.
Acid pump.
Aquameter.
Aquapult.
Ball hydrant.
Beer pump.
Bore-hole pump.
Brine-forcing pump.
Bucket.
Bung-bucket.
Cam-pump.
Centrifugal pump.
Cesspool pump.
Chain bucket.
Chain pump.
Circulating pump.
Compound engine pump.
Compression pump'g engine.
Counter pump.
Cup leather.
Deck pump.
Deep-well pump.
Differential pump.
Donkey pump.
Door piece.
Double-acting plunger pump.
Draining pump.
Drip pump.
Driven well.
Driven well pump.
Ejector.
Ejector condenser.
Excavating pump.
Feed pump.
Fire cock.
Fire engine.
Fire extinguisher.
Fire plug.
Fire pump.
Fixed-piston pump.
Flush-deck pump.
Force pump.
Fountain pump.
Garden engine.
Garden syringe.
Gas-compressing pump
Gas drip II pump.
Gas-fitter's pump.
Gas-tar pump.
Giffard injector.
Glass-barrel pump.
Greenhouse syringe.
Hand pump.
Hand rotary pump.
Hollow-plunger pump.
Horizontal pump.
Horse-power pump.
Hose carriage.
House pump.
Hydraulic balance.
Hydraulic engine.
Hydraulic force pump.
Hydraulic machinery.
Hydraulic motor.
Hydraulic press.
Hydraulic pressure pump.
Hydraulic pumping engine
Hydraulic ram.
Hydraulic regulator.
Hydraulic steering gear.
Hydraulic works pump.
Hydro-motor.
Hydronette.
Hydrostatic regulator.
Hydrotrophe.
Injector.
Inspirator.
Irrigating barrel.
Irrigation pump.
Irrigator.
Jigger pump.
Lift.
Locomotive pump.
Marine pump.
Mine pump.
Noria.
Odorless excavator.
Oil line pump.
Oil pump.
Oil well pump.
Oscillating pump.
Pendulum pump.
Penstock.
Plumber's force pump.
Portable engine pump.
Portable pump.
Post pump.
Propeller pump.
Pulsator.
Pump bucket.
Pumping engine.
Pulsometer.
Racking pump.
Relief valve.
Rotary pump.
Rotary force-pump.
Rotary water-engine.
Sand holder.
Sand pump.
Scoop wheel.
Ships' pump.
Sinking pump.
Siphon pump.
Sirup pump.
Slide-bar pump.
Spiral pump.
Spray nozzle.
Spreader.
Sprinkler.
Stand pipe.
Stand pipe fire apparatus.
Starting valve.
Steam jet.
Steam jet pump.
Steam pump.
Steam siphon pump.
Stone-ware pump.
Street watering port.
Suction pipe.
Suction primer.
Syringe.
Tail piece.
Thief bucket.
Three cylinder pump.
Three cylinder water-engine.
Three-throw pump.
Tube well.
Tubular plunger pump.
Turbine.
Turbine pump.
Tympanum.
Vacuum pump.
Vacuum steam pump.
Vault emptier.
Vent.
Vertical pump.
Wash-room pump.
Water bucket.
Water charger.
Water column.
Water column pump.
Water crane.
Water elevator.
Water engine.

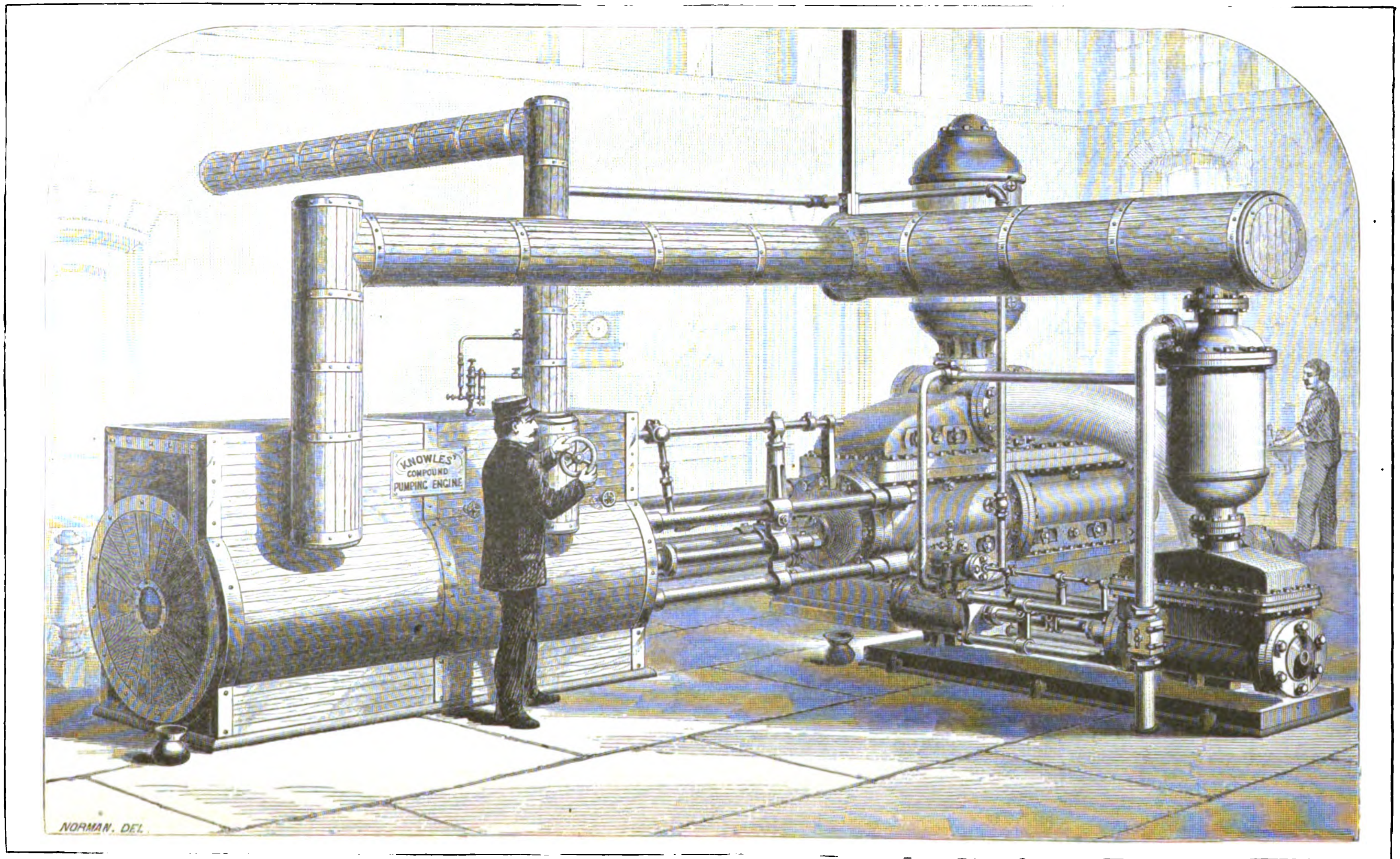


PLATE XI.

KNOWLES' DIRECT-ACTING COMPOUND CONDENSING PUMPING ENGINE

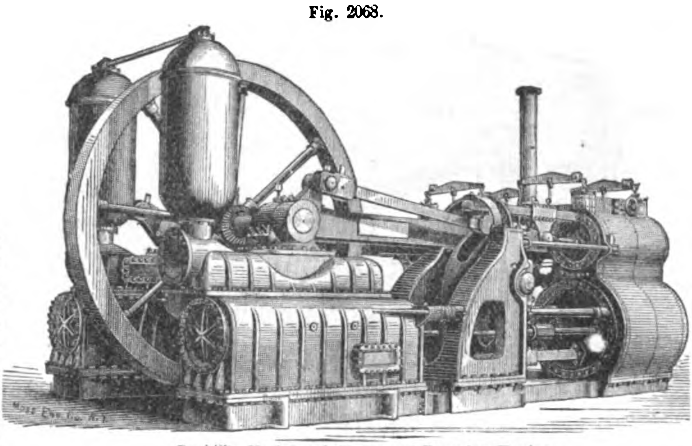
See page 729.

Watering can.
Water meter.
Water motor.
Water power.
Water regulator.
Water thief.
Water tower.
Water wheel.
Water wheel governor.
Water wheel regulator.
Wine pump.
Wrecking pump.
Yoke pump.

Pump Au'ger. A long auger for boring wooden logs for pump stocks, or for pipes.

In a modern form the auger is surrounded by a thin metallic shell, in which the volute portion runs loosely. This shell or tube is turned true and straight; it follows and guides the auger, the shavings or cuttings being carried out through its interior. The lips or cutters of the auger are expanded at the end, so as to cut a hole just large enough for the passage of the tube.

Fig. 2068.



Gaskill's Horizontal Compound Pumping Engine.

Pump Buck'et. The reciprocated member of the pump, which carries the valve.

When valveless, it is a *plunger*.

Pump Cart. A vehicle carrying a pump and reservoir; used for watering and irrigating. See p. 508, Fig. 1473, 1474, *supra*, and references *passim*.

Pump'ing En'gine. Various forms, Cornish, horizontal duplex, are shown in Plate XLIV., p. 1828; Plate XV., p. 763, "*Mech. Dict.*"

See also list of pumps, p. 1827, *Ibid.*, and *supra*, p. 728.

Louisville water works engine	p. 1828, "*Mech. Dict.*"
Worthington duplex	p. 763, *Ibid.*
"Leeghwater," Haarlem Lake	p. 1830, *Ibid.*
India State Railway	p. 1831, *Ibid.*
Cornish	p. 626, *Ibid.*
Centrifugal	p. 515, *Ibid.*
Draining	p. 739, *Ibid.*
Scoop	p. 2056, *Ibid.*

The engine shown in Plate XXXIX is the Knowles direct-acting compound condensing pumping engine.

The high-pressure cylinder is nearest to the water end, and to this is connected the main piston-rod, which extends through to the water-plunger. The low-pressure piston has two smaller piston-rods which pass through sleeves cast on the outside of the high-pressure cylinder, and are connected to the main rod by a cross-head at their outer ends. All the stuffing-boxes of the steam end being on a line on the back cylinder head. The steam cylinders and steam chest are properly steam-jacketed. The valve arrangement of the high-pressure cylinder is the same as that of the ordinary Knowles steam pump, viz., a double ported flat slide valve which is surmounted and operated by a round piston, which has a slight rotating motion imparted to it by the rocker bar, which receives its motion from a friction roll attached to the tappet arm. The slight oscillation of the chest piston places its parts in connection with those in its cylinder; it is then driven horizontally by the steam pressure, in which motion it carries the main slide valve, to which it is directly connected. From the front end of the valve-driving piston is extended a rod, which operates the valve of the low-pressure cylinder. The steam is exhausted from the low-pressure cylinder through a coil feed-water heater direct into the jet condenser, which is connected to and operated by an independent air pump, as shown in engraving.

The water end of the engine is of the "inside plunger" pattern. The plunger, which is made of either iron or composition, passes through a broad ring cast in the center of the cylinder, the inner surface of which ring is either grooved to form a water-packing bearing upon the plunger, or is furnished with a stuffing-box, so that the plunger may be packed as may be required by the position of the engine. The water valves are of rubber, working upon composition seats. The suction valves are below, and the discharge valves above the plunger. The valves are readily reached through hand holes situated immediately above the valve plates.

Fig. 2068 is the Gaskill pumping engine, built by the Holly Manufacturing Co. for Saratoga Springs, N. Y.

It is horizontal, of the rotative, non-receiver, compound-beam type. The engine has four steam cylinders, one high and one low-pressure in each pair; the low-pressure (42″ diam., 36″ stroke) beneath the high-pressure (21″ diam., 36″ stroke). There is one pump to each pair of steam cylinders, and each has a double-acting plunger 20″ diam., 36″ stroke. The fly-wheel revolves between, and has its pillow-blocks upon the pump cylinders. The cross-heads of high-pressure cylinders are connected by links to a beam, which is in turn connected, one end to the crank, and the other end to the piston-rod of the low-pressure cylinder and pumps.

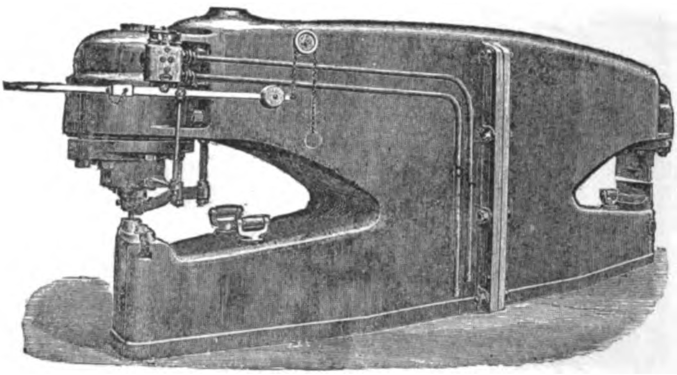
The following data were obtained on trial: —

Time	20 hours.
Average pressure by engine gage	74.25 pounds.
Average pressure by, in force main	95.068 pounds.
Average vacuum	27.295″.
Average temp. feedwater to boilers	169.175°, Fah.
Revolutions in 20 hours	21,449.
Revolutions per minute	17.8742′.
Piston speed per minute	107.2452.
Total coal burned	6,750 pounds.
Discharge per revolution	187.125 gallons.
Delivery at 18 revolutions per minute	4,850.280 gallons.
Net absolute duty	108,793,525 pounds.

. Duty: number of pounds lifted one foot high by consumption of 100 pounds good anthracite coal.

Barrow	* "*Scientific Amer.*," xxxix. 324.
Engine, compound duplex, *Blake*	* "*Am. Man.*," July 30, 1880, p. 13.
Compound, *Blake*	* "*Manufact. & Builder*," xii. 73.
Knowles	* "*Manufact. & Builder*," xii. 97.
Rotary, *Brakell*, Br.	* "*Engineer*," xliv. 106, 211.
Bushtiehrad mines, Bohemia	* "*Engineering*," xxvii. 155.
Household, *Carr*	* "*Manuf. & Builder*," viii. 211.
Chiswick drainage Works. *Hathorne & Davey*	* "*Engineering*," xxvii. 476.
Clausthal, Ger.	"*Iron Age*," xxii., Oct. 10, p. 20.
Covington, Ky.	"*Scientific American Sup.*," 55.
Croydon, Br.	* "*Engineering*," xxiv. 356.
Compound, *Davey*, Leeds, Br.	* "*Engineering*," xxii. 421.
Heater, feeder, and condenser, *De Beaumont*	* "*Iron Age*," xx., Aug. 30, p. 1.
Dean Bros.	* "*Scientific American*," xl. 248.
Dean	* "*Scientific Amer.*," xxxiv. 128.
Lift and force, *Daylass*	* "*Iron Age*," xvii., March 16, p. 9.
Engine, caloric, *Ericsson*	* "*Scientific American*," xliii. 326.
Farcot et fils, Fr.	* "*Engineering*," July 26, 1878, p. 70.
Underground, Fohnsdorf	"*Scientific American Sup.*," 1232.
Geared, *Fonderie de l'Horme*	* "*Engineering*," xxvi. 294, 334.
Force pump, *Guilds*	* "*Scientific American*," xliii. 4.
Ships, *Gwynne*, Br.	* "*Engineer*," l. 91.
And winding eng., Hartley Pit Colliery, Br.	* "*Engineer*," xli. 298.
Holly	* "*Scientific American*," xxxix. 95.
	* "*Engineering*," xxviii. 366, 376.
	* "*Scientific American Sup.*," 2219.
Cornish, Hull	* "*Sc. Am. Sup.*," 264, 265, 357.

Fig. 2069.



Punch and Shear. (*Toulon, Fr. Dock-yard.*)

Cornish, Hull, Br.	* "*Engineer*," xli. 133, 136, 156.
Lawrence, Mass, *Leavitt*	* "*Scientific American Sup.*," 1039.
Lawrence, Mass.	* "*Engineering*," xxvii. 58.
Rotative, zinc mines, Lehigh	* "*Engineer*," xli. 446, 470, 488.
	* "*Scientific American Sup.*," 502.
Levers colliery, Br.	* "*Engineer*," xlvii. 292, 296.
Mathieson	* "*Scientific American Sup.*," 164.
Machinery, (Mid Calder)	"*Scientific American Sup.*," 196.
Force pump, *Nason*	* "*Manuf. and Builder*," ix. 193.
Pumping engine, North Stavely, Br.	* "*Engineer*," xlix. 368, 424.
Pearn, Engl.	* "*Scientific American Sup.*," 1059.
Pittsburg	"*Scientific American*," xliii. 84.
Providence, R. I.	* "*Engineer*," xlii. 324.
Reciprocating barrel	* "*Scientific American*," xl. 355.
Mining, *Rittinger*, Ger.	* "*Engineering*," xxx. 158.
Haud, *Robaugh*	* "*Scientific Amer.*," xxxvi. 162.
Sprengel, *Rood*	* "*Scientific American Sup.*," 3825.
Rotative, 450 horse power. Salt mine, Ligeberg, Pruss.	* "*Engineer*," xliii., 117, 144, 241.
Portable, *Shand, Mason & Co.*, Br.	* "*Engineer*," xlvi. 286.
Cam pump. *Smith, Valle & Co.*	* "*American Miller*," vii. 7.
Plunger pump, S. Durham colliery, Br.	* "*Engineer*," xlvii. 79.
Machinery, Effra Creek, Thames	* "*Engineer*," xlviii. 306.
For hydraulic presses, direct act., *Tweddell*, Br.	* "*Engineer*," xlv. 84.
Twickenham Sewage Works, Br.	* "*Engineer*," xlviii. 362.
Underground	"*Scientific American Sup.*," 660.
Erin colliery, Westphalia	* "*Engineer*," xlii. 238.
Underground, Erin colliery, Westphalia	"*Van Nostrand's Mag.*," xv. 284.
Walker	* "*Scientific American Sup.*," 292.
Deep well, *Watson*	"*Scientific Amer.*," xxxix. 309.
Bilge, *Jas. Watt & Co.*, Br.	* "*Engineer*," xliii. 250.
Machinery works. *Worthington*	* "*Scientific American*," xliii. 143.
Duplex, *Worthington*	* "*Engineer*," xlii. 364.
Worthington	* "*Scientific American Sup.*," 887.
Auxil., yacht "Comet"	* "*Engineering*," xxvii. 568.
"Yellow Jacket," Mine	* "*Van Nostr. Mag.*," viii. 476.
Hydraulic, Zurich	* "*Engineer*," l. 165.

Report of *Chas. E. Emery*, "*Centennial Exhibition Reports*," includes those of —

Worthington (duplex) *.
Philadelphia engine (beam) 1800 *.
Knowles (direct action).
Blake (direct action).
Andrews (centrifugal) *.
Andrews (oscillating) *.
Heald & Co. (centrifugal) *.
Bagley & Sewall (rotary) *.

Pump Joint Ma-chine′. A machine for boring out and turning down the respective ends of the wooden sections where they meet in coupling to form the stocks of pumps, or which are thus united by socket joint to form pipes for conveyances of water.

The machine consists of a heavy steel spindle, which is placed in the bearings of a lathe head stock. The spindle has a screw chased to fit chucks of different sizes. The end of the spindle has a centering collar, changeable for different sizes by removing a nut, the cutting-knife in the chuck extending the whole length; a second knife at the end, which works at right angles to the first cutter, finishes the end of the stock.

In operating, the stock is placed in a rest, the hole in the stock fitting the self-centering collar. The stick is fed in by hand, and a perfect joint made, each one of the same size. There are two sizes of chucks, 3″ and 3¼″ diameters.

Pump Valve. The moving piece in a pump which opens or closes to allow the water to pass or prevent its return, respectively. See list under PUMPS: VALVES.

Perreaux's flexible valve is shown in Fig. 1061, p. 347, *supra*.

Painter's flap valve for thick and viscous matters has a flexible valve flap which is arranged to close and guard the port, by an extensive superficial contact of said flap and a fixed coincident surface.

Punch and Shear. Punches, single or combined with shears, are shown on pp. 1833, 1834, "*Mech. Dict.*"

The Tweddell punch and shear, to cut 1¼″ thickness, erected in the dock-yard of Toulon, France, is shown in Fig. 2069. The respective ends are separable so as to make two distinct machines. Each tool has its own ram, valves, and water supply; the latter is from an accumulator loaded to 1500 pounds per square inch.

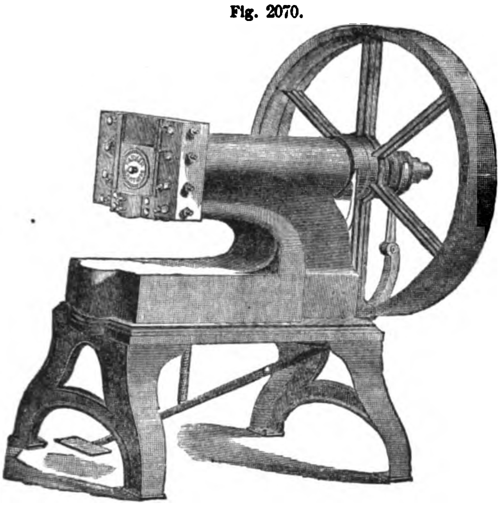
Punch and shearing machine, *Berry & Sons*, Br.	* "*Engineering*," xxii. 502.
	"*Iron Age*," xix., March 15, p. 24.
Berry & Son, Engl.	* "*Scientific American Sup.*," 930.
Lyon	* "*Iron Age*," xxi., May 2, p. 18.
Hydraulic, *Tweddell*, Toulon, Fr.	* "*Engineering*," xxii. 441.
Hydr., quadruple, *Tweddell*, Br.	* "*Engineer*," xlii. 228.
Press	* "*Sc. Amer.*," xli. 166, 179, 194.
And straightening mach., *Landue Siemens Steel Works*	* "*Engineer*," xlii. 25.
Punching mach., *Baer*	* "*Scientific American*," xxxv. 166.
For plates and angle irons, *Bemast*	* "*Engineering*," xxii. 538.
With automatic table, *Bemast*	* "*Engineering*," xxx. 228.
Bush	* "*Min. & Sc. Press*," xxxiv. 209.
Metal, *Robertson*	* "*Scientific American*," xxxvii. 50.
Swing weight	* "*Engineer*," xlix. 71.
Hydraulic, *Tweddell*	* "*Scientific Amer.*," xxxvi. 102.
Punching nuts. *Hooper & Townsend*	* "*Scientific American Sup.*," 1855.
Press, *Ferris & Miles*	* "*Engineer*," xli. 463.
Press, power, *Merriman*	* "*Iron Age*," xvii., Feb. 17, p. 20.
	* "*Engineer*," xli. 485.
Press, "Peerless"	* "*Scientific American*," xliii. 83.
Stiles	* *Thurston's* "*Vienna Rep.*," ii. 239.
Shaping and sharpening. *Thomson, Sterne & Co.*, Br.	* "*Engineering*," xxviii. 237.
Spiral, *Kennedy*	"*Iron Age*," xxi., May 23, p. 5.
Factory, *Stiles & Parker*	* "*Scientific American*," xlii. 159.
Punching iron, paper on	"*Scientific American Sup.*," 1071.

Punch′ing Press. Fig. 2070 is a view of a Stiles and Parker press with eccentric adjustment.

The slide of the press receives its reciprocating motion from a crank-pin which revolves within an eccentric ring in the sliding block. This block traverses in the oblong mortise in the slide as the crank revolves, thus imparting the motion of the crank to the slide. By bringing the eccentric out of its position by a key and turning the same by a lever, the punch may be adjusted to the die to the hundredth part of an inch.

The amplitude of the motion remains the same, but the range is changed so as to suit dies of various thickness above the bed plate.

Fig. 2070.



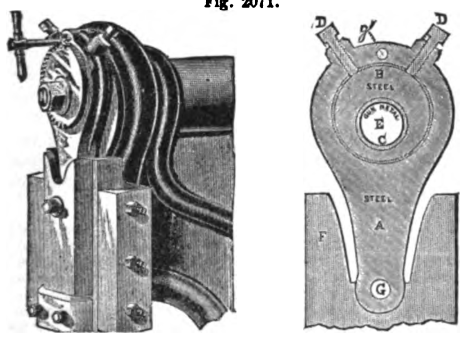
Fowler Press with Eccentric Adjustment.

The eccentric is a substitute for the former plan of placing shives of metal above and below the box.

The Stiles adjustment is shown in Fig. 2071.

The upper end of the pitman *A*, which connects the slide *F* with the crank-shaft *E*, is bored out and enlarged to receive the eccentric disk *B*. The lower end of the pitman is secured to the slide by the pin *G*. The disk *B* is bored out of center, and fits the crank shaft loosely to allow the interposition of a gun metal bushing. The disk is turned by the pinion *g*, and held by the screws *D D*. The pinion is turned by a gear wrench.

Fig. 2071.



Punching Press. (*Stiles Adjustment.*)

By this device the amplitude of the stroke is not changed, but the punch is raised or lowered to the direction in which the disk is turned. The two set-screws will hold the eccentric-ring under the greatest strain. In this arrangement the securing of the adjustment will not throw the bearings out of line, but will leave the pitman as true and free to work as before.

In the Merriman press the adjustment is by means of a right and left threaded screw and two threaded sockets.

Punc'tur-ing In'stru-ment. (*Surgical.*) A term specially applied to the *sonde-a-dard* used in supra-pubic lithotomy; the instrument for puncturing, — speaking in general terms — are so numerous as to make the recitation tedious. See list under SURGICAL INSTRUMENTS.

Pun'jam. (*Fabric.*) A strong cotton cloth made at Vizagapatam, in India. The meaning of *punjam* is "120 threads," and the cloth is denominated 10, 12, 14, up to 40 punjam, according to the number of times 120 is contained in the number of threads in the warp.

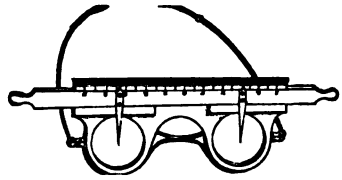
The loose night dress with drawers, *punjanias*, is named from this cloth; or, perhaps, *pijama*, leg cloth. *Jama* is a full dress coat.

Pun'ty. (*Glass.*) 1. Probably from It. *punto*, a point. A glass decanter, for instance. It is said to be cut in *punties* when the ornamentation consists of dots or cup-like depressions, usually circular but sometimes oval.

2. The glass blower's tube. *Ponty, pontil.*

Pu'pil-lom'e-ter. (*Surgical.*) An instrument for measuring the distance between the axes of the pupils.

Fig. 2072.



Chevalier's Pupillometer.

Pu'ri-fi'er. (*Milling.*) A separator to remove bran scales and flour from grits or middlings; a process repeated between each grinding in the *high-milling* process. See MIDDLINGS PURIFIER; GRITS PURIFIER.

In the process of high milling, in the step by step reduction of the grain, starting with the pointed kernels, there are with each grinding three products: coarse fragments, with much bran attached; less coarse fragments, with less bran attached; and minute fragments, with little or no bran attached. These are separated from each other by the sifting and purifying machines. Each of the several products is again subjected to grinding, and the product in each case again sorted into grades, and so on, until the last traces of the white interior of the berry have been separated from the dark hull and graded.

Purse Net. (*Fishing.*) A net stretched on wires, similarly to an umbrella, and, when ready to hoist, closed like a purse. See DROP-NET, Fig. 3317, p. 1522, "*Mech. Dict.*"

Purse Seine. (*Fishing.*) A seine which is closed by pulling upon a line or lines to inclose the fish. They have wings and a bag, and are used in the mackerel fishery.

"Purse seines range in length from 120 to 220 fathoms, and from 750 to 1,000 meshes in depth, reaching the depth of 20 to 30 fathoms of water. The average mesh is 2¼″. They are made of fine Sea-Island cotton twine, and cost from $750 to $1,500 complete. The pursing weight varies from 100 to 150 pounds." — "*Bulletin U. S. National Museum.*"

Thimbles and snatch-block are used for the running rope which closes the seine.

Push Car. (*Railway.*) 1. A light four-wheeled car used in transporting light matter, express packages, mail-bags, etc., in transferring from one train to another, or otherwise.

2. A car used as an intermediate, to connect a locomotive with a train in moving the latter up or down an incline leading to a ferry-boat. See FERRY PUSH-CAR.

Push'er. (*Hat-making.*) One form of hat-fulling machine, which see.

Pyr-he'li-om'e-ter. An instrument to measure the heat of the sun.

Pouillet's heliometer is shown in Fig. 4056, p. 1837, "*Mech. Dict.*"

The pyrheliometer of A. Crova is described in "*Comptes Rendus*" and "*American Journal of Science and Art.*" — "*Scientific American Sup.*," 234.

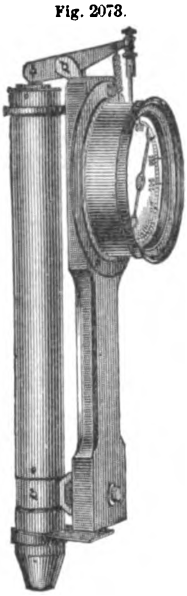
Ericsson's colorometer, for measurement of solar heat, * "*Scientific American Supplement*," 1103.

Solar engine, * "*Scientific American*," xli. 67.

Py-ri'tes Burn'er. An apparatus in which pyrites is burned to obtain sulphuric acid. See report of *Prof. Jackson's*, "*Paris Exposition Reports*," 1878, vol. iv., p. 10, *et seq.*, having references to those of: —

Hemptinne.
Bode.
Perret.
Maletra.
Hasenclever & Helbig.
Walker.
MacDougal.
Spencer.
Holloway, "*Nature*,"
"*Van Nostrand's Magazine*," xx. 387.
"*Iron Age*," xxiii., March 27, 15.

Fig. 2073.



Brown's Pyrometer.

Py-rom'e-ter. Brown's portable hand pyrometer is used as a test gage and check upon those pyrometers which are constantly inserted in the hot blast to ascertain if they are correct and in working order.

It may be described as a metal conducting tube open at each end, for the free current of the hot blast; within the tube is a thin expansion strip, conveying its motion to a dial upon a bar outside of the conductor. On applying this instrument to any orifice in the blast pipe, the hot air rushing through will give an accurate indication in less than one minute. By having several plug holes in the length of the blast pipe, its temperature at any part may be ascertained. It is useful to ascertain the loss of temperature between the stove and tuyere, and the gain derived from covering the pipes.

The instrument is set at the atmospheric temperature previous to the trial, by an adjusting screw.

* "*Sc. American Sup.*," 523, 2732.
Brown . . . . . . * "*Iron Age*," xviii., Dec. 7, p. 24.

Byström's (Swedish) "*Ordnance Report*," 1878, Plates IV, V., accompanying Appendix R, 3, and p. 375.

Hot blast, *Hobson* . . * "*Engineer*," xli. 484.
Regulator, *Hobson* . . * "*Technologiste*," xxxvii. 221.
Main . . . . . . * "*Technologiste*," xxxvii. 220.

Py'ro-phore. The name of a body which has the faculty of inflaming by contact with air or water. See pp. 1838, 1839, "*Mech. Dict.*"

The self-lighting signal logs which are thrown overboard to rescue men in the water, inflame on contact with the water. This forms a guide for the man to swim to, and to the boatmen who go to his rescue. The self-luminous safety buoys of the French Marine Service have phosphide of calcium. See BUOY; LIFE BUOY.

The property seems to be due to the rapid absorption of oxygen by the combustible body. Certain metallic oxides, that of iron, for example, reduced by hydrogen at a low temperature, become extremely pyrophoric. By calcining in a luted crucible 6 parts of lamp-black mixed with 11 of sulphate of potassa, a compound of sulphur and carbon is obtained which inflames with great facility by contact of the air.

"*Manufacturer & Builder*" . . . . xi. 24.

Py-ro-ste're-o-type. A process in which an intaglio is burnt in wood to serve as a mold in which a printing plate in relief may be cast.

It is said to be used in France in making music plates, and the apparatus is figured in *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," tome iii., article "*Stéréotypie*."

A block of lime or linden wood, with the design traced upon it, is secured upon the table, and steel plugs of forms suited to the various signs, keys, or notes, and heated by gas, are brought down upon it, to burn out holes corresponding to the shapes of the tool. One tool at a time occupies the plunger-rod, and after all the required impressions have been made by it, another is substituted, and so on.

Py-rox'y-line. See GUN COTTON, COLLODION, *supra*.

Q.

Quad'rant E'lec-trom'e-ter. A form of electrometer invented by Sir William Thomson.

Fig. 2074.

Thomson's Quadrant Electrometer.

It consists of four metallic segments supported in the same plane, but not in contact. They are connected alternately with two projecting knobs and balls (at the right). Over the segments hangs a strip of aluminium by a fine wire, from the inside of a Leyden jar feebly charged (seen at the top). If now one pair of the sectors are charged, while the other are connected with the earth, the strip of aluminium will move towards them if the charge is opposite to that of the aluminium rod and the jar; but if the charge is of the same kind, repulsion will take place and the aluminium strip will move away from them and over the other segments that are not charged. In order to give a directive force to the aluminium strip a small compass needle is attached to it. In order to observe and measure slight motions of the aluminium strip, a small mirror is attached to it, and a ray of light reflected by it upon a scale placed against the wall; the least turning of the mirror will cause this ray of light to travel sideward — in fact, it will act like a very long hand on a dial against the wall.

It is evident that such a delicate instrument should always be placed under a glass shade, in order to prevent disturbances by air currents, such as those generated by breathing near them. In this case the Leyden jar is also under the glass shade, so as to keep it charged longer; it is charged by the curved rod seen under it, which is connected with its inside covering, while the outside covering is connected exteriorly with the earth, when it is charged, but after being charged the connection may be severed. The two knobs seen at the right side below serve to charge the segments.

Bifilar suspension . . "*Journal Soc. Tel. Eng.*," v. 481.
Thomson . . . . * "*Manufact. & Builder*," xi. 253.
* *Prescott's* "*Electricity*," p. 947.
* "*Engineering*," xxiii. 259.

Quad'ri-cy-cle. A four-wheel vehicle adapted to be propelled by the feet.

The bicycle and tricycle are respectively two and three-wheeled.

"*Railroad Gazette*" . . . . * xxii. 597.

Quad'ri-form Group Flash'ing Light. A peculiar lighting apparatus for light-houses, invented by J. R. Wigham, and first erected at Galley Head, a promontory on the coast of Cork, Ireland, between Cape Clear and the Old Head of Kinsale.

The quadriform arrangement consists of 32 lenses arranged in four tiers, with a gas-light in the focus of each. As the lenses touch each other the lights blend at a few yards distance and form a pillar of light 13′ high and 3′ broad.

The *group flashing* denotes that the flashes from the lenses instead of being *single* flashes, as usually exhibited at light-houses, are each of them, by the repetition, extinction, and reignition of the gas, broken up into four or five beams, which constitute a *group* of flashes recurring at regular intervals, presenting a distinctive appearance. The interval between the groups of flashes is 1 minute; between the flashes in each group 2 seconds. The flashing is accomplished by the same clock-work machine by which the lenses are caused to revolve.

Quad'ru-ple Coil Spring. A car spring made of four coils; in a nest, as in *s*, Fig. 1143, p. 483, "*Mech. Dict.;*" or merely associated in the manner indicated at *u*, same figure.

Quad'ru-ple Nose Piece. (*Optics.*) An attachment to a microscope; a piece having four object glasses of different powers, either of which may be brought into apposition with the body of the microscope; avoiding the trouble of unscrewing and attaching a different power.

Double nose-piece, Fig. 3335, p. 1534, "*Mech. Dict.*"

Quad'ru-plet. Four united acting together, as of springs. *s*, Fig. 1143, p. 483, "*Mech. Dict.*"

Quad'ru-plex Tel'e-graph. An amplification of the duplex system; by the quadruplex system, four messages may be sent over the same wire, simultaneously, two in each direction. See DUPLEX TELEGRAPH, p. 764, "*Mech. Dict.*"

It was used by Prescott & Edison in 1874, by Nicholson of Cincinnati, Myer of Paris.

Cf.	* "*Engineer,*" xlvi. 5.
Farmer (1858)	"*Scientific American Sup.,*" 14.
Muirhead & Winter . .	* "*Telegraphic Journal,*" vii. 223.
Paper on, *Pope* . . .	* "*Telegraphic Journal,*" iv. 2.
Smith	* "*Telegraphic Journal,*" vi. 198.
Working	* "*Telegraphic Journal,*" iv. 231.

Quan'ti-ty. (*Electricity.*) The amount of electricity generated in a given time.

Quar'ry-faced Stone. (*Stone Cutting.*) Masonry stones, the faces of which are left untouched, as they come from the quarry.

As distinct from hammer-faced, pitch-faced, tooled, etc.

Quar'ter Bend. A curved section of pipe subtending an angle of 90°. *c*, Fig. 295, p. 97, *supra.*

Quar'ter-ing Ham'mer. A steel hammer of from 1 to 2 pounds weight used in blocking out masses of flint for flaking. See BLOCKING HAMMER.

Quar'ter-ing Ma-chine'. A machine for quartering driving wheels on their axles; *i. e.*, boring the wrist pin-holes at 90° distance apart. Fig. 4067, p. 1844, "*Mech. Dict.*"

London and N. W. Ry. .	* "*Engineering,*" xxviii. 260.
Urquhart, Br.	* "*Engineer,*" xlvii. 389.

Quar'ter Sa'ver. (*Knitting.*) A device attached to a knitting machine to prevent the work from running off when the thread breaks or runs out. — *Cooke.*

Quar'ter Tack'le. (*Nautical.*) A tackle used in hoisting aboard water, etc.

Quar'ter-turn Belt. One which has a twist of 90°, transmitting motion between pulleys on shafts at right angles to each other.

Nine dispositions of * *Cooper's* "*Belting,*" Phila., 1878, p. 172.

Quar'ter-turn Goose'neck. A bent pipe coupling having a turn of 90°, and connecting the discharge pipe with the nozzle.

Quartz Mill. A machine for crushing auriferous quartz. See Figs. 4068–4078, pp. 1844–1846, "*Mech. Dict.*"

Hand power, *Eaton* . .	* "*Min. & Sc. Press,*" xxxviii. 217.
Rotary, *Howland* . .	* "*Min. & Sc. Press,*" xxxiv. 25.

Queens'ware. (*Ceramics.*) 1. Queen Charlotte's ware, now known by the contracted title. A celebrated cream-colored Wedgwood ware. It is of white clay and flint.

2. A form of stone ware also the invention of Wedgwood, and occupying a position between porcelain and pottery. See STONE WARE.

Quick'silver Bat'te-ry. See MERCURY BATTERY.

Quick'silver Fur'nace. See MERCURY FURNACE.

Qui'et-ing Cham'ber. (*Steam.*) An arrangement to prevent the noise incident to blowing-off of steam. The sides of the exhaust pipe have numerous small branch tubes, the sum of their areas equal to that of the main pipe.

Shaw's	See Fig. 987, p. 320, *supra.*
* "*Railroad Gazette*"	xxiii. 141.
* "*Min. & Sc. Press*"	xxxvi. 313.

Quin'tu-plet. Said of springs when five of similar type are associated in a group.

R.

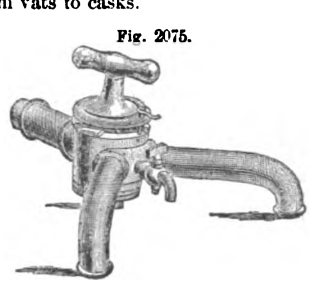
Ra'cer. The British name for a traverse circle beneath the chassis of a gun. See CIRCLE; also Plate VIII., p. 448, "*Mech. Dict.*"

Rack Car. (*Railway.*) A freight car with open slat sides, and a roof. Used for iron in pigs, pipes, and castings; oil in barrels; coke, etc.

Rack-cut'ting Ma-chine'. A machine tool for cutting the teeth of racks. It is a modification of the nulling machine, standing on a column and having, in the size shown (Fig. 2076), a table 31″ long, with a vertical adjustment of 6″, and a transverse horizontal adjustment of 17″. The spindle carries two cutters for *blocking-out* and *finishing* the tooth at the same time. Several racks may be cut at once or a single rack up to a width of 6″. Any pitch and any length of rack can be cut. The feed is automatic, with self-acting, adjustable stop-motion. The driving-spindle has a cone of two grades, and actuates the cutter spindle through the medium of gears.

Rack'ing Fau'cet. A faucet for transferring wines or beer from vats to casks.

Fig. 2075.



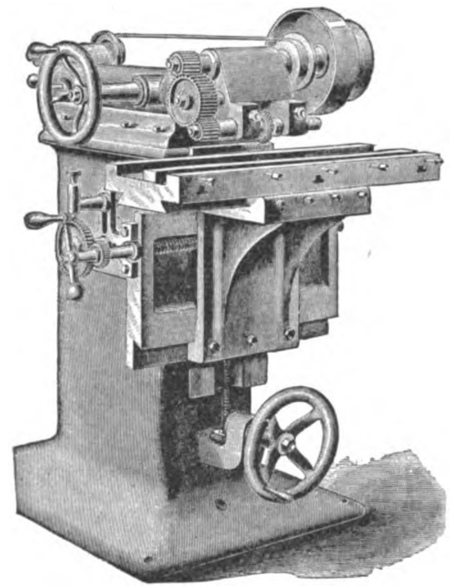
Double-armed Racking Faucet.

Used in running wines off their lees after fermentation or fining; also in filling beer kegs from vats.

The two nozzles enable two kegs to be filled at once, keeping the racking-off uninterrupted. The small spigot in the middle enables the liquid to be examined at any time.

Rack'ing Pump. A pump used in the transference of wines from vats to casks and from cask

Fig. 2076.



Rack-cutting Machine.

to cask when the difference of level prevents the use of siphon or faucet.

Fig. 2077.

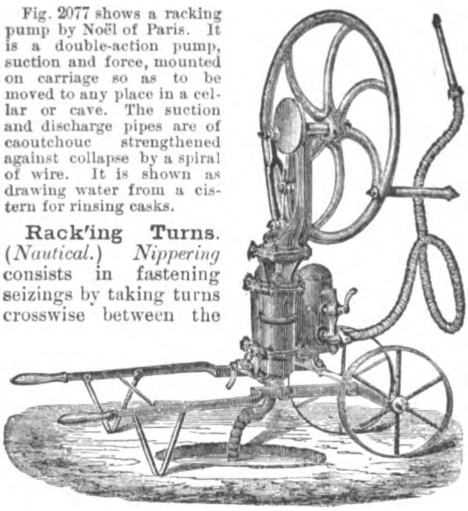


Fig. 2077 shows a racking pump by Noël of Paris. It is a double-action pump, suction and force, mounted on carriage so as to be moved to any place in a cellar or cave. The suction and discharge pipes are of caoutchouc strengthened against collapse by a spiral of wire. It is shown as drawing water from a cistern for rinsing casks.

Rack'ing Turns. (*Nautical.*) *Nippering* consists in fastening seizings by taking turns crosswise between the parts to jam them; and a *racking turn* is a round turn before each cross.

French Racking Pump.

Rack Rail'way. A form of railway having a rack between the rails, engaged by a gear wheel on the locomotive. See p. 1852, "*Mech. Dict.*," and references *passim*.

See also: "*Scientific American Sup.*" * 1106, * 1313.
"*Engineering*" . . . . . * xxiii. 413.
"*Van Nostrand's Mag.*" . xxii. 9; xxiii. 230.

Ra'di-al Ax'le Box. One which preserves its position radial to the track, even when the car is upon a curve. — *Widmark*, Br.

"The axle-box has planed parallel sides, and is free to slide in a direction which is rectilinear and horizontal, but inclined to the axle of the wheels. The box at the opposite end of the axle is inclined in the opposite direction, so that, when the wheels and axle deviate toward one side in consequence of the curvature of the road, the axle is simultaneously set in an oblique position to the engine frame, but radial to the road, one end being advanced in relation to the frame, while the other is drawn back by the inclined form of the axle-boxes and the intermediate guides.

"As the sides of the axle-boxes are parallel planes, and as there are no flanges, the axle-boxes are free to turn round a horizontal axis which is at right angles to these side planes. Thus one axle-box may rise and the other fall in the guides, as required by the state of the road." — "*Engineer.*"

Ra'di-al Drill'ing Ma-chine'. A vertical drilling machine, the operating portion of which is adjustable on a horizontal arm projecting radially from the vertical pillar. It is used for drilling a row of holes on an object placed on the table beneath. Fig. 4099, p. 1852, "*Mech. Dict.*"

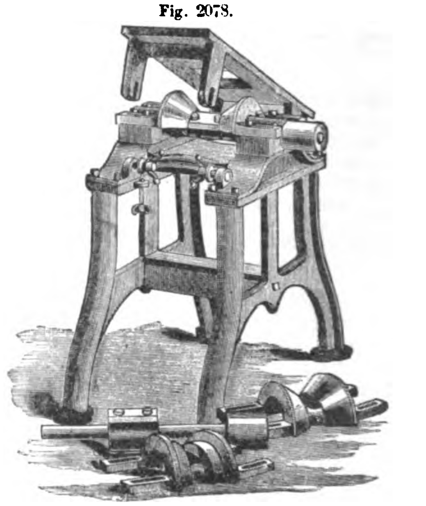
See also the following references: —

Arqueth, Br.	* "*Engineer*," xlv. 163.
	* "*Engineering*," xxiv. 16.
	* "*Scientific American Sup.*," 1347.
Box & Co.	* "*Iron Age*," xviii., Nov. 2, p. 20.
	* "*Iron Age*," xxiv., Dec. 11, p. 1.
Sharpe, Stewart & Co., Br.	* "*Engineering*," xxv. 366.
	* "*Scientific American*," xxxix. 8.
English	* "*Scientific Amer.*," xxxvii. 111.
	* "*Scientific American*," xxxviii. 51.

Ra'di-al Pla'ner. A machine for rounding off the corners of stuff, especially in implement and carriage work. Also known as a *rounding machine*, *cornering machine*, or *chamfering machine*; see the latter.

It performs some of the duties of a spoke-shave. It is used for forming pieces of hard wood in irregular shapes and planing smooth where the grain of lumber sets different ways on the same piece. With the adjustable top bed the machine forms a smooth plane for plane surfaces. With a side-jointing head it is adapted for squaring off the ends of hard wood pieces.

Fig. 2078.



Radial Planer.

Ra'di-a'tion Ther-mom'e-ter. One specially adapted for marking the results of radiation from grass, and for ascertaining the direct heating powers of the rays of the sun.

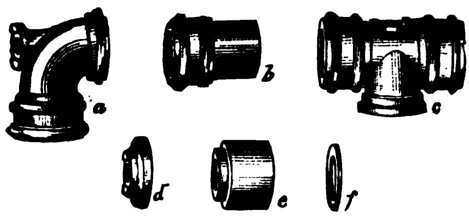
The former are termed *terrestrial* radial thermometers, and the latter *solar* radiation thermometers.

The terrestrial instrument is a minimum spirit registering thermometer, with a forked tube taking the place of the bulb. It is graduated on its own tube, and inclosed in an outer glass jacket. When in use, it is supported with one end on a fork, and the bulb is placed resting on the grass.

The solar instrument is a registering maximum thermometer, with its bulb blackened to facilitate the absorption of solar heat. The instrument is inclosed in a large outer glass tube from which all air has been removed, in order to prevent vitiation of the result, by the communication of its own heat by the air to the bulb.

Ra'di-a'tor. A heating chamber or coil in an apartment. Various forms are shown in Figs. 4101–4104, p. 1853, "*Mech. Dict.*" Fig. 2079 shows a group of accessory parts.

Fig. 2079.



Radiator Attachments

a. Radiator ell (or L). *d.* Cap.
b. Radiator socket. *e.* Separating piece.
c. Radiator tee (or T). *f.* Ring packing.

See also MANIFOLD; RETURN BEND; COIL.

Ra'di-o-graph. An instrument invented by Waistanley for the measurement and record of solar radiation.

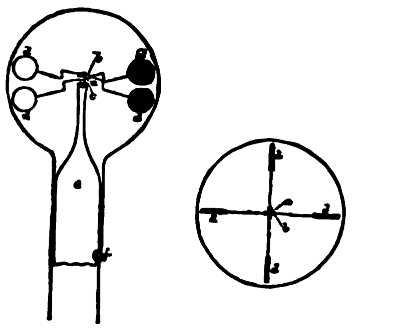
* "*Engineering*"	xxx. 366.
"*Scientific American Supplement*"	4081.
"*Scientific American*"	xliii. 104.

Ra'di-om'e-ter. An instrument invented by Mr. William Crookes for demonstrating the mechanical action of light, and the conversion of radiation into motive power.

According to Prof. Frankland, the movement is due to heat.

The instrument consists of four arms of some light material, to the ends of which are fixed thin disks of pith with one side black and the other white, the black sides for the

Fig. 2080.



Radiometer

four disks all facing the same way. These arms cross each other at right angles and are balanced at their center points on a hard steel point, *a*, resting on a jewel-cup, *c*, so that they may freely revolve in a horizontal plane. A thin glass globe, drawn out to a tube at the lower part so as to form a support, incloses the whole, and is exhausted to the greatest attainable vacuum and hermetically sealed.

When this instrument is placed subject to the influence of light, the arms rotate with greater or less velocity directly in proportion to the intensity of the incident rays.

Prof. Crooke's "*Lecture on Radiant Matter*," British Association for the advancement of Science, Sheffield Meeting, Aug. 22, 1879. Queen, Phila.

Cf. as a light measurer	"*Telegraphic Journal*," vi. 87.
Principles of, *Baldwin*	* "*Scientific American*," xlii. 98.
Barrett	"*Scientific American Sup.*," 1974.
Crookes	* "*Engineering*," xxv. 155, 195, 253, 293.
(20 Figs.), Br.	* "*Engineer*," xlviii. 170.
(20 Figs.)	* "*Engineering*," xxviii. 165, 187. "*Scientific Amer.*," xxxiv. 318; xxxv. 23, 79, * 176, 242.
Paper by *Crooke*	"*Sc. Amer. Sup.*," 408, 523, 582, 667, 699, 908, 1187.
Frankland	"*Scientific American Sup.*," 809.
Webster	
Young	"*Scientific American Sup.*," 1093.

Ra'di-o-phone. A modification or application of the radiometer; an instrument for the production of sound by radial energy.

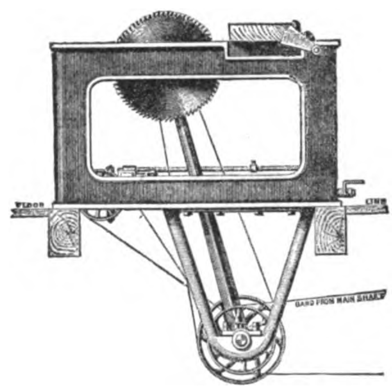
Ra'di-us Bar. A bar or pivoted link which permits any adjustment in which the link forms a radius.

A bar or pivoted link which moves on a center at one end, and at the other is connected to an object to preserve its relative distance, and permit adjustment concentric to the object so connected; *i. e.*, any adjustment or motion relative to the said center while preserving the relative distance.

See the parallel motion in the Cornish steam engine, Fig. 3548, p. 1680, "*Mech. Dict.*"
The hinged link is used in harvesting machines also.

Ra'di-us Saw. A machine saw in which the circular saw is journaled on the end of a radial arm, pivoted below to a shaft, on which is placed the driving pulley. By a pedal or hand arrangement the saw is drawn forward so as to cross-cut the timber on the bench, and falls back by gravity when the work is done.

Fig. 2081.



Ransom's Radius Cross-cut Saw.

It is a form of cross-cutting machine similar in duty, but not in construction, to the TRAVERSE SAW, Fig. 6626, p. 2619, "*Mech. Dict.*"

Ra-fa-el'le Ware. (*Ceramics.*) A name given to *Majolica* owing to so many of Rafaëlle's designs being found on that species of pottery.

Raft. See Figs. 4105–4108, pp. 1854, 1855, *Mech. Dict.*"

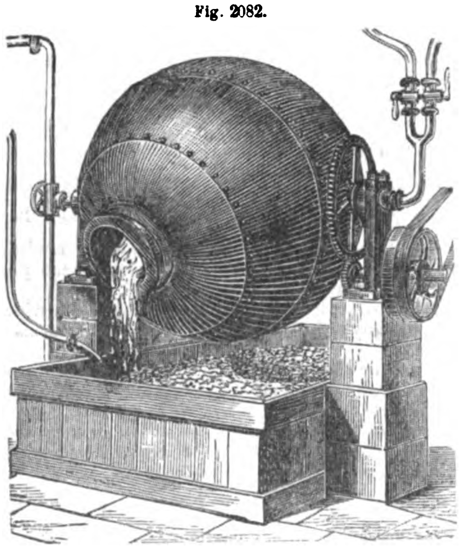
Raft, Life, and Davits, *Cramp* . * "*Engineering*," xxii. 262.

See also PORTABLE RAFT; LIFE BOAT; *supra.*

Rag Boil'er. The rag-boiler is fixed or movable, heated by open fire or by steam; is generally rotative, which gives a continual agitation to the contents.

In the illustration, the boiler is spherical, turning on its axis. Water or steam is admitted at the ends for rinsing or boiling, as the case may be, and

Fig. 2082.



Rag Boiler.

at one end is the gearing for rotation, either to agitate the contents during the process while the cover is closed, or to discharge the contents into the tub when the operation is finished.

The figure shows a spherical boiler, supported on hollow gudgeons, at which water and steam respectively are admitted.

Elevated faucets at the right hand admit the alkaline solution or water, respectively.

On the left are the steam valve and water-pipe, the latter for washing out the tub.

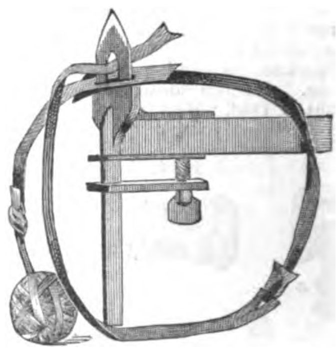
The process of boiling the paper material to make pulp, is for the purpose of disengaging the cellulose matter, and the details of the process, that is, the strength of the alkali, and the temperature and duration of the process, depend upon the character of the material under treatment, the object being to disengage the fiber, uninjured, from the cellulose and other matters which are associated with the fiber in the growing plant. The pectique principle which gives the parchment qualities which are found in some papers it is also desirable to preserve.

Rag Knife. (*Rag Engine.*) One of the knives in the cylindrical cutter, operating against those in the bed, or *bottom plate.* See Fig. 4112, p. 1856, "*Mech. Dict.*"

Rag Loop'er. Used in splicing rags for rag-carpet. It loops them together without sewing. Both ends are impaled on the perforated knife and the end of the last attached piece rove through the hole in the knife and pulled taut. The knife is raised and as its lower end is a pair of prongs it allows the knotted strip to slip off. See Fig. 2083.

Rag Pick'er. A shoddy machine for pulling to shreds woolen rags, stocking clip, hosiery, yarn, wool waste, old carpet, etc., and reducing them to cotton or wool staple, as the case may be. The material is fed from the table between a pair of rollers to the cylinder; this is 16¼″ wide.

Fig. 2083.

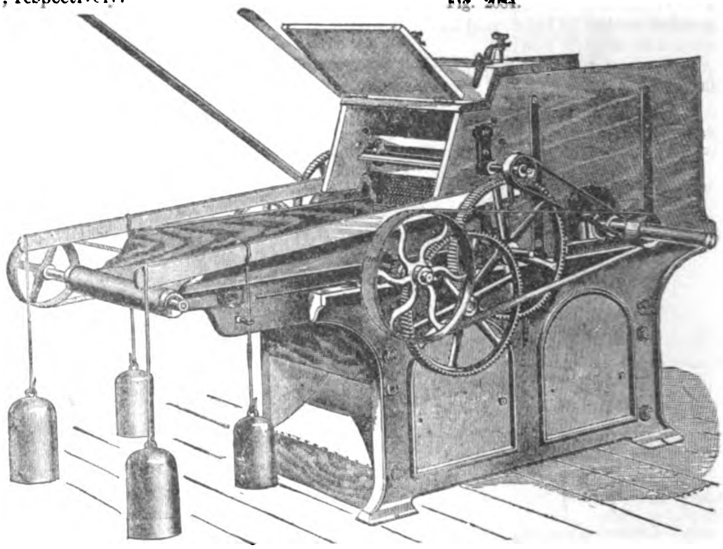


Rag Looper.

The face of the teeth is of steel and they are set in lags on the cylinder. The pressure on the feed rollers is adjusted by slipping the weights out or in upon the levers. The capacity is from 200 to 800 pounds per day, according to size. A lumping attachment throws out lumps and knots from the shoddy. See Fig. 2084.

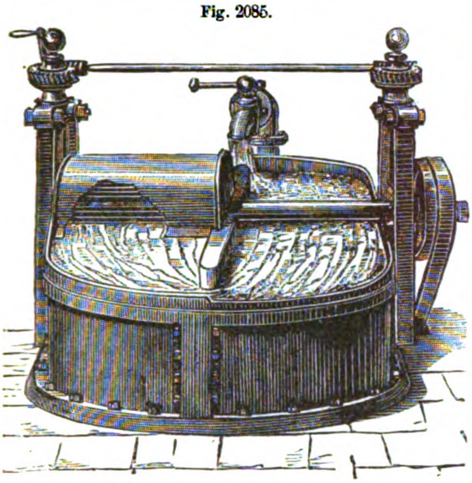
Rag Wash'er. A form of apparatus like the pulping machine in form and action, but differing from it in this, that, instead of having on the cylinder knives acting as shears against the blades of the concave beneath to cut the rags into fine shreds and eventually into pulp, the rag washer has a cylinder with wooden or bronze bars which merely rub the material against a plate beneath, serving to disengage any dirt and traces of the coloring matters or salts incident to the material or the remains of processes through which it has previously passed. In the center is the water supply; on the left the cylinder case; above is the gearing by which the cylinder shaft is raised or lowered so as to adjust its position vertically. See Fig. 2085.

Fig. 2084.



Rag Picker.

Fig. 2085.



Rag Washer.

Rag Wheel. (*Add.*) A polishing wheel made of disks of rags, rove upon a mandrel and clamped thereon. Such a wheel is from 4″ to 8″ diameter and runs at a speed of 7,000 per minute.

For use on iron: use a polishing material of equal parts of Vienna lime, crocus, and beeswax.

Boil these together, cool, cut into cakes. Dip a cake in oil and apply to the rag wheel occasionally.

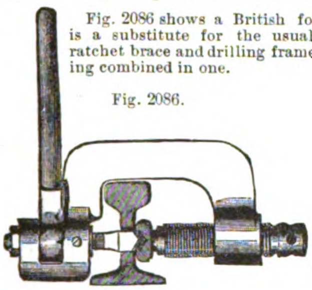
For brass, take crocus 2, wax 1, rouge $\frac{1}{8}$; melt, mix, and apply as in the former case.

For nickel, use rouge with water or oil.

Rail Bor′er. A hand machine for boring the webs of rails for the passage of the bolts of fish-bars.

Fig. 2086 shows a British form which is a substitute for the usual separate ratchet brace and drilling frame, both being combined in one.

Fig. 2086.



Rail Borer.

Rail Key. (*Railway.*) A wedge-piece driven in between the rail and its chair.

Rail Ma-chin′er-y. Machines for rolling, bending, straightening, drilling, etc., railway rails.

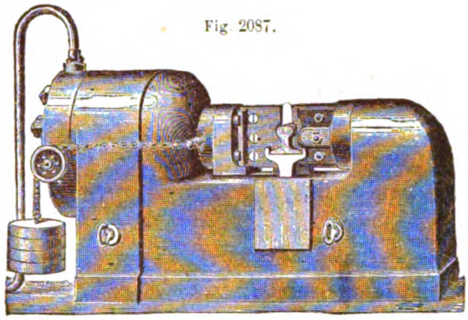
See the following references: —

Rail-bending machine. *Schrabetz*	"*Van Nostrand's Mag.*," xxi. 260. "*Iron Age*," xxii., July 4, p. 19.
Rail drilling machine.	* "*Engineering*," xxv. 383.
Beland	* "*Engineer*," xlix. 412.
Rail-paring machine. *Landore Siemens Steel Works*	* "*Engineer*," xlii. 25.
Rail saw, *Kitson*, Engl.	* "*Scientific American*," xxxv. 134.
Slitter	* "*Iron Age*," xviii., Nov. 2, p. 1.
Rail straitener, *Chisholm*	* "*Scientific American Sup.*," 834.
Wear-impl. for measur.	* "*Railroad Gazette*," xxiii. 126, 305.
Rail mill, Joliet Iron & Steel Co.	* "*Iron Age*," xvii., Jan. 6, p. 1.
Phila. & Reading Ry.	* "*Engineering*," xxv. 147.
Rails, rapid rolling	"*Scientific American*," xxxiv. 21.

See also ROLLING MILL.

Rail Shears. An application by Tweddel of the hydraulic power to cutting or squaring off the ends of rails. It has one stationary and one movable abutment, the faces of which conform to the shape of the rail to be cut. It is used without the accumulator, which is usual with riveters, the complete plant consisting of a boiler, ram, and shears.

Fig. 2087.



Tweddell's Rail Shears.

The ram has a steam cylinder of relatively large diameter, the total pressure on which is imparted to a plunger of small diameter, producing a corresponding pressure on the water in the hydraulic cylinder. The machinery is entirely controlled by steam valves.

Automatic cut-off gear is fitted to the steam cylinder so as to allow for expansion of the steam. This is effected by opening the tap at the point of cut-off required, and when the piston has passed the opening, the steam escapes through the tap, and closes a specially constructed throttle valve in the steam-inlet passage.

Rail′way. History and development, pp. 1860 *et seq.*, "*Mech. Dict.*"

See also the following references: —

Railways in China	* "*Scientific American Sup.*," 710.
In Japan	* "*Sc. American Sup.*," 691, 695.
Peruvian, Meiggs	* "*Sc. American Sup.*," 1311, 1329.
Rigi, Lucerne	* "*Scientific American Sup.*," 3897.
In U. S., early	"*Iron Age*," xx., Oct. 18, p. 9.
In U. S., 1877	"*Scientific American*," xxxvi. 89.
Vera Cruz, Mexico	"*Scientific American Sup.*," 896.
Vesuvius	"*Iron Age*," xxii., Oct. 17, p. 7. "*Sc. Am.*," xxxix. 327; xlii. 281, 309, 393. * "*Sc. Am. Sup.*," 3735, 3755, 3819.
Wetli mountain, Switz.	* "*Scientific Amer.*," xxxvi. 114.
Railways of the world. *Stuermer*	"*Scientific American Sup.*," 421.
Railway appliances at Phila., 1876, *Galton*	"*Scientific American Sup.*," 1988.
Car, bullet proof	"*Iron Age*," xix., May 3, p. 11. "*Scientific American*," xxxvii. 37.
Cost of	"*Scientific American*," xli. 209.
Derrick, *Voruz*, Paris, 1878	"*Scientific American Sup.*," 1989.
Subst. for hand car. *Noble*	"*Scientific American*," xxxv. 79.
Hitching while in motion, *Hanrez*	* "*Scientific American Sup.*," 4073.
Iron, *Kellogg & Seaver*	"*Min. & Sc. Press*," xxxviii. 163. "*Scientific American Sup.*," 895.
Lighting	"*Scientific American Sup.*," 1811.
Metallic	"*Scientific American Sup.*," 772.
Sliding, Cox	* "*Scientific American*," xliii. 70.
Spring propelled. *Leveaux*	* "*Scientific American Sup.*," 740.
Steel	* "*Scientific American Sup.*," 596.
Street	* "*Scientific American Sup.*," 598. "*Scientific American Sup.*," 513.
Two-story, Br.	* "*Engineering*," xxi. 104.
Velocipede	"*Scientific Amer.*," xxxviii. 101. * "*Scientific American Sup.*," 2825.

See Report on Railway Apparatus, Paris, 1878, by William A. Anderson; describes the Continental system of way and rolling stock. See "*Paris Exposition* (1878) *Reports*," vol. iv., p. 419, *et seq.* It contains the following illustrations: —

	Page.
First-class passenger car; Western Railway of France	446
Austrian first-class passenger car	448
Austrian second-class passenger car	448
Austrian third-class passenger car	448
Austrian freight car	448
Sleeping car; Austrian State Railway	448
Decauville's tramway car	458, 459

Crossing, *Carey*	* "*Scientific American*," xliii. 215.
Early in U. S.	"*Scientific Amer.*," xxxvii. 213.
Elevated, N. Y.	"*Scientific American Sup.*," 2018.
Field and military.	
Fell, Engl.	"*Scientific American Sup.*," 865.
Inspec. train, Penn. Ry.	* "*Railroad Gazette*," xxi. 47.
Interlocking signals and switches, *Buel*	* "*Railroad Gazette*," viii. 64, 107.
Rail joint, *Acaster*, Engl.	* "*Scientific American Sup.*," 1988.
	* "*Railroad Gazette*," xxi. 371.
Mead	* "*Scientific American*," xxxiv. 22.
Nicholl	* "*Sc. American*," xxxvi, 358.
Robinson	* "*Railroad Gazette*," viii. 43.
Sandberg, Br.	* "*Engineer*," xlii. 325, 328, 340.
Rail lock, *Turl*	* "*Scientific American*," xli. 118.
Locomotive. See list on pp. 556–558, *supra*.	
Railway, military, *Fell*	"*Van Nostrand's Mag.*," xvi. 90.
India	"*Iron Age*," xvii. Jan. 20, p. 3.
Haddan, Engl.	"*Scientific American Sup.*," 2084.
Pioneer or military.	
Haddan, Eng.	* "*Scientific American Sup.*," 2239.
10-inch Gage	"*Scientific American Sup.*," 1668.
Iron, Permanent way.	
Wood	* "*Engineering*," xxv. 269.
Barlow, *	
Wood, *	
Potel, *	
Hohenegger, *	
MacLellan, *	
Thoumen, *	
C. I. Borel Sleeper.	
Serres & Battie.	
Hilf.	
Hill	"*Iron Age*," xxxiii., Feb. 13, p. 9.
Seaton, Br.	* "*Engineering*," xxiii. 275.
Harvey & Roe, Br.	* "*Engineering*," xxiii. 98.
Newman	* "*Engineering*," xxiii. 136.
Livedey	* "*Engineering*," xxiii. 164.
Speilemann, Br.	* "*Engineering*," xxvi. 242.
Thomas, Br.	* "*Engineering*," xxiv. 135.
Trevis iron, Br.	* '*Engineer*," l. 183.
Wood, iron, Br.	* "*Engineering*," xxviii. 273.
Wood, iron, 10 Figs., Br.	* "*Engineer*," xlv. 235.
Pilot, Penn. Ry.	* "*Engineering*," xxiv. 86.
Portable, *Bass*	* "*Manuf. & Builder*," viii. 32.
Greig	"*Iron Age*," xxiv., July 31, p. 1.
Pioneer Works	* '*Iron Age*," xix., May 17, p. 1.
Rack railings	"*Van Nostrand's Mag.*," xxii. 9.
Locomotives, Switz.	* "*Engineering*," xxiii. 413.
Agudio	"*Van Nostr. Mag.*," xxiii. 230.
Rail compound, *Clark*	"*Iron Age*," xviii., Oct. 19, p. 9.
Rails, wear of	* "*Railroad Gazette*," xxi. 121.
Tests of, *Dudley*	* "*Railroad Gazette*," xxiii. 26.
Rail sections, standard, *Sandberg*	* "*Railroad Gazette*," xxiv. 327.
Fish plate, etc., standard	* "*Railroad Gazette*," xxiii. 643.
Rail, Sutton	* "*Scientific American*," xxxv. 35.
Vaughn	* "*Scientific American*," xlii. 296.
Life of steel rails.	
Williams	"*Scientific American Sup.*," 517.
Railway resistances.	
Shinez & Dudley	"*Scientific American Sup.*," 541.
Rolling stock, *Paris, Lyons & Med. Ry.*	* "*Engineering*," xxvii. 46.
Penn. Railway	* "*Engineering*," xxiv. 338.
Single Rail, Stone	* "*Scientific American Sup.*," 511.
Single track	"*Scientific American*," xxxv. 402.
Speed	"*Sc. Amer.*," xxxiv. 354, 393, 408; xxxv. 340.
N. Y. & Phila	"*Sc. American*," xxxix. 180.
England	"*Scientific American*," xliii. 117.
	"*Scientific American Sup.*," 436.
Splice	* "*Railroad Gazette*," xxii. 410.
Standard section.	
Sandberg	* "*Engineering*," xxv. 277.
Raising a railway station.	
Chepstow, Engl.	"*Scientific American Sup.*," 1668.
Rail for streets.	
Aldred & Spielmann	"*Engineer*," xlvi. 223.
Beloe, Br.	* "*Engineer*," xlvi. 315.
Edge, Br.	* "*Engineer*," xlvi. 341.
Railway, street, *Aldred & Spielmann*, Br.	* "*Engineer*," xlvi. 21.
Vignoles, Br.	* "*Engineering*," xxvii. 265.
Switch, *Carey*	* "*Scientific American*," xliii. 214.
Railway Term. ("Northern" & France).	* "*Scientific American Sup.*," 631.
Ties, iron	* *Blake's* "*Report Vienna Exp.*," iv. 66, 67.
	"*Iron Age*," xxi., Jan. 31, p. 20.
	"*Iron Age*," xix., April 19, p. 1.
Preserving	"*Scientific American Sup.*," 1146.
Reese	* "*Scientific American*," xli. 83.
Iron, *Schofield*	* "*Scientific American*," xliii. 101.
Travis	* "*Iron Age*," xxiii., March 6, p. 1
Iron *vs.* wood, *Weyers*	"*Van Nostrand's Mag.*," xvii. 525.
Wood	* "*Scientific American Sup.*," 1986.
Track, *Hall*	* "*Scientific American*," xl. 98.
Foster	* "*Am. R. R. Journal*," lii. 591.
Track sweeper, *Olmstead*	"*Railroad Gazette*," xxi. 397.
Underground, London	"*Scientific American Sup.*," 1793.
Extension of London	* "*Sc. American Sup.*," 833, 886.
Underground, Paris	"*Scientific American Sup.*," 1971.
Water	* "*Scientific American Sup.*," 758.
Wheels, cast iron	* "*Scientific American Sup.*," 490.

The *Vesuvian Railway* has the double-rope system, a car traversing on each line of rails, one descending as the other ascends, mutually counterbalancing. Each carriage has two compartments each capable of holding 6 persons. The depot and engine are at the bottom, and at an elevation of 810 meters above the sea, and 210 meters above the observatory. A carriage drive leads from the observatory to the railway. The angles of inclination are respectively 40, 63, and 50 in a hundred, at different parts of the ascent. The road is 900 meters long and terminates some distance short of the crater. The ascent is made in 7 minutes.

Railway Elevations. — A British journal gives the following as the highest elevations above the level of the sea, attained by any point on the railways named: —

	Meters.
Apennine line	617
Black forest line	850
Sömmering line	890
Caucasus	975
St. Gothard tunnel	1,154
Bremmer line	1,367
Mt. Cenis line	1,338
Northern Pacific	1,652
Central Pacific	2,140
Union Pacific	2,513
Andes line	4,769

Railway Speed. — The following rates of regular train speed are given in the journals (fractions omitted): —

British.

"Flying Dutchman," Great Western Railway, London to Exeter, 194 miles, with 4 stops, 4 hours 14 minutes; 46 miles per hour.

"Leeds Express," Great Northern Railway, London to Leeds, 187 miles, with 4 stops, 4 hours; 47 miles per hour.

"Morning Express," Great Northern Railway, London to Edinburg, 395 miles, 9 hours; 44 miles per hour.

"Irish Mail," London and North Western Railway, 40 miles per hour.

"Scotch Express," Midland Railway, London to Glasgow, 425 miles; 40 miles per hour.

United States.

"Boston and New York Express," Boston and Albany Railroad, 284 miles, 6 hours, 12 stops; 37 miles per hour.

"San Francisco Express," Jersey City to San Francisco, (ending June 4, 1876), 83 hours; 34 miles per hour. Jersey City to Pittsburg, 444 miles, 10 hours.

See also Locomotive, pp. 555, 556, *supra*.

Average Express Rates.

	Per hour.
Paris & Marseilles Express	66.3 kilometers
Berlin & Cologne (Lelviter line)	60. kilometers.
Spandan & Stendal (Lelviter line)	71.8 kilometers.
Berlin & Magdeburg (Potsdam line)	67.9 kilometers.
Brandenburg & Magdeburg (Potsdam line)	69.15 kilometers.
Great Western, Br.	53¼ miles.
Great Northern, Br.	51 miles.
London & Brighton, Br.	47¼ miles.
London & Northwestern, Br.	47¼ miles.
Midland, Br.	46 miles.
London, Chatham & Dover, Br.	45 miles.
Southeastern, Br.	45 miles.
Great Eastern, Br.	44 miles.
London & Southwestern, Br.	44 miles.

Refer to "*Van Nostrand's Mag.*," xxi. 439.
"*Scientific American*," xli. 115, 119, 266, 277.
"*Sc. American Sup.*," 3820, 3821.

Rail'way Ap'pa-ra'tus, Run'ning Stock, and Parts.

See under the following heads: —

Air brake.	Air pump.
Air cylinder.	Air strainer.
Air gage.	Anthracite furnace.

Ash pan.
Atmospheric brake.
Automatic air-brake.
Automatic car-brake.
Automatic ventilator.
Axle.
Axle box.
Axle box guides.
Axle collar.
Axle frame.
Axle packing.
Axle seat.
Axle stop-key.
Back-truck locomotive.
Baggage car.
Basket rack.
Bathing car.
Bell cord.
Bell ringer.
Bell rope.
Bell strap.
Block signal system.
Block system.
Boarding car.
Bob-tail car.
Bogie.
Boiler.
Bolster spring.
Bonnet.
Box car.
Box cattle car.
Box packing.
Brake.
Brake beam.
Brake cylinder.
Brake hose.
Brake hose coupling valve.
Brake lever.
Brake pipe.
Brake rod.
Brake rubber.
Brake shoe.
Brake shoe valve.
Break-down van.
Broad-tread wheel.
Buffer.
Cab.
Cabin car.
Cable carrier.
Cannon car.
Car.
Car axle.
Car brake.
Car coupler.
Car-door hanger.
Car heater.
Car load.
Car platform.
Car pusher.
Car runner.
Car seal.
Car signal.
Car spring.
Car transfer truck.
Car truck.
Car truck shifter.
Car unloading plow.
Car ventilator.
Car washing machine.
Car wheel.
Cattle car.
Center bearing.
Center draft draw bar.
Center pin.
Center plate.
Centripetal railway.
Chafing plate.
Cheek chain.
Check valve.
Cleaning hole.
Clear story.
Clip chair.
Cluster spring.
Clutch coupling.
Coach.
Coal car.
Coal-dust-burning locomotive.
Combination spring.
Combined car.
Compound locomotive.
Compound spring.
Compressed air brake.
Compressed air locomotive.
Compressed air rail-car.
Compromise wheel.
Conductor's car.
Conductor's valve.
Consolidation locomotive.
Continuous brake.
Couplet.
Coupling.
Coupling bar.
Coupling case.
Coupling chain.
Coupling hook.
Coupling hose.
Coupling link.
Coupling pin.
Coupling valve.
Cradle.
Crank pin.
Cremating car.
Cross-head.
Cross-tie.
Crown arch.
Crown bar.
Cushioned axle.
Cylinder.
Cylinder car.
Dash-guard.
Dead-blocks.
Dead-lock.
Dead weight.
Derrick car.
Diamond truck.
Door apron.
Door guard.
Door strap.
Double-coil spring.
Double-deck car.
Double-ender locomotive.
Double-plate wheel.
Double-truck locomotive.
Draw-bar.
Draw-clevis.
Draw-gear.
Draw-hook.
Drawing-room car.
Draw-rod.
Draw-spring.
Drilling.
Driver brake.
Driving-wheel.
Driving-wheel brake.
Drop-and-transfer table
Drop bottom.
Dummy car.
Dump car.
Dumping wagon.
Dust collar.
Dust guard.
Edge-rolled spring.
Ejector.
Elastic wheel.
Elder brake.
Electric railway.
Elevated railway.
Equal-bar nest spring.
Equalizing bar.
Equipment.
Exhaust nozzle.
Express car.
Face plate.
Faggoted axle.
Feed.
Fender board.
Ferry push-car.
Finish.
Fireless locomotive.
First-class car.
Flat bar spiral spring.
Flat car.
Flexible wheel-base.
Floating lever.
Flume car.
Fourway cock.
Frame.
Freight car.
Freight truck.
Front rail.
Furnace.
Furniture.
Gage.
Geared locomotive.
Gondola car.
Graduated spring.
Grain car.
Grain door.
Grate.
Grated door.
Gravel car.
Grease box.
Group spring.
Guide.
Guide yoke.
Gum spring.
Half-round-bar spiral spring.
Hand car.
Hand strap.
Hand wheel.
Hauling engine.
Hay car.
Head light.
Head lining.
Heater cock.
Helper ring.
Hibbard spring.
Hodge brake.
Hollow spoke wheel.
Hood.
Horn block.
Horns.
Horse car.
Hotel car.
House car.
Housing box.
Hub bolt.
Hydraulic railway brake.
Ice car.
Inclined-plane car.
Independent car-wheel.
Independent track.
India-rubber spring.
Injector.
Inner-hung brake.
Inspection car.
Intermediate floor.
Iron wheel.
Janney coupler.
Jet valve.
Joint splice.
Journal bearing key.
Journal box.
Journal box cover.
Journal packing.
Journal spring.
Key-shaped spiral spring.
King-bolt plate.
Lamp jack.
Lazy cock.
Leaden seal.
Leakage valve.
Lever hand-car.
Life.
Locomotive.
Locomotive crane.
Locomotive cup.
Lodging car.
Log railway.
Mail car.
Mail catcher.
Main frame.
Milk car.
Mine car.
Mine car wheel.
Mine locomotive.
Mogul locomotive.
Monitor car.
Muley axle.
Multicoil spring.
Narrow gage.
Narrow gage locomotive.
Nest spring.
Oil box.
Oil car.
Oil cellar.
One-legged railway.
One-rail railway.
Open-plate wheel.
Ore car.
Outer hung brake.
Paper wheel.
Passenger car.
Pedestal.
Permanent way.
Petticoat pipe.
Pilot.
Piston.
Plate wheel.
Platform.
Pneumatic dispatch.
Pneumatic tube.
Pneumatic tubular dispatch.
Pole railway.
Pony tank-locomotive.
Portable railway.
Portable-road locomotive.
Post-office car.
Prismoidal rail.
Pull iron.
Push car.
Quadruple-coil spring.
Quadruplet.
Quieting chamber.
Quieting nozzle.
Quintuplet.
Rack car.
Rack railway.
Radial axle box.
Rail.
Rail chair.
Rail key.
Rail splice.
Railway.
Railway brake.
Railway car.
Railway car brake.
Railway crossing.
Railway gage.
Railway gate.
Railway signal.
Railway speed.
Railway switch.
Railway tie.
Railway track bolt.
Railway velocipede.
Raised roof.
Reducing valve.
Refrigerating car.
Releasing lever.
Restaurant car.
Retaining ring.
Reversible seat.
Reversible street-car.
Reversing cylinder.
Road locomotive.
Rocker.
Rod.
Roof-apron.
Roofing canvas.
Roof light.
Roof step.
Round-bar spiral spring.
Rubber spring.
Rubber-center spiral spring.
Rubber-center spring.
Running board.
Safety chain.
Safety hanger.
Safety link.
Sand brake.
Seal hook.
Seal lock.
Seal press
Seal wire.
Seat lock.
Ship railway.
Shunt.
Shunting engine.
Side bearing.
Single-coil spring.
Single-plate car-wheel.
Single-plate street-car wheel
Single-rail railway.
Slack-burning locomotive.
Sleeper.
Sleeping car.
Sliding-door lock.
Smoke-stack.
Snow flanger.
Snow plow.
Snow scraper.
Spark arrester.
Spark ejector.
Spark netting.
Spiral spring.
Splice joint.
Spoke wheel.
Spool-shaped spiral spring.
Spring.
Spring-beam.
Spring block.
Spring case.
Spring plank.
Spring saddle.
Spring stud.
Square-bar spiral spring.
Stake.
Stake hook.

Stake pocket.
Stake rest.
Stake sleeve.
Stanchion.
Standard gage.
Starting valve.
Steam gong.
Steam sled.
Steam street-car.
Steam valve.
Steeled wheel.
Steel-tired car-wheel.
Steel wheel.
Stock car.
Stop plate.
Stove-pipe jack.
Stove-pipe ring.
Street-car.
Street-car locomotive.
Swing-motion gear.
Switch.
Switch chair.
Switching eye.
Tail lamp.
Tandem engine.
Tank.
Tank car.
Tank dome.
Tank locomotive.
Telescopic tank car.
Tender.
Tender hose.
Tie.
Tip car.
Tire.
Tool box.
Tool car.
Towing.
Towing locomotive.
Track bolt.
Track laying machine.
Track laying tools.
Track lifter.
Track sweeper.
Traction engine.
Trailing-tank locomotive.
Train brake.
Train car.
Tramway.
Tramway locomotive.
Transfer table.
Traverser.
Triple-coil spring.
Triplet.
Triplet spring.
Triple valve.
Truck.
Truck bolster.
Truck frame.
Truck side bearing.
Tube.
Turntable.
Twin locomotive.
Undergear.
Underground railway.
Vacuum brake.
Valve motion.
Ventilator deflector.
Ventilator hood.
Volute spring.
Waist.
Warming valve.
Washburn wheel.
Washer.
Water crane.
Water supply for locomotives.
Way.
Wheel.
Wheel box.
Wheel center.
Wheel flange.
Wheel flange lubricator.
Wheel plate.
Wheel rib.
Wheel seat.
Wheel tread.
Whistle.
Wicket.
Wide gage.
Window opener.
Wire rope conveyor.
Wire tramway.
Wooden rail.
Wool-packed spiral spring.
Wrought-iron wheel.

Rail'way Bridge. See Bridge, *supra*, pp. 132–134, where are numerous references to railway bridges in different parts of the world, and tables of relative dimensions.

See also list under Bridge, "*Mech. Dict.*"

See also the following references: —

Howe, Ashtabula . . * "*Scientific American Sup.*," 895.
Blackwell's Isl., E. River * "*Scientific American Sup.*," 1876.
Lay span, paper by *T. C. Clark* . . . . . . "*Scientific American Sup.*," 2095.
Key, River . . . . . * "*Scientific American Sup.*," 1044.
Louisville . . . . . * "*Scientific American Sup.*," 866.
Poughkeepsie . . . . * "*Scientific American Sup.*," 1043.
"*Scientific American Sup.*," 1794.
Sarpsfos, Norway, *C. Phil* * "*Scientific American Sup.*," 1934.
Tay, Tests of . . . . "*Scientific American Sup.*," 1877.
Tay, Scotland . . . . * "*Scientific American Sup.*," 1042.
River Tay . . . . . * "*Scientific American Sup.*," 2107.

Rail'way Car Brake. A means for bringing friction upon the wheels of a car to restrain rotation and slacken the speed of or stop the train. The subject is considered under Air Brake; Car Brake; Pneumatic Brake; etc., "*Mech. Dict.*" See references under Railway Brake, p. 1862. *Ibid.*

The Westinghouse automatic brake is shown in Plates XLI., XLII., which, taken together, illustrate the consecutive portions of the apparatus, The plates also show side and end elevations of a locomotive with apparatus attached, and a view of the under side of a part of a locomotive and tender, similarly furnished.

The *Westinghouse* automatic brake consists of the following essential parts: —

The steam engine and air-pump, which produce the compressed air. These are shown to the right hand in Plate XLII., the steam engine above and the air-pump below; the pistons and rods in line.

The main reservoir, in which the compressed air is stored.

The engineer's brake-valve, which regulates the flow of air from the main reservoir into the brake-pipe for releasing the brakes, and from the brake-pipe to the atmosphere for applying the brakes.

The main brake-pipe, which leads from the main reservoir to the engineer's brake-valve, and thence along the train, supplying the apparatus on each vehicle with air.

The auxiliary reservoir, which takes a supply of air from the main reservoir, through the brake-pipe, and stores it for use on its own vehicle.

The brake-cylinder, which has its piston-rod attached to the brake-levers in such a manner that, when the piston is forced out by air pressure, the brakes are applied.

The triple valve, which connects the brake-pipe to the auxiliary reservoir, and connects the latter to the brake-cylinder and is operated by a sudden variation of pressure in the brake-pipe, (1) so as to admit air from the auxiliary reservoir to the brake-cylinder, which applies the brakes, at the same time cutting off the communication from the brake-pipe to the auxiliary reservoir, or (2), to restore the supply from the brake-pipe to the auxiliary reservoir, at the same time letting the air in the brake-cylinder escape, which releases the brakes.

The couplings, which are attached to flexible hose, and connect the brake-pipe from one vehicle to another.

The automatic action of the brake is due to the construction of the triple valve, the primary parts of which are a piston and a slide-valve. A reduction of pressure in the brake-pipe causes the excess of pressure in the auxiliary reservoir to force the piston of the triple valve down, moving the slide-valve so as to allow the air in the auxiliary reservoir to pass directly into the brake-cylinder and apply the brakes. When the pressure in the brake-pipe is again increased above that in the auxiliary reservoir, the piston is forced up, moving the slide-valve to its former position, opening communication from the brake-pipe to the auxiliary reservoir, and permitting the air in the brake-cylinder to escape, thus releasing the brakes.

Thus it will be seen that any reduction of pressure in the brake-pipe applies the brakes, which is the essential feature of the automatic brake. If the engineer wishes to apply the brakes, he moves the handle of the engineer's brake-valve to the right, which first closes a valve retaining the pressure in the main reservoir, and then permits a portion of the air in the brake-pipe to escape. To release the brakes, he turns the handle to its former position, which allows the air in the main reservoir to flow into the brake-pipe, restoring the pressure and releasing the brakes. A valve, called the conductor's valve, is placed in each car, with a cord running the length of the car, and any of the train-men, by pulling this cord, can open the valve, which allows the air to escape from the brake-pipe. Should the train break in two, the air in the brake-pipe escapes, and the brakes are applied to both sections of the train; and should a hose or pipe burst, the brakes are also automatically applied.

The gage shows the pressure in the main reservoir and brake-pipe when they are connected, and the pressure in the brake-pipe alone when the main reservoir is shut off by the movement of the engineer's brake-valve.

A non-automatic brake cannot be made to work satisfactorily upon more than from 10 to 12 cars, while it is possible to work trains of 50 cars with the automatic brake without difficulty. With the non-automatic brake the air is stored upon the engine and transmitted back through the pipe, and consequently there is a loss of time both in putting on and taking off the brakes. With the automatic brake, the air is stored upon each car ready for use, and this supply is readily brought into action by a slight reduction of pressure in the main pipe, which reduction requires the movement of but a trifling quantity of air as compared with that used for setting a non-automatic brake.

A modification of the automatic car brake adapts it specially to freight cars. The operation is the same, but the triple-valve, brake-cylinder, and reservoir are bolted together and avoid the pipe connections.

The following brakes are described and illustrated in Forney's "*Car-builder's Dictionary.*"

Tyler, lever.	*Creamer*, lever.
Hodge, lever.	*Smith*, vacuum.
Stevens, lever.	*Eames*, vacuum.
Tanner, lever.	*Westinghouse*, automatic air-brake.

Capt. Douglas Galton's report, "*Centennial Exhibition Reports*," vol. vi., Group XVIII., p. 34, describes early devices and notices of continuous brakes: —

Westinghouse.	*Goodale.*
Henderson.	*Smith.*

Achard, electric, Fr. . . * "*Engineering*," xxiv. 395.
* "*Telegraphic Journal*," vi. 327.
"*Railroad Gazette*," xxiv. 590.
Barker, hydraulic, Gt. * "*Engineer*," xlvii. 409.
Eastern Ry., Br. . . * "*Telegraphic Journal*," vi. 301.
Becker, automatic Austria * "*Engineer*," xlv. 73.
* "*Railroad Gazette*," xxii. 76.
Clark & Webb . . . . "*Telegraphic Journal*," vi. 300.
Congdon Brake shoe . * "*Railroad Gazette*," xxi. 398.

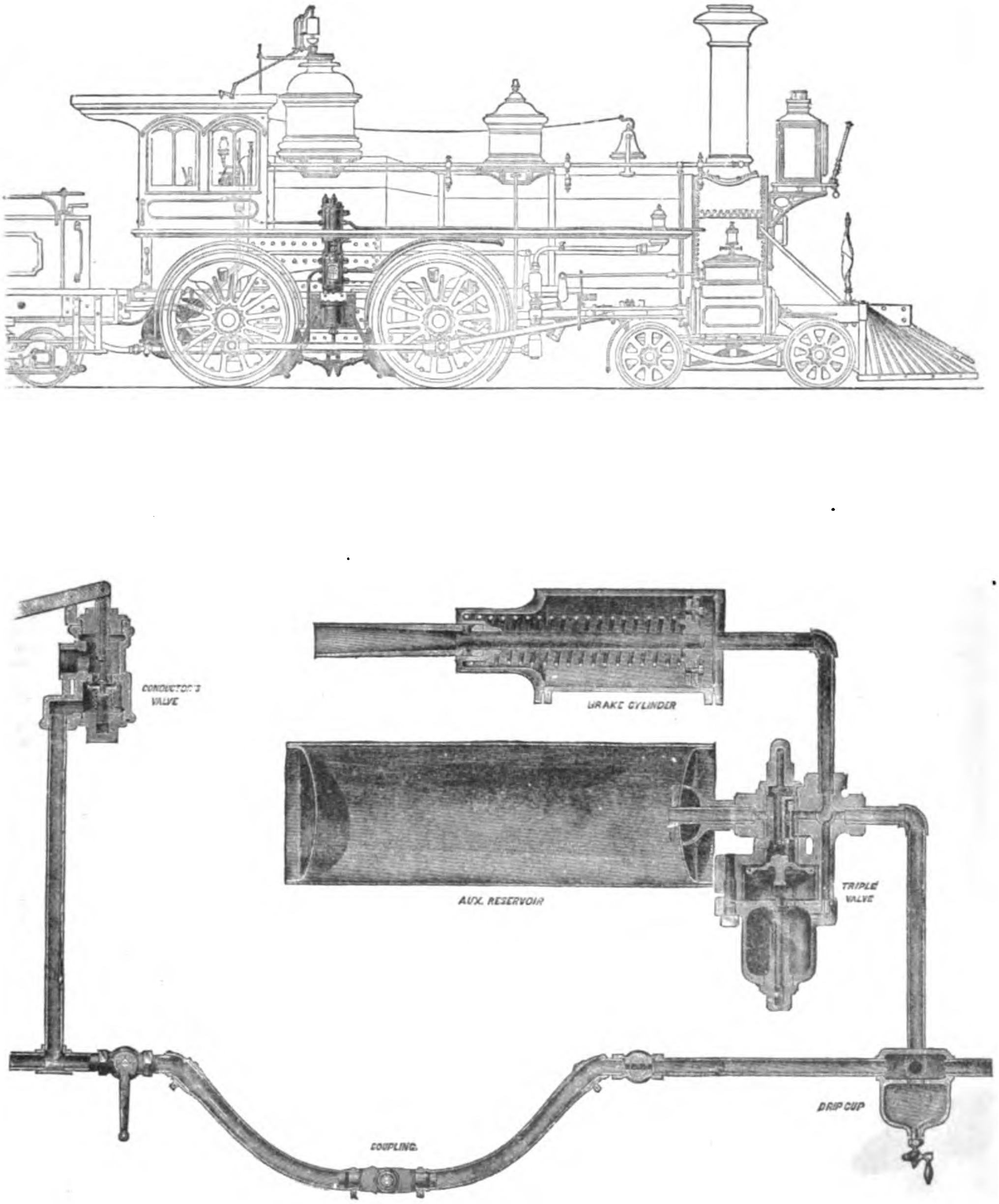


PLATE XLI. **WESTINGHOUSE AUTOMATIC BRAKE.** (CAR ATTACHMENTS.) *See page* 740.

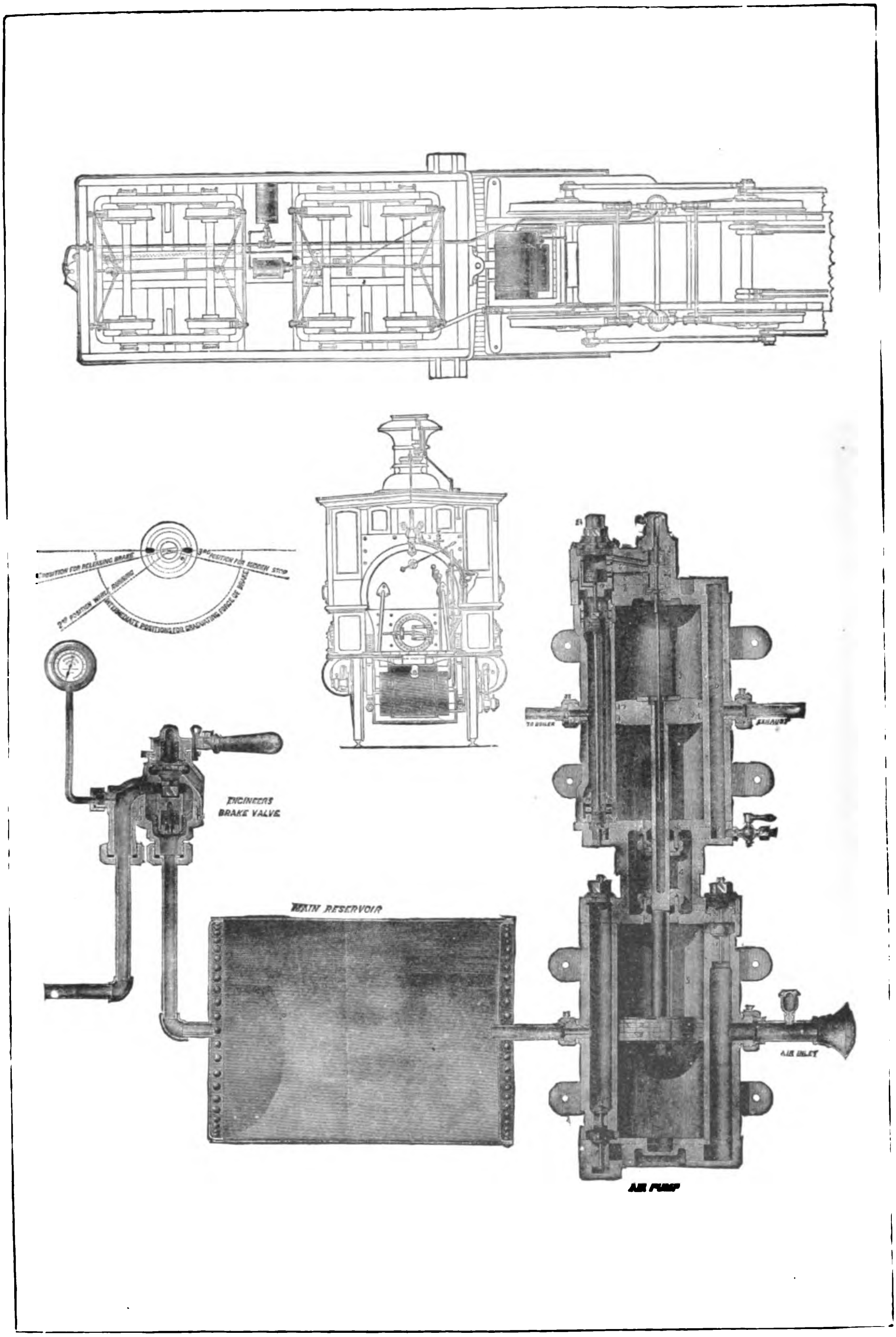


PLATE XLII. WESTINGHOUSE AUTOMATIC BRAKE. (LOCOMOTIVE ATTACHMENTS.) See page 740.

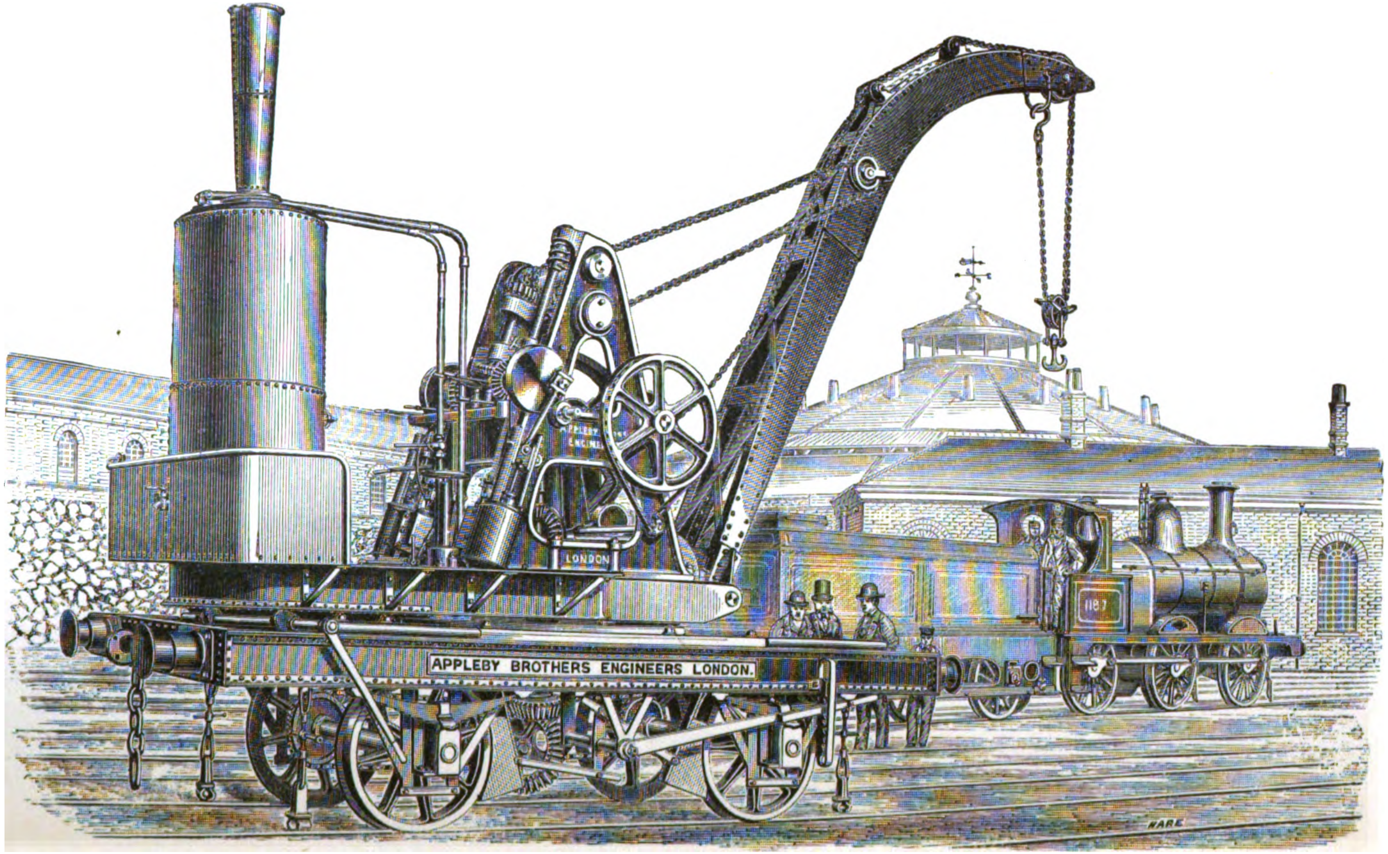


PLATE XLIII.

APPLEBY'S ENGLISH LOCOMOTIVE STEAM CRANE.

See page 741.

Conover, electric . . .	"*Scientific American*," xlii. 294.
French, electro-mag. .	* "*Scientific American Sup.*," 1760.
Guerin	* *Laboulaye*, i., "*Chemins de fer*," 144.
Hofeker	* "*Scientific American*," xxxv. 66.
James, automatic . .	* "*Scientific American*," xxxii. 22.
Lander	* "*Engineer*," xlii. 7.
Loughbridge	"*Scientific Amer.*," xxxiv. 289.
Sanders, vacuum . . .	"*Telegraphic Journal*," vi. 301.
Shellhorn	* "*Scientific American*," xxxv. 258.
Smith, Br.	* "*Engineer*," l. 421.
	"*Scientific American*," xxxvii. 53.
	"*Telegraphic Journal*," vi. 282.
Thompson	"*Am. R. R. Journal*," xlix. 771.
Westinghouse	* "*Railroad Gazette*," viii. 159.
	"*Telegraphic Journal*," vi. 282.
	* "*Engineer*," xlviii. 65, 68.
	* "*Engineering*," xxvi. 422.
On Engl. R. R. . . .	* "*Scientific American Sup.*," 1935.
	* "*Engineering*," xxii. 239.
N. E. Ry., Br.	* "*Engineering*," xxviii. 28, 55, 74.
Reducing Valve . .	* "*Engineering*," xxvii. 85.
Phila., 1876	* "*Scientific American Sup.*," 863.
On screw brake, * *Sanders*	"*Engineer*," xlv. 77.
Chain brake, *	
Vacuum brake, *	
Hydraulic brake, *	
Compressed air brake,*	
Automatic vacuum. *	
French report on continuous brakes	* "*Scientific American Sup.*," 2270.
Trials, Br. report, tables	"*Engineering*," xxiii. 12, 94.
	"*Railroad Gazette*," xxi. 33.
Calculation, Engl. . .	"*Scientific American Sup.*," 555.

Rail'way Crane. A crane adapted to travel on a railway track; either as a wrecking crane, or for loading and unloading purposes. Such are also used in building sea-walls, depositing blocks of concrete in advance of the track, which is laid piecemeal as the foundation advances.

The crane shown in Plate XLIII. is made by Appleby, of London. It is mounted on a permanent way truck with buffers and springs, and has a curved wrought iron jib, and a boiler acting as a counterpoise. It carries a load of 5 tons. It is self-propelling, or the traveling motion can be thrown out of gear, and the crane, being securely locked, can be attached to a train for traveling to any part of the line where its services are required. The cylinders are fitted with link reversing gear, and the several motions are transmitted from the engine shaft; there are four speeds of lifting, and the load can be lowered either by the brake or by reversing the engines; the turning motion is effected through double friction clutches, and suitable gear which drives a wide roller immediately under the jib, and this operation is performed in either direction, and simultaneously with any of the others, and being obtained entirely by the friction of surfaces instead of by toothed gear on the base-plate, the risk of breakage arising from stopping or starting too suddenly is avoided. The derrick motion for altering the radius is worked by worm gear and a pair of chains, one end of which is attached to the crane-frames, the other end coiling round the derrick barrel. The traveling motion is obtained by a shaft passing through the center of the crane post, and driven from the crank-shaft, the lower end of this vertical shaft giving motion to another shaft fixed horizontally under the crane-carriage, and in order to allow of the deflection of springs, the power is transmitted through pitch chains from this shaft to both traveling axles. The crane is mounted on a wrought-iron carriage similar in all respects to the ordinary permanent-way stock. The jib is curved in order to give sufficient clearance for lifting large logs on to trucks, for stacking timber, etc., or even to lift a disabled truck and place it on a platform truck.

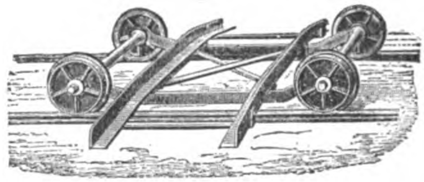
A very large and efficient form of crane of this description is shown at Fig. 5652, p. 2335, "*Mech. Dict.*" A smaller one at Fig. 5651, previous page. See also BALANCE CRANE, Fig. 176, p. 66, *supra*.

There are other forms of cranes which run on rails in manufacturing establishments, machine shops, etc., the floorways of foundries, etc. See also OVERHEAD CRANE; TRAVELING CRANE, etc., "*Mech. Dict.*"

Rail'way Cros'sing. A temporary bridge for carriages across a line of rails. It consists of a pair of angle-irons arched so as to span the track. A somewhat similar device is the hose-bridge which allows street cars to cross fire hose laid across the rails. Fig. 2579, p. 1131, "*Mech. Dict.*"

The form shown in Fig. 2088 is the French transbordeur de wagonetts; the bridge plates are carried on a low truck so as to be transportable on the line of rails which they bridge.

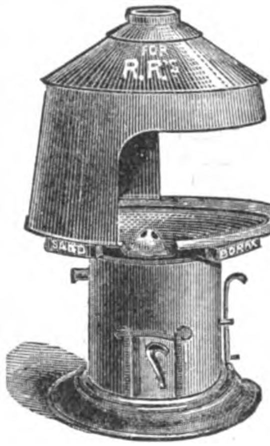
Fig. 2088.



Railway Crossing.

Rail'way Forge. A form of portable forge specifically adapted for work on railways, shown in Fig. 2089. It has a lantern bellows inclosed in the pillar and worked by a handle. The cowl is shiftable to windward to protect the fire.

Fig. 2089.



Adjustable Cowl Forge.

Rail'way Plow. 1. A plow attached to a car or locomotive and used in excavating or ditching alongside the track. See references under PLOW.

2. A snow plow.

Rail'way Scale. A track scale for weighing cars in transitu. See *m*, Plate LXXIII, p. 2754, "*Mech. Dict.*"

Rail'way Sig'nal. The interlocking system of switches and signals is used in connection with switches at stations and junctions.

The block system is used to prevent more than one train from occupying a given space between stations at the same time. See BLOCK SYSTEM, p. 110, *supra*, and references *passim*.

See the following references: —

Car signal, Engl., *Stewart*	"*Scientific Amer.*," xxxiv. 164.
By train, audible . . .	* "*Scientific American Sup.*," 647.
Audible, *Aird*, Br. . .	* "*Engineer*," xli. 69.
Brierly	* "*Railroad Gazette*," viii. 477.
Audible, *Brown*, Br. .	* "*Engineer*," xliii. 112.
Interlocking signals and switches, *Buell*, on .	* "*Railroad Gazette*," viii. 64, 107.
Automatic, *Hall* . . .	* "*R. R. Gaz.*," xxiii. 563, 577, 589.
N. Ry. of France . . .	* "*Railroad Gazette*," xxiii. 283.
Burns, Br.	* "*Engineer*," xlv. 128.
Robinson	* "*Scientific American*," xxxv. 66.
Saxby & Farmer, Br.	* "*Engineering*," xxv. 403.
	* "*Railroad Gazette*," viii. 341, 342, 443, 453.
	"*Engineering*," May 24, "1878."
Electric.	
Siemens & Halske . .	* "*Scientific American Sup.*," 1024.
Signal recorder, *Siemens*	* "*Telegraphic Journal*," vi. 90.
Electric, insulated track	* "*R. R. Gaz.*," xxiv. 141, 153, 163.
Electric repeaters for signals	"*Telegraphic Journal*," iv. 329.
Electric train in transitu	"*Van Nostrand's Mag.*," xv. 475.
By rails as conductors .	"*Telegraphic Journal*," iv. 247.
Explosive	* "*Scientific American Sup.*," 191.
Locking apparatus. . .	
Saxby & Farmer, Br.	* "*Engineer*," xli. 87.
Switch signals, on, Br. .	* "*Engineering*," xxii. 519.

See *Pope & Hendrickson's* pamphlet, "*Electric Railroad Signals*," Russell Bros., N. Y., 1876.

Rain'-wa-ter Stop. 1. A valve or chute to turn rain-water to a cistern or to waste, as may be required. In the latter case to allow the roof to be washed before turning the water into the cistern. Fig. 1572, p. 667, "*Mech. Dict.*"

2. A three-way cock, as the divarication of a pipe which has branches leading to the cistern and well respectively.

Raised Rôof. A clear-story car roof.

Rais'ing Ves'sels. See pp. 1874, 1875, "*Mech. Dict.*"

Air bags for, "*Engineering*"	"*Van Nostrand's Mag.*," xiv. 122.
"Edith,"	* "*Scientific American Sup.*," 1729.
Tassey	* "*Scientific American Sup.*," 690.
"Vanguard"	"*Scientific American Sup.*," 1089.

Rake. See HAY RAKE, *supra*, and Figs. 4152–4158, pp. 1876, 1877, "*Mech. Dict.*"

Ram. 1. (*Hydraulic.*) See page 1150, "*Mech. Dict.*"

Ram, hydraulic	* "*Eng. & Min. Jour.*," xxvi. 294.
Rams for rural water works, *Hett*, Br.	* "*Engineer*," l. 174.
Montgolfier, *Jones*	* "*Scientific American Sup.*," 2463.

2. (*Naval.*) See page 1878, "*Mech. Dict.*"

Ra'mie Ma-chin'e-ry. Machinery for decorticating and reducing the *rhea* fiber or China grass; better known by its Malay name, *ramie:* the *Bœhmeria nivea* of the botanists. It is the material of China-grass cloths. — *Falconer; Hooker.*

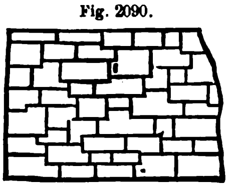
Shown in various stages of manufacture at the London Exhibition of 1851. See Report of Group VIII., "*Centennial Exhibition* (Phila.) *Reports*," 1876, pp. 4, 5.

Ramie mach., *Favier*	"*Technologiste*," xli. 76.
Leger	"*Technologiste*," xxxiv. 117.
Jute, *Lockert*	"*Technologiste*," xli. 171.
Ramie fibre	"*Scientific American Sup.*," 1483.
Machines, *Bouchard*	* "*Scientific Amer.*," xxxvii. 278.
Coleman	* "*Scientific Amer.*," xxxvii. 278.
Lefranc & Nagoua	* "*Scientific Amer.*," xxxvii. 278.
Bouchard	* "*Min. & Sc. Press*," xxxvi. 8.
	"*Sc. American*," xxxviii. 72.
Manufacture	"*Scientific American*," xl. 845.

See also RHEA FIBER.

Rand Breast'ing Ma-chine'. A guillotine knife operated by treadle to trim the front face or breast of heel rands. See RAND, page 1879, "*Mech. Dict.*"

Fig. 2090.



Random Stone Work.

Ran'dom Stone Work. (*Masonry.*) Flat stone not laid in courses; differing in this respect from RANGE WORK, which see.

Range Find'er. An instrument for measuring distances by sight.

See DISTANCE MEASURER, p. 262, *supra*; TELEMETER, Figs. 6255, 6256, pp. 2513, 2514, "*Mech. Dict.*"

On	"*Engineer*," xlii. 109.
	"*Scientific American*," xxxvii. 20.
	* "*Sc. American Sup.*," 884, 2777.
Berdan	* "*Engineer*," xlvii. 212.
	* "*Engineer*," xliii. 179.
Lieut. Edwards	"*Van Nostr. Mag.*," xxiii. 437.
Watkins	* "*Scientific American Sup.*," 1555.
	"*Scientific American*," xxxvi. 22.

See report on Range finders, "*Ordnance Report*," 1879, Appendix X., p. 373, *et seq.*, with 6 plates. Including

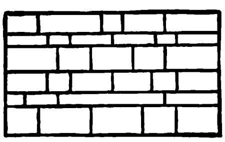
Watkins' range finder, p. 373, Plate I.

Berdan telemeter, p. 379, Plate II.

Berdan telemeter (improved) p. 384, Plate III.

Nolan's range finder, p. 385, Plates IV.–VI.

Fig. 2091.



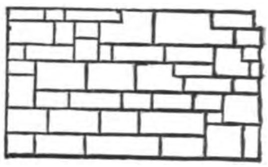
Range Stone Work.

Range Stone Work. (*Masonry.*) Stone work laid in courses.

Range Work may have courses of different thicknesses, but the level joint is preserved.

In *Broken range work* the uniformity is occasionally broken by thicker stones, as in Fig. 2092.

Fig. 2092.



Broken Range Stone Work.

Range work, whether of squared stones, or of ashlar, is usually backed up with rubble masonry, which in such cases is specified as coursed rubble.

Ran'ging Rod. (*Surveying.*) The rod of the chain-man, which is held vertical while being observed by the transit-man.

Heller's self-plumbing ranging rod, for transit field work, is described in * "*Manufacturer & Builder*," xii. 184.

Rar'e-fied Air Ap'pa-ra'tus. Apparatus in which the effect of the diminution of atmospheric pressure on living organisms is observed.

Prof. Bert's investigations are contained in a book of 1168 pages with 89 engravings, referred to in * "*Manufacturer & Builder*," x. 60. See also DEPURATOR, p. 687, "*Mech. Dict.*" The opposite idea is the compressed-air bath. See AËROTHERAPY APPARATUS, p. 9 *supra*, and Fig. 67, p. 31, "*Mech. Dict.*"

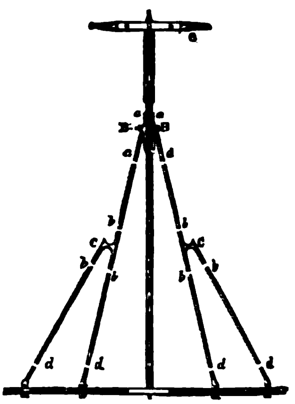
Ratch'et Brace. A boring brace, the handle of which is reciprocated, being effective in one direction only, by means of ratchet and click. Figs. 4175, 4176, p. 1882, "*Mech. Dict.*"

Brace	"*Engineer*," l. 6.
Support for	* "*Scientific American Sup.*," 161.
Drill, *Hutchins*	* "*Iron Age*," xvii., June 1, p. 9.
Lathrop	* "*Iron Age*," xxv., April 15, p. 7.
Renshaw	* "*Scientific American*," xl. 132.
	* "*Iron Age*," xx., July 26, p. 1.
	"*Manufact. & Builder*," xi 280.
Wrench	* "*Min. & Sc. Press*," xl. 1.
Coleman	* "*Min. & Sc. Press*," xxxvi. 145.
Pawl and ratchet	* "*Iron Age*," xxiii., April 17, p. 11.

Ratchet Coup'ling. A device to uncouple machinery from the driving-wheel when the motion of the latter is suddenly arrested by an obstruction.

A ratchet wheel is placed on the driving-wheel shaft, and slips within a sleeve on the extension shaft. The ratchet is efficient as long as it is a driver, but, if arrested by an obstruction to the master wheel, the sleeve slips on the ratchet and allows the machinery to move on until it loses its momentum.

Fig. 2093.



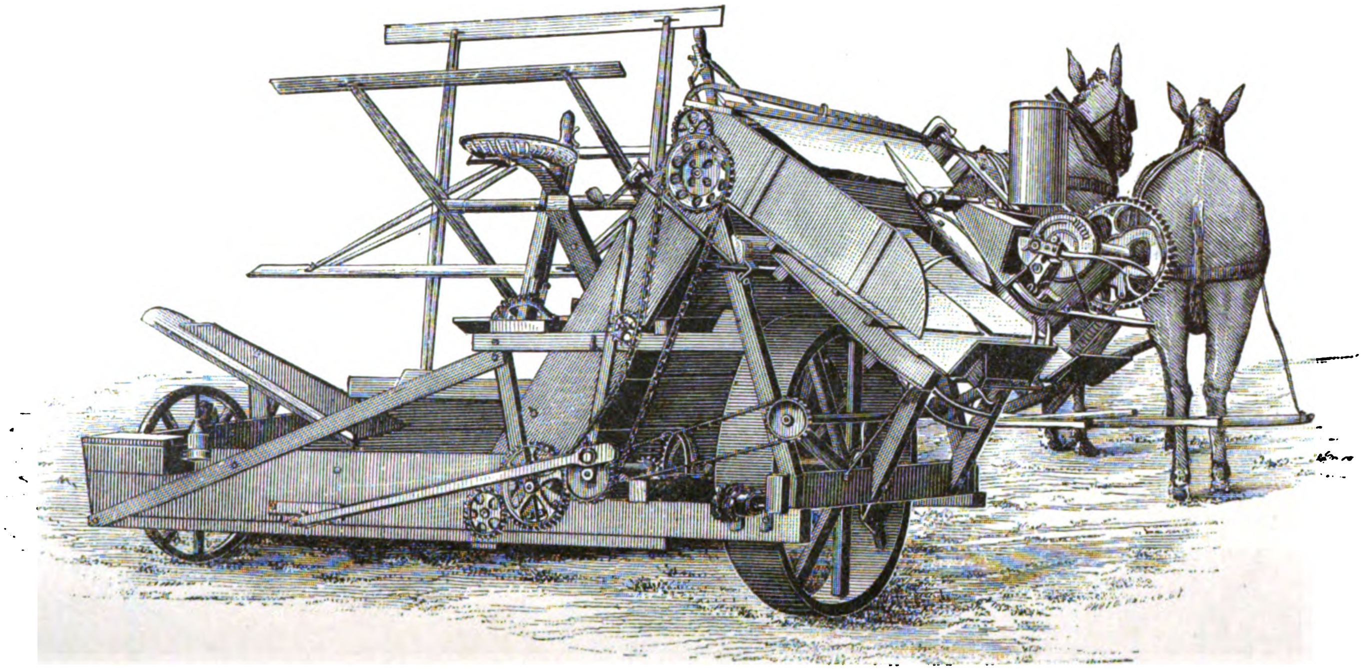
Reach.

B. Stay end.
C. Offset.
a a. Welding points of stay end and stay iron.
b b. Welding points of offsets and stays.
d d. Welding points of stay end ties.
e. Reach plate.

Ra'tion Press. See BALING PRESS, Fig. 184, p. 69, *supra.*

Rat'tle Bar'rel. A tumbling box for castings, to remove sand, and, in some cases, cores.

PLATE XLIV.



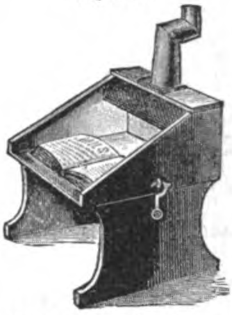
McCORMICK'S TWINE-BINDING REAPER.

See page 748.

Reach. That portion of the running gears of a vehicle which connects the fore and hind axles. See Fig. 2093.

Read'ing Lamp. A lamp for ministers and lecturers. It is so screened as not to send any light into the room but to illuminate the reader's notes which are laid upon the desk.

Fig. 2094.



Lecturer's Reading Lamp.

British Museum reading-room. "*Sc. American*," xli. 36.

Reap'ing Ma-chine'. 1. The history and development of the reaping machine from the Gallic implement of the first century, A. D., to the period of the Centennial Exhibition in Philadelphia, 1876, has been referred to, rather than exhaustively told, on pp. 1888–1898, "*Mech. Dict.*" The classification by structural features is given on p. 1898, and illustrations of the 38 principles of action are given in Plates XLVII.–L., pp. 1894–1897, *Ibid.*

The features which the reaper has in common with the mower are considered under MOWER, pp. 1487–1493, "*Mech. Dict.*" The principles of cutting apparatus on Plate XXX., p. 1489, *Ibid.* The classification of mowers by structural features is given on p. 1488, *Ibid.*, and thirty-six illustrations, occupying Plates XXXI.–XXXIII., pp. 1490–1492, show the variations in the following features: —

Modes of connecting the cutting apparatus with the frame.
Modes of driving cutters.
Styles of cutters.
Truck clearers.

The latest classification of harvesters by structure, embracing the whole subject under 141 heads, is given on page 442, *supra*.

The British experiments in building reaping machines from the period of the Boyce patent, 1799, to the Bell machine of 1826, were numerous and unsuccessful. The side cut was tried in 1806, up to which time the machine was pushed ahead of the horses. The knives were rotary until 1822.

The McCormick reaper, invented and put to service in 1831 and exhibited at the London World's fair in 1851, caused the resurrection of a number of old British devices, especially the machine of Patrick Bell (1826) shown in Fig. 4202, p. 1891, "*Mech. Dict.*" The terms of the French award of the Grand Gold Medal of honor in 1855, express the position of the McCormick reaper as "the type after which all the others are made."

While there have been many valuable improvements in detail it may be truthfully said that to dispense with Cyrus H. McCormick's invention would be to wipe every reaper out of existence. The same may be said of mowers, except the small class known as lawn mowers. The original machine of McCormick embraces the following features: —

The serrated reciprocating blade operating in fingers or supports to the grain being cut.

The platform for receiving the cut grain deposited thereon by the reel, and from which it was raked to the side in gavels ready to bind.

A divider to separate the grain to be cut from that left standing.

Two forms of the combined reaping machines, that is, adaptable for either reaping or mowing, are shown in Plate XLVI., p. 1892, "*Mech. Dict.*," the three figures in the Plate showing the machine as a reaper, a dropper, and a self raker. The single reaper is made with but a single driving wheel and is shown in Plate XXX., p. 630, *supra*.

The McCormick "Daisy" reaper shown in the Plate is a single wheel self-raker cutting 5′ wide and weighing 700 pounds. It is a center-cut machine, the ground-wheel and grain-wheel being in line. It has no cogs in the main-wheel. Both ends of the cutter-bar can be raised at the same time by one lever, operatable while the machine is in motion. By a second lever the guards can be tilted up or down to suit the variety of surface or the condition of the crop. By a simple tripping device the operator can regulate the action of the rakes in forming the size of the bundles.

At the Paris Exposition of 1878 there were exhibited, in the field, in Class 76 (the writer being a member of the jury of that class): 4 binding reapers; 21 simple and combined reapers; 1 steam reaper; 16 mowers.

The binding reapers shown at the Paris Exposition of 1878 were 9 in number, 6 American and 3 British. 4 of the American machines went into the field-trials, all of which used wire, and each of the owners has since placed a twine binder on the market. Two twine binders were shown at the exposition, one American and one British, but did not compete in the field.

The four competing machines were those of —

Cyrus H. McCormick, *D. M. Osborne & Co.*,
Walter A. Wood, *Aultman & Co.*

The results of the trial at Marmont, near Paris, in 1878, are given in detail under DYNAMOMETER, p. 288, *supra*. The McCormick machine was awarded the grand prize, and subsequently the gold medal of the Royal Agricultural Society of Great Britain, Bristol, 1878, where the same machines competed, and again in 1881, at a competitive trial of the prominent twine binders from England and America at Derby, England, the Royal Agricultural Society awarded the gold medal to the McCormick machine.

The McCormick twine binding reaper is shown in Plate XLIV. The grain, as cut by the reciprocating knife, is delivered by the reel upon the platform, which is a moving web of canvas, which carries it to the elevating aprons which deliver it upon the binding table. The position of the band on the sheaf is regulated for long or short straw by means of a shifting lever, which moves the table backward or forward so as to place the band around the middle of the bundle, either in long or in short grain.

The packing apparatus which regulates the size of every sheaf, making them all uniform, consists of two arms with forked points, which work alternately up through two slots in the table. They rise up quickly, raising the straw and moving it gently forward, pressing it into a receptacle, thus forming a compact bundle, and when the regulated amount has accumulated the pressure against the trip-hook removes a stop, thus throwing the binding mechanism into gear. The two curved trip-hooks can be shifted on the sword arm, so as to adjust the bulk of sheaf desired, and when once set for sheaves of any given size, sheaves of that size are continuously made

The binding apparatus consists of a needle arm, gripper, and discharging device, with the necessary gear. The needle arm and part of the discharging device are below the platform, and the gripper, knotter, and two discharging arms overhang the sheaf. After the sheaf has been perfectly tight, and the binding apparatus has been thrown into gear, as described above, the needle arm rises up through the table, carrying the twine with it, and thus encircling the sheaf, places the twine in the gripper, where it is held fast until by a quick motion the knot is tied, the cord cut off, and the discharge arms throw off the bundle to the ground, when the binding apparatus stops and the packers immediately begin the formation of a new sheaf. The discharging device makes the separation between the bound bundle and the unbound grain. The binding material is long-fibered manilla twine. The tension, when once set, binds all bundles with uniform tightness.

The binding apparatus is more specifically shown in Fig. 2095.

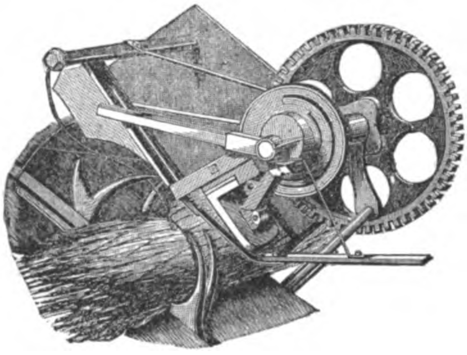
The binding mechanism is attached to that form of American harvester which has traveling platform, elevator, and binding table. The first motion is by a spur wheel on the main axle, 24″ in diameter, which drives a pinion on a counter-shaft, which, at its opposite end, carries a bevel wheel sliding on a feather and actuated by a clutch under the control of the driver. This bevel wheel drives a bevel pinion on a second shaft, running backwards and forwards and parallel to the main driving wheel; on its rear end is a triple wheel, comprising a small chain wheel which drives the binding gear; a spur-wheel to drive the bottom apron through an intermediate wheel, and a larger chain wheel for the elevator, on the other side of which is the pitman crank, working the knife from behind. The binding mechanism comprises first, a shaft, which runs from back to front of the machine under the binding table. On its forward end is a small chain-wheel, driving on to a square shaft with a loose chain on it, so as to adapt its position to the table when the latter is shifted. On the rear end are two cranks, actuating the packers, which sink through slots on the binding table. On the foremost end of the last-mentioned shaft (No. 4) is a small geared pinion, also loose, with a stop pivoted to it, which is held by a pawl actuated by the compressor. On the extreme end of the shaft, beyond the stop, is a clutch with two driving prongs, which engage into the tail of the stop when the pawl is out of gear. When the pawl comes into gear with the stop, the tail of the latter is so depressed as to allow the clutch to clear it, and so the pinion is thrown out of gear.

This pinion, through two intermediate wheels, drives the knotting-gear, by means of a large spur-wheel on the binder-shaft (No. 5), with cams on both sides; that on the outside works a tension lever for the string.

A crank-pin on the outside cam actuates a crank and rocking-shaft, the opposite end of which carries the needle arm.

The compressor is pivoted on a crank at the back of the needle arm; and it actuates first a rocking-shaft, with a cam which locks the pawl which holds the driving pinion on No. 4 shaft already described; and secondly, the lever of a rock-

Fig. 2095.



The McCormick Twine Binding Mechanism.

ing-shaft, the opposite end of which has a crank connected by a spring rod to a cam roller on the inside of the large cam-wheel on a shaft, No. 5; the object being first to compress the sheaf at the moment of its being tied, and then to depress the compressor after the string is cut, to allow of the sheaf being discharged. The crank to which the compressor is attached has also two light discharge arms which serve to depress the hinged tail-boards of the platform, which are fixed at an angle during the collection and formation of the sheaf, so as to prevent any scatter of straw, etc.

The large tyer-wheel, shown in the illustration (Fig. 2095) is keyed on to shaft No. 5, which goes half-way across the table and drives the knotting gear.

The operations to be performed comprise: —

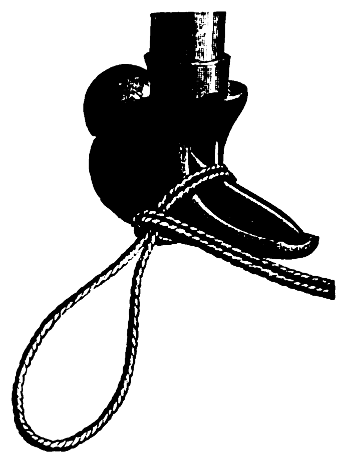
1. Holding the free end of the string.
2. The action of the needle arm and supply of string.
3. The making of the knot.
4. Cutting the string.
5. Discharging the sheaf.

1. On shaft No. 5, near its center, is a cam-wheel, which actuates a plunging bolt kept against it by a volute spring. In the event of an accident to this spring the same action is secured by a central plunger cam on the end of the shaft No. 5.

The plunger bolt works through eyes attached to the knotter frame, and supports a loose rocking frame carrying the twine-holding disk. This disk is about $2\frac{1}{2}''$ in diameter, and has six smooth-edged recesses, into any one of which the string is guided. One edge of this disk works closely between cheeks, between which and itself, by its revolution, it carries and jams the string, and so holds the free end. The rotary motion is communicated by the plunger bolt, lever and pawl, and ratchet, with a spring-catch on the opposite side to prevent it from turning backward, and so liberating the string.

2. The string, which is fed from a tin canister on the top of the machine through a tension-regulator and taker-up of slack, passes through guide eyes and tubes, to the side of the needle arm and along the needle for about one third of its length, without roller or springs.

Fig. 2096.

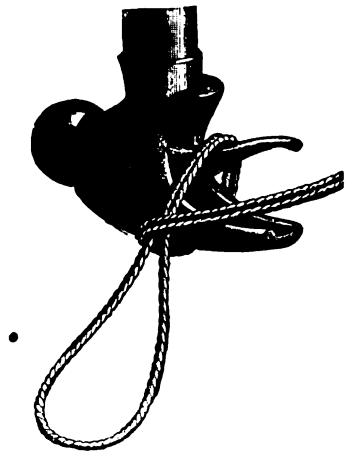


Forming of the Loop by Rotation of the Beaks.

3. The knotter is of the bird-beak type and of the Appleby patent. The lower half of the beak or jaw has simply a revolving motion. The upper beak can be opened by a cam surface and closed by a spring-cam actuating a small roller on the back end of the beak.

The motion for making a knot consists of one complete revolution in one direction only, and is obtained by a short-toothed segment on the cam-wheel on shaft No. 5. Both strands of the string pass over both beaks, as seen in Fig. 2096, and are prevented from getting out of place by a tucker, consisting of a lever actuated by a cam or cam-wheel, and which follows the string as soon as the needle has passed over the beaks; and, without actual contact, it effectually prevents the string getting out of place. At the proper moment for making the knot, the beaks revolve, forming the loop as shown in Fig. 2096. Then the upper beak opens, engages both strings, nips them tight (see Figs 2097 and 2098), and at this moment the knife-arm pushes

Fig. 2097.



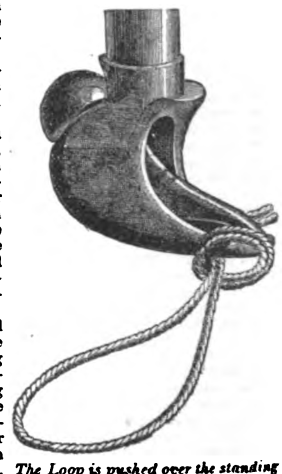
The upper Beak opens to grasp the standing part of the Strings.

the loop over the portion held by the beak, thus making the knot.

4. The knife is fixed to the lower side of the knife-arm, which is pivoted to the knotter frame, and actuated by an inner cam on the cam-wheel on shaft No. 5. It does not actually cut against anything, but it works within a quarter of an inch of a fixed guide which offers the necessary resistance.

5. The sheaf is discharged by the action of the light arms, which are seen in Fig. 2095. These arms are keyed on the knotter-shaft, about a foot apart, on either side of the cam-wheel and gear. Their action is simply to push off the sheaf, as the shaft revolves, the hinged platform and compressor arm dropping at the same moment.

Fig. 2098.



The Loop is pushed over the standing part, thus making the Knot.

A small *butter*, hinged from the top of the frame, with revolving apron, can be set at different angles, according to the length of the crop, these changes being made by the driver whilst the machine is in motion, by a lever-rod. The action of the *butter* is to square-up the butts of the sheaves, and has a very useful office in insuring a neat, compact sheaf. The apron is revolved by bevel gear from the end of the elevator-shaft.

The steam reaper shown at the exposition was by Aveling & Porter, Rochester, England.

It consists of a wide-swath reaper, on the "Bell" principle, driven by a traction engine at its rear. It was a striking revival of the machine invented and used by the Rev. Patrick Bell, at Forfar, Scotland, in 1828, but cut a swath of 12′ wide at the rate of 2¼ miles per hour, over double the work of the Scotch machine. This was no extraordinary advance in point of economy, as the Bell machines worked with two horses and laid the swath in the same manner. The Aveling & Porter machine had a nominal power of five or six times as great.

Like its prototype, the tongue of the machine extends to the rear, the power being behind, but, instead of a pair of horses hitched to the end of the tongue and facing their work, a 10 or 12-horse traction engine pushed the reaper into the grain, the cutting apparatus, grain-reel, and endless discharge-apron being worked by gearing driven by an endless chain from a sprocket-wheel or the fly-wheel shaft of the engine. The endless apron is inclined, and discharges the cut grain in a regular and continuous swath on the left of the machine, with the butts towards the engine and out of the way of the latter, which followed in the rear.

In front of the engine is a crane with tackle operatable from a drum, which may be thrown in connection with the engine when required. During the turning of corners while at work, and in transporting the apparatus to and from the field, the reaper is lifted and hangs suspended from the crane.

The machine is operated and guided by one man, the various levers being conveniently placed; so that the reaper may be raised or lowered, the locomotive moved forward, backed, or guided to left or right, and the gearing which controls the functions of the reaper proper put into or out of operation.

The machine did very good work, but it can hardly be said that it was regarded as of much practical value.

See also the following references: —

Steam, *Aveling & Porter*,	* "*Engineer*," xlii. 148.	
Br.	* "*Scientific American Sup.*," 566.	
	* "*Engineering*," xxii. 32.	
Reaping machine.		
Burgess & Co., Br. .	* "*Engineering*," xxiv. 45.	
Howard, Br. . . .	* "*Engineering*," xxii. 52.	
Tests, Leamington.		
Br., 1876	"*Engineer*," xlii. 151.	
Trials, table of tests .	"*Engineering*," xxii. 190.	
Wood	* "*Engineer*," xli. 22.	
Binding reaper.		
Howard, (details) Br.	* "*Engineer*," xlviii. 431.	
Howard, Br. . . .	* "*Engineering*," xxviii. 7.	
Mc Cormick (details) .	* "*Engineer*," xliv. 114.	
Samuelson, Br. . .	* "*Engineer*," l. 435.	
Wood	* "*Iron Age*," xix., June 21, p. 1.	
W. A. Wood	* "*Engineer*," xlv. 163.	
Wire cutting pliers.		
Miller	* "*Scientific American*," xli. 18.	
Harvester, *Crawford &*		
Co., Canada	* "*Scientific American*," xliii. 83.	
Binder, Johnston . . .	* "*Iron*," Aug. 17, 1878.	
Harvester, "Centennial."		
Cal., *Rice*	"*Min. & Sc. Press*," xxxvii. 55.	

Dr. Knight's report, on Class 76 at the Paris Exposition of 1878, gives views and description of the following. See "*Paris Exposition* (1878) *Reports*," vol. v., pp. 124–149.

Binding reaper, *Cyrus H. Mc Cormick* . .	United States.
Binding reaper, *Walter A. Wood*	United States.
Binding reaper, *D. M. Osborne & Co.* . .	United States.
Binding reaper, *Johnston* (string binder) .	United States.
Binding stick	France.
Automatic binding implement	France.
Sweep rake harvester, *Johnston*	United States.
Sweep rake harvester, *Warder, Mitchell & Co.*	United States.
Sweep rake harvester, *Hornsby*	England.
Sweep rake harvester, *Howard*	England.
Dropper, *Cumming*	France.
Single horse reaper, *W. A. Wood*	United States.

2. A file having two parallel flat sides and two inclined edges, all flat.

Rear′cut Mow′er. One the cutter bar of which is in the rear of the axle of the carriage. As distinct from *front cut* and *middle cut*. See upper figure in Plate XLVI., p. 1892, "*Mech. Dict.*"

Rear Sight. The hind sight of a gun, rifle, or cannon. There are various kinds: *open*, *peep*, *vernier*, *California*, etc. See list under SIGHT. See also HAUSSE.

The rear sight of Russian cannon. "*Ordnance Report*," 1877. Col. Benton's report and Appendix L, p. 578, and Fig. 1.

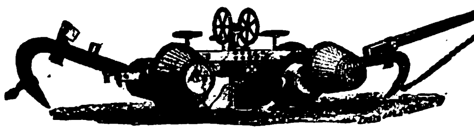
Re-cap′per. A tool used in reloading shells, to put the cap on its seat in the end of the shell. See RELOADING TOOLS.

Rec′la-ma′tion Plow. A plow for breaking new land, grubbing its furrow among roots and stones.

Fig. 2099 is the plow used in the stony tracts of Sutherlandshire, Scotland. It is used in connection with the ordinary steam plow engine.

The plow is preceded by steel disks, which lift the share over stones or other obstructions, so as not to break it or the moldboard. The plow will turn a furrow 2′ wide and

Fig. 2099.



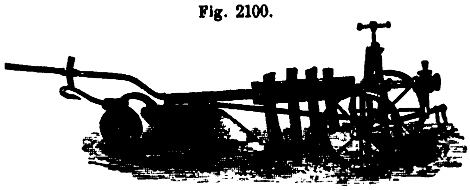
Fowler's Steam operated Land Reclamation Plow.

16″ deep completely over, an operation materially assisted by the rollers, which catch the furrow-slice at the moment of leaving the moldboard. The stones which have been passed over are torn out by the hook-tine which comes behind the plow. They are then removed by men with teams and stone-boats. The tine thoroughly subsoils the land to a depth of 2′, and materially assists the drainage of the soil.

The plow for horses or oxen is a strong one, of ordinary form, but with a stiff and sharp colter for cutting roots. Incidentally many of our heavy plows are calculated for such work as it may occur. Others, like our prairie-breakers, are for stubborn sod, wild-grass meadows, and low situations with patches of willow or hazel, brambles or rose bushes, as the case may be.

The *déboiseuse*, or French clearing plow, Fig. 2100, is designed for clearing ground which has grown up in thickets

Fig. 2100.



Clearing Plow. Delahaie-Tailleur & Bajac, Liancourt, France.

or copses. It is made with 2, 3, 4, 5, or 8 cutters in advance of the plow proper. Each cuts into the land below the preceding one, so that a *déboiseuse* of 5 cutters will divide the roots to an ordinary plow depth.

Re-coil′ Check. 1. An apparatus to absorb the recoil of a cannon, otherwise known as a hydraulic buffer, which see.

See 10″ gun-carriage, with hydraulic recoil check. Plate VI., attached to Appendix H, "*Ordnance Report*," 1876.

2. A spring cushion attached to the butt-end of a gun-stock to take the force of the recoil.—*Miller*, No. 169,465.

Re-coil′ Dy′na-mom′e-ter. An instrument to measure the recoil of small arms.

Lieut. Metcalfe's device is to measure the recoil by substituting for springs a material of uniform resistance, such as copper or lead, and measuring the recoil by means of a cut made in the material by a Rodman knife interposed between the metal and the butt of the gun. See "*Ordnance Report*," 1878, Appendix N, p. 109, and plate.

See CRUSHER GAGE; PIEZOMETER, and references *passim*.

Rec′tal Di-la′tor. (*Surgical.*) A flexible caoutchouc tube, introduced *per anum*, and then inflated, to distend a constricted bowel. — *Dr. Wales*.

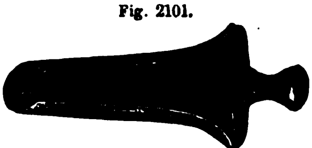
See also ANAL DILATOR, pp. 30, 31, *supra*.

Rec'tal In'stru-ments (*Surgical.*) The list includes: —

Anal dilator.	Hemorrhoidal clamp.
Anal fissure knife.	Insufflator.
Bistoury.	Irrigator.
Bougie.	Ligator.
Cautery irons.	Puncturer.
Cystotome.	Pile clamp.
Curette.	Pile needle.
Dilator.	Porte-caustic.
Divulsor.	Porte-meche.
Dressing forceps.	Probe.
Electrode.	Speculum.
Endoscope.	Sphincter and dilator.
Enema pump.	Sponge holder.
Exploring needle.	Suppository.
Feeding tube.	Syringe.
Fistula scissors.	Tenaculum.
Forceps.	Trocar.

Rec'tal Spec'u-lum. (*Surgical.*) A distending instrument for displaying the mucous surface of the rectum. See ANAL SPECULUM, p. 31, and references *passim*.

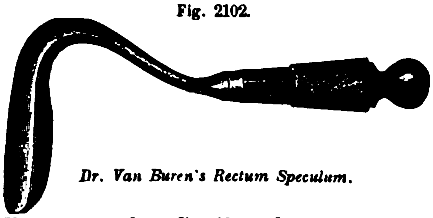
Fig. 2101.



Dr. Allingham's Rectal Speculum.

Figs. 2101, 2102, show two forms, both metallic.

Fig. 2102.

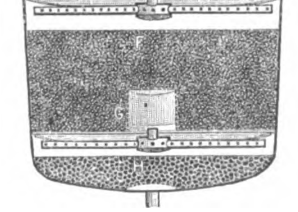


Dr. Van Buren's Rectum Speculum.

Rec-tan'gu-lar Staff. (*Surgical.*) A staff bent at a right angle, serving as a director for the bistoury in the operation of lithotomy.

Rec'ti-fi'er. *Add.* A filtering apparatus for deodorizing and purifying spirits. It usually consists of a leach tub through which the raw spirit percolates through animal charcoal.

Fig. 2103.



Rectifier.

Fig 2103 shows a forcing apparatus in which the liquor under a pressure of 50 pounds per square inch is introduced by pipe *A*. *B* is the cover of the rectifier, *C*, the radial arm distributer; *D*, the upper chamber packed with charcoal free of dust; *E*, the perforated bonnet chamber outlet to distributer underneath; *F*, the second chamber packed with finer coal than the first; *G*, the perforated bonnet chamber outlet to the bottom chamber; *H*, the bottom space and blanketed strainer discharge to delivery pipe, whence the rectified liquor is conveyed to the receivers.

Rec'ti-lin'e-ar E-cra'seur. (*Surgical.*) An écraseur which, instead of a wire loop or chain loop, has a clamp the jaws of which have a fin and groove respectively.

Rec'to-co-lo'nic Ap'pa-ra'tus. (*Surgical.*) Instruments which reach the rectum and colon, such as some forms of endoscopes and enema syringes.

Re-cu'pe-ra'tor. A name applied, sometimes, in England to the *regenerator* of the Ponsard or Siemens furnace.

See REGENERATOR, and references *passim*. See "*Engineer*," xlvi. 231.

Red Lit'mus Pa'per. (*Gas.*) Used as a test to show the presence of ammonia in illuminating gas.

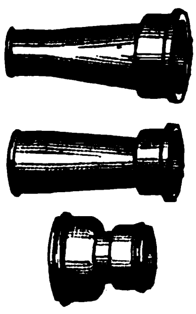
Take 6 parts by weight of water and one of powdered litmus, shake, allow to stand several days. Then add, drop by drop, a small quantity of dilute sulphuric acid until the pink or neutral tint is obtained. Pieces of white filtering paper are then soaked in the solution, dried, cut in pieces of convenient size, and kept in a stoppered bottle.

Re-dres'sor. (*Surgical.*) A replacing instrument, *e. g.*, the uterine redressor.

Re-du'cer. A joint-piece for connecting pipes of varying diameter.

The term is also applied to other pipe connections where one of the members has a smaller diameter. See BRANCH, CROSS, TEE; also list under PIPE COUPLING.

Fig. 2104.



Reducers.

a, *b*. Reducing pipes.
c. Reducing hub.

Re-du'cing Coup'ling. A pipe coupling with ends of varying diameters, to unite pipes of different sizes.

Re-du'cing Press. In sheet-metal working, an auxiliary press for the further deepening and drawing of articles partially struck up.

Re-du'cing Squares. A mode of making reductions of drawings or designs. The original has lines drawn over it, dividing it off into squares, as numerous as the nature of the picture may require.

A piece of paper of the size desired is then divided into a similar number of squares, and the objects contained in the former squares delineated in the smaller ones.

A frame with crossing threads or wires may be laid over the original. The same frame may be erected in front of a person at a desk so as to divide a landscape in the same manner.

Re-du'cing Tee. A T-shaped pipe coupling, the arms of different diameter from the stem, to unite pipes, joining at right angles and having different diameters.

Re-du'cing Valve. A device in the West-

Fig. 2105.

Reflecting Drawing Board.

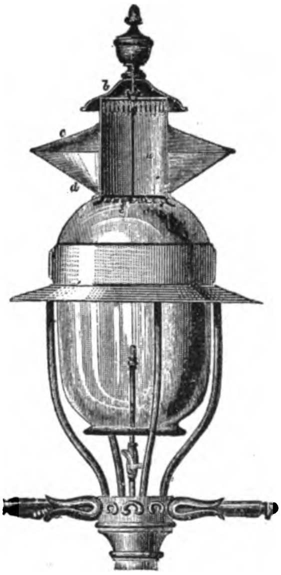
inghouse automatic railway brake to regulate the pressure on the brakes, so as to insure the proper degree of retardation without skidding the wheels, at varying speeds.

Fig. 1, p. 86, "*Engineering*," xxvii.

Re-flect'ing Draw'ing Board. An arrangement to assist in copying drawings. See Fig. 2105.

The drawing to be copied is placed on the board to the left of the glass and the blank paper on the right. The artist stands so as to view the surface of the glass obliquely, and the original drawing is reflected from the surface of the glass to his eye, and at the same time he sees the surface of the white paper through the transparent glass, so that the lines of the drawing appear as upon the white paper, but reversed in position. These apparent lines are to be followed with a pencil on the blank paper.

Fig. 2106.



Reflecting Lamp.

a. Chimney.
b. Chimney cap.
c. Cover to upper reflector.
d. Upper reflector.
g. Metallic clasps on chimney bent against inside of the glass.

Re-flect'ing Lamp. A lamp with upper reflector to throw down the upward beams.

Fig. 2106 shows a form for street use. It exhibits front half of top chimney and upper reflector cut away.

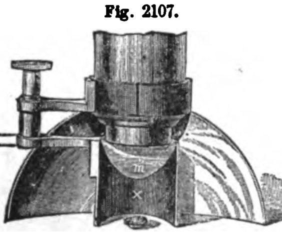
Re-flect'ing Sight. (*Fire-arm.*) The sight has a reflecting surface placed at such an angle as to reflect to the eye light from one direction only.

Stillman's patent . . . . No. 38,965.

Reflec'tor. (*Optics.*) Sorby's addition to Beck's parabolic illuminator, consisting of a plain silvered mirror covering one half of the aperture of the object-glass.

The rays falling upon it are thrown down upon the object, and reflected direct up the tube of the microscope, thereby

Fig. 2107.



Reflector.

producing a mode of illumination exactly the reverse of that of the parabolic illuminator, where the rays impinge at an oblique angle, and so only those diverted by the object enter the field of view.

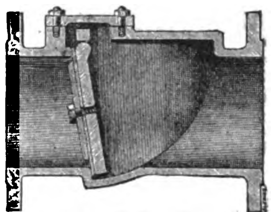
See also ILLUMINATOR, p. 1171, "*Mech. Dict.*," where the *opaque*, *white cloud*, *oblique*, and *black ground* illuminators are described. See also CONDENSER, SIDE REFLECTOR, PARABOLIC ILLUMINATOR, PARABOLIC REFLECTOR, LIEBERKUHN, SPOT LENS, CATOPTRIC LIGHT, MIRROR, etc., *Ibid.*

Reflector candle, *Meigs* * "*Scientific American*," xl. 261.
Gas light, *Bailey* . . . * "*Iron Age*," xxi., May 9, p. 5.
Reflecting Illuminator.
Balestrieri . . . . * "*Scientific Amer.*," xxxiv. 367.
Shive . . . . . . * "*Scientific Amer.*," xxxiv. 406.
Reflector, Parabolic . . "*Scientific Amer.*," xxxvi. 180.

Re'flux Cath'e-ter. (*Surgical.*) A double-current catheter which allows the liquid to pass by one duct and return by another. Fig. *c*, 1190, p. 504, "*Mech. Dict.*" See also DOUBLE-CURRENT CATHETER, p. 266, *supra*, and references *passim*.

Re'flux Valve. An automatic valve to prevent reflux. A back-pressure valve.

Fig. 2108.



Stone's Reflux Valve.

Fig. 2108 shows Stone's cast-iron reflux or back-pressure valve, with clear straightway, to keep the water in mains when the pressure is taken off.

Re-frig'e-ra'tor. The storage, domestic, and railway car refrigerators are referred to on pp. 1910, 1911, and Figs. 4238–4243, "*Mech. Dict.*"

The subject of cooling is also included under ICE MACHINE, pp. 1164–1169, and Plate XXVI., *Ibid.*; ICE-CREAM FREEZER, * p. 1162; LIQUID COOLER, * p. 1326; BEER COOLER, * p. 264; CONDENSER, * p. 607, *Ibid.*

In the refrigerator car used for transportation of California fruit eastward, the car is attached to one of the regular passenger trains, and is provided with a fan-blower, driven by one of the axles, by means of which the air is forced through the ice-chamber and thus reduced to a low temperature. This chilled air is distributed among the fruit-boxes through a large perforated pipe laid along the bottom of the car. After it has circulated among the fruit, it returns to the blower, and is again forced through the apparatus. By this means the atmosphere of the car is kept at the uniform temperature of 40° Fah.

Refrigerator basket.
Hare . . . . . . * "*Scientific Amer.*," xxxix. 290.
Cars . . . . * "*Scientific Am. Sup.*," 1411, 1119.
Tiffany . . . . . "*Iron Age*," xix., April 26, p. 23.
* "*Railroad Gazette*," xxi. 311.
Winants . . . . . * "*Scientific American Sup.*," 276.
Cellars and storerooms.
Pictet . . . . . . * "*Manufact. & Builder*," x. 182.
Chambers for ocean transport . . . . "*Scientific American Sup.*," 237.
French . . . . . * *Laboulaye's* "*Dict.*," iii. "*Refrigerant.*"
Apparatus for glaciaria.
Gamjee, Br. . . . * "*Engineer*," xli. 378.
For ships, etc., *Pictet* . * "*Manufact. & Builder*," x. 121.

Re-gen'er-a'tor. A chamber in which the outgoing waste gases heat the incoming air.

They are of two kinds: —

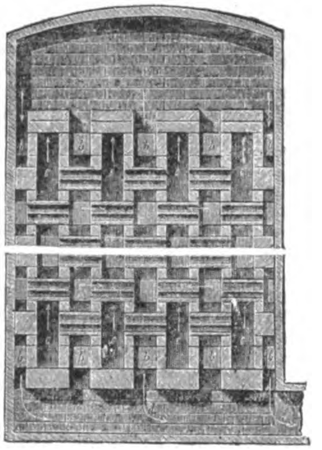
1. Those in which, as in the Ponsard furnace, the waste gases descend through one set of channels inclosing another set through which the incoming air passes, the walls heated by the waste imparting heat to the air. This is on the principle of many feed-water heaters for boilers; and many other instances might be cited.

Fig. 2109 shows the Ponsard regenerator, which is a chamber with a built-in arrangement of hollow refractory bricks. The waste gases from the laboratory or combustion chamber of the furnace come in above, descend through the conduits *b b*, and escape below to the chimney, either directly or after having passed through the flues of a steam boiler, to be therein farther utilized.

The cold air enters below at openings provided with registers, and passes upward through the conduits *c c*, intermediate between the driving flues *b b* of the waste gases, and thence passes to the combustion chamber. The passages *b b* mutually interchange by means of hollow bricks, and so do the passages *c c*. See also GAS-GENERATING FURNACE, Figs. 1161, 1162, p. 387, *supra*.

In Frank's regenerative gas furnace, Fig. 2110,

Fig. 2109.

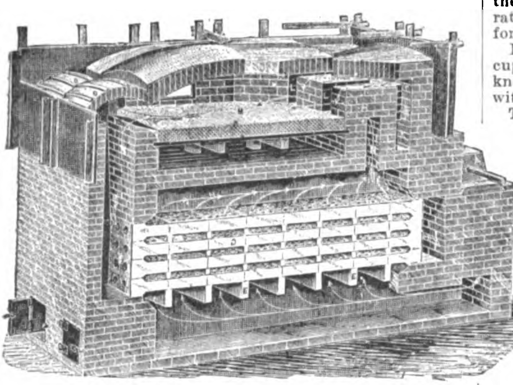


Ponsard Regenerator.

the gas is made in a producer built against the furnace at the right.

The air from the producer enters from the right and is diverted right or left to one or the other regenerator, there being two of them. Passing beneath the regenerator the gas courses upwardly among the stack of hollow blocks *G* and thence to its point of junction with the air which is diverted

Fig. 2110.



Frank's Regenerator Furnace for Glass.

by valve *A* to pass through the other regenerator. The gas and air respectively pass through vertical openings in the blocks *G*, while the hot current from the furnace *M* courses through the horizontal openings in the said blocks and thence to the stack.

2. The other form of regenerator is that invented by M. M. Siemens, and has two pairs of chambers used in pairs alternately.

The chambers have bricks piled up in them, and stacked loosely together so as to expose a great surface. The draft of waste gases passes through one pair of chambers which are for the time being in the line of communication between the furnace chamber and chimney; and the bricks are heated. The other pair previously heated is placed in the duct by which gas and air pass to the furnace chamber, extracting in their passage heat from the bricks. By turning a valve the relation of the respective regenerators is changed. See Figs. 1159, 1160, p. 386, *supra*.

Furnace, *Siemens*	* "*Engineering*," xxvi. 41.
	* "*Iron Age*," xx., Dec. 20, p. 3; xxii., Nov. 14, p. 3.
	* "*Manufact. & Builder*," xii. 270.
	* "*Am Man.*," Sept. 12, 1879, p. 12; May 7, 1880, p. 7.
Troy, N. Y.	* "*Engineering*," xxx. 615.
Springfield, Ill., *Pernot*	* "*Engineering*," xxix. 374.
	"*Engineer*," xli. 20, p. 30.
	* "*Am. Man. & Iron World*," xxiv., April 25, p. 8; May 2, p. 8.
Siemens	* "*Am. Man. & Iron World*," xxv., May 7, p. 7.
Ponsard	* "*Scientific American Sup.*," 2355.
Stoves, on, *Hartman*	* "*Engineer*," xlix. 359.
Crown Point, N. Y.	* "*Engineering*," xxv. 216.
Cowper, Br.	* "*Engineering*," xxviii. 212.
List and descriptions	"*Scientific American Sup.*," 3738.

Re-gen'er-a'tor Fur'nace. A furnace in which the outgoing waste heat is made to heat the incoming air of combustion.

Practically, in metallurgy, also in glass and gas works furnaces, the principle has been so much extended that the definition is incomplete as to the best examples of this class. Such are the *Siemens*, *Bicheroux*, and *Ponsard*, for instance, though there are others comprised in the same class.

In the improved form the regenerators are 4 in number, working in pairs. Through one pair the waste heat passes, heating the bricks which are built up in a cellular structure within side of the chamber and thereby absorbing a large portion of the escaping heat. When this is accomplished, a damper is turned, when the waste heat is turned through the other pair of regenerators in order to heat them, and the chambers of the former pair are devoted, one of them to heat the gases coming from the producer, and the other to heating the incoming air which is to be mixed with the said gases on entering the puddling or pot chamber, as the case may be.

Fig. 1999, p. 701, shows the gas producer with its fuel. The grate differs from the Siemens furnace in having a lower horizontal portion on which the depth of the bed of fuel varies according to its composition. The upper part is at the ground level and has one or more feeding shafts with covers. Holes are provided for inspection and stoking. A damper of refractory clay is capable of being slipped in or out to govern the size of the flue conducting the heated gases to the laboratory, as the chamber where the work is performed is called for distinction.

In some cases the fire is fed with heated air from the recuperator, in which case grates are not used. Such are known as superheated gazogens. They are sometimes blown with steam jets or injectors.

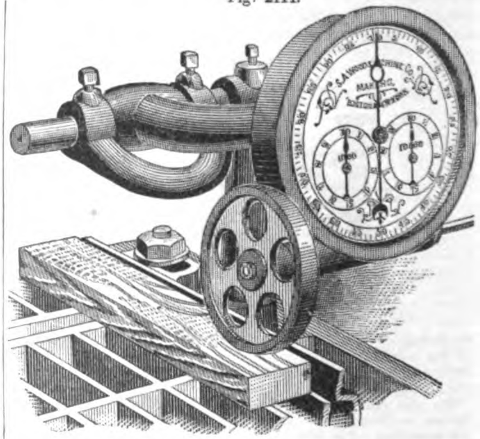
The subject of the methods of using, the purposes of the furnace, and the chemical reaction are considered under GAS-GENERATING FURNACE, pp. 384–388, *supra*. See also REGENERATOR.

Reg'is-ter. A device for recording.

See list, examples, and references on pp. 1912, 1913, "*Mech. Dict.*"

The register shown in Fig. 2111 is for showing the sum of the lengths of boards or other stuff run through a planing machine. The circumference of the wheel is a known quantity and each revolution is registered on the counter, the dials of which represent units, hundreds, and thousands of feet.

Fig. 2111.



Planing Machine Board-register.

Reg′is-ter-ing Scale. A weighing scale made by *Chameroy* of Paris, which, by pressure upon a stud, impresses upon a slip of card the weight of the object on the scale. See SCALE.

Reg′is-ter-ing Ther-mom′e-ter. One which has a means for indicating the highest or lowest point reached between observations.

Registering thermometers are considered on pp. 2548, 2549, "*Mech. Dict.*"

A new registering thermometer by M. Hervé Mangon has a long and fine capillary tube bent on itself, supported by an iron frame, and containing mercury; it passes through the stopper of a bell jar and terminates with a fine point in a mercury dish placed in one scale of a balance; the other scale contains a vessel of glycerine communicating by glass and india-rubber tubing with another glycerine vessel on the same level in an adjoining frame. When, on rise of temperature, mercury is forced out into the vessel, the balance is depressed on one side and an electric contact made, affecting an electro-magnet in the registering apparatus, which is composed of M. Redier's double wheel work with differential train. When the depression referred to has occurred, a suspended float in the second glycerine vessel descends, and raises the glycerine in the first, increasing the weight in that scale. The curve obtained (from a pencil on moving paper) is of zigzag form, the wheel-work being in constant motion, now to the right, now to the left.

See also * "*Scientific American Supplement*," 125, 935.

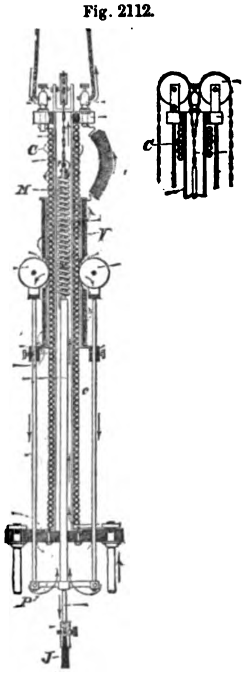
Reg′u-la-ting Valve. One for graduating the effective opening in a pipe to determine the amount of fluid passing.

Reg′u-la′tor. (*Electricity.*) 1. The shield for covering or uncovering the core, thus exposing it more or less to the magnetism of the coil, and in this way regulating the current.

Regulator for induction coil.
Floyd . . . . . . * "*Scientific American Sup.*," 2425.

2. The apparatus for maintaining the relative distance between the carbons in the voltaic arc light. See ELECTRIC LIGHT.

Fig. 2112.



Thomas' Electric-arc Lamp Regulator.

Thomas's regulator for electric arc lamps in series is shown in Fig. 2112.

The figure shows a section in the plane of the lamp's geometric axis; the negative electrode being omitted. Also in a smaller figure the solenoid to a larger scale.

Illuminative equilibrium throughout the series is secured by the respective attraction toward and repulsion from a prime helix *C* on the line of its axis, of two helical current-carriers *M r*, both integrally attached to holder *P* of positive electrode *J*. Of these current-carriers one, *M*, is a solenoid through which current reaches the electrode from the prime helix. The convolutions of this solenoid are such as to cause its upward attraction by the prime, proportional to the strength of the main current. The other carrier, *r*, possesses such resistance as to be comparatively inert during normal or less than normal separation of electrode-points, while extreme electrode separation, on the other hand, operates to shunt portions of current around the electrodes through said carrier. Said carrier, being so wound as when thus energized to be repelled downward by the prime, operates to antagonize and even reverse such excessive lifting action of carrier *M* as would tend to greatly weaken the series-current and to extinguish the weaker lamps.

Strong and broken arrows indicate respectively the course of the main and shunted currents.

Re′in-force′. (*Cartridge.*) A lining or plate to strengthen the head of a cartridge, sometimes also acting as an anvil or a gas check. See CUP ANVIL; DISK ANVIL; GAS CHECK.

Re-lief′ Print′ing. A process applied by Thuillier, of Rouen, and Petit-Didier, of St. Denis, to silken tissues, which are scattered over with brilliant points in relief, and of different colors so as to imitate embroidery.

It is executed with a resinous matter, either colored or left colorless, which is deposited upon the tissue in melted drops by means of a plate engraved in relief. On cooling, these drops acquire hardness enough to form, so to speak, a part of the tissue and to resist friction.

Depouilly and Meyer have devised something analogous for fixing upon very light tissues, like tulles, brilliant drops in relief, which by their limpidity recall pearls or precious stones. They are obtained by means of gelatine or gums deposited while liquid by means of pins arranged symmetrically. This style has been named "diamond tulle." — "*Teinturier Pratique.*"

See also instances referred to under PHOTO-PRINTING PROCESS, pp. 676, 677, *supra.*

Re-lief′ Pro′cess. See photo-relief process, "*Mech. Dict.;*" RELIEF LINE ENGRAVING, p. 1915, *Ibid.*

In Joyce's mode of producing relief-plates for printing, a smooth steel plate is covered evenly with a thin coat of plaster of Paris and potter's clay; the design is then drawn through this (as through wax in etching) down to the plate. A stereotype-metal cast is taken from this reverse-plate, giving lines in relief.

Relief blocks from photos. "*Scientific Amer.*," xxxiv. 196.
Relief stamping press, paper monograms, etc.
Richmond, Br. . . . * "*Engineer*," l. 812.

Re-lief′ Valve. An automatically acting valve which yields to a given pressure to avoid bursting of the object to which it appertains.

1. For barrels containing beer or other effervescent or fermenting contents.

2. For pipes of beer-engines.

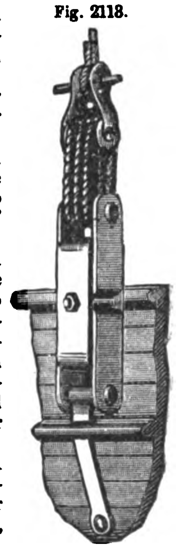
3. For regulating the pressure in fire engine hose. *Bailey; Blake.*

4. For discharging condensed steam from cylinders during intervals of rest. — *Bagshaw*, Br., * "*Engineer*," xlvi. 427.

5. For turning the feed water into the hot well when the boiler is sufficiently full.

6. To provide escape for feed water when shut off from the boiler, the pump continuing to work. — * "*Scientific American*," xxxvi. 351.

Fig. 2113.



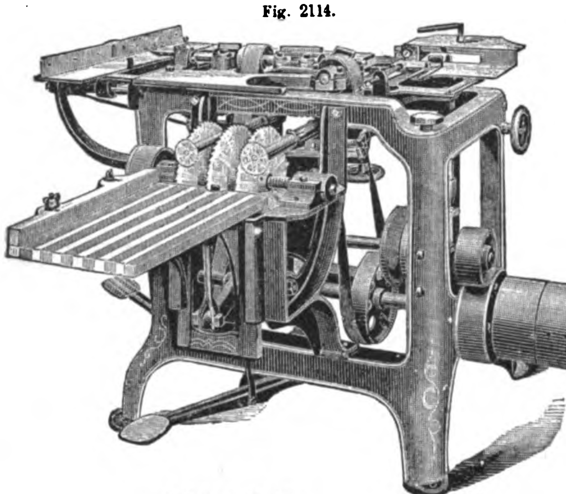
Reliever.

Re-liev′er. (*Nautical.*) A device for attaching the wire shrouds or stays of yachts to the hull. It is an elastic connector involving the compression of a caoutchouc block and giving a certain amount of resiliency to the tension, to avoid breakage of the stay, rope, or what not.

Rel′ish-ing Ma-chine′. A machine for shaking the shoulders of the tenons which bear against the rail of the door, sash or blind.

The machine shown is for sash, window, and blind relishing and for mortising. Such stuff is relished at one operation and handling. Blinds are relished and recess made for end of rod at one operation. The meeting and bottom rail are mortised at one operation by a

Fig. 2114.



Relishing Machine.

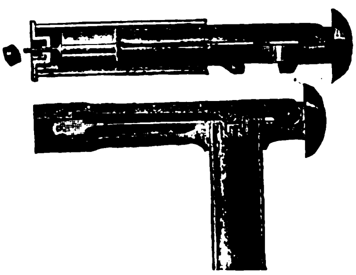
hollow chisel. The door relishing is done at one operation by the five saws shown to the left. All the parts described may be run simultaneously.

Greenlee . . . . * "*Engineer*," xli. 430.

Re-load'ing Tools. For reloading spent capsules of breech-loading fire-arms. A complete set for rifle cartridges consists of primer extractor, charger, loader, and reprimer, which see.

Fig. 2115 shows a single tool with the functions of decapper, recapper, and rammer comprised within a weight of

Fig. 2115.

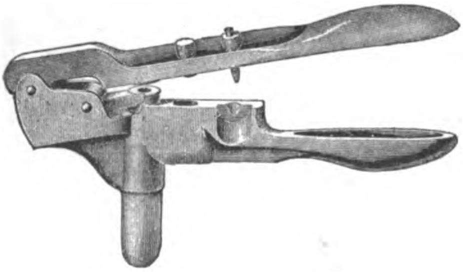


Reloading Tools for Breech-loading Shot-guns.

5 oz. On the side is also a device for extracting expanded shells. — *Providence Tool Co.*

Fig. 2116 is a tool which removes the exploded primer, in-

Fig. 2116.



Reloading Tool for Breech-loading Rifles.

serts the new primer and fastens the ball in its shell, at the same time swaging the cartridge to form.

Rep. (*Fabric.*) 1. A French worsted goods, usually for furniture, made of long combed wool on loom with taffetas armure.

2. A double threaded taffeta with a cotton warp and medium wool weft.

Re-peat'ing Ri'fle. One which fires charges consecutively from a magazine.

The German repeating rifle, made at the School of Musketry at Spandau, is a Mauser rifle with magazine attachment. The magazine is made from steel plate, and contains 11 cartridges. It can be readily put off and on the rifle, and is worked on it solely by opening and shutting the chamber in such a way that at every opening movement a cartridge falls through the groove into the rifle, and by every shutting movement the next cartridge is made ready for use. This apparatus can be attached to all breech-loaders with a cylinder breech. By it 12 rounds are fired in 24 seconds; the magazine can be refilled in 15 seconds. When the magazine is removed the piece forms an ordinary one-barrelled gun.

See also MAGAZINE GUN, pp. 570 *et seq.*, *supra*, and "*Mech. Dict.*"

Rifle, *Winchester*, 1878 * "*Min. & Sc., Press*," xxxvi. 241.

Spandau, Ger. . . * "*Amer. Manufact.*," 1880.

Re-pel'lent. (*Fabric.*) A waterproof cloth.

Re-pla'cing Ap'pa-ra'tus. (*Railway.*) For the replacing of derailed rolling stock upon the line.

N. Ry. of France . . . . * "*Engineering*," xxvii. 459.

Re-plen'ish-er. (*Electricity.*) *a.* A dynamo-electric device of Sir Wm. Thomson, which, in a few revolutions of the armature, induces a static charge of considerable magnitude from primary charges which are practically infinitesimal.

"*Engineering*" . . . . xxiii. 319.

b. That part of an electrometer (Thomson electrometer) whereby the normal charge of the indicator-needle is maintained by occasional connection with a condensor. — *Gordon*, i, p. 42.

Re-pos'i-tor. (*Surgical.*) A replacer. The uterine repositor or elevator, for instance.

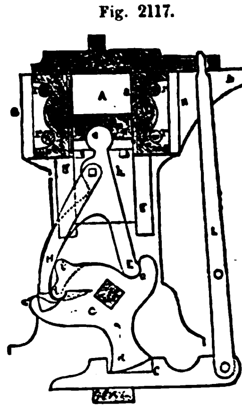
Repoussé. (*Fine Art Metal-working.*) A mode of forming and ornamenting silver-ware by blows delivered internally.

It is done by means of a snarling-tool (Fig. 5248, "*Mech. Dict.*"), which is planted in a vise, while its outer end rests against the interior of the object. A blow on the shank of the snarling iron is transferred to the object and causes an interior dent and an outward bulge.

The Bryant vase is a remarkable success of Tiffany & Co. in this line of ornamentation.

Re-press'ing Press. A machine compacting partially dried bricks by a second pressure, giving them hardness, smoothness, and symmetry.

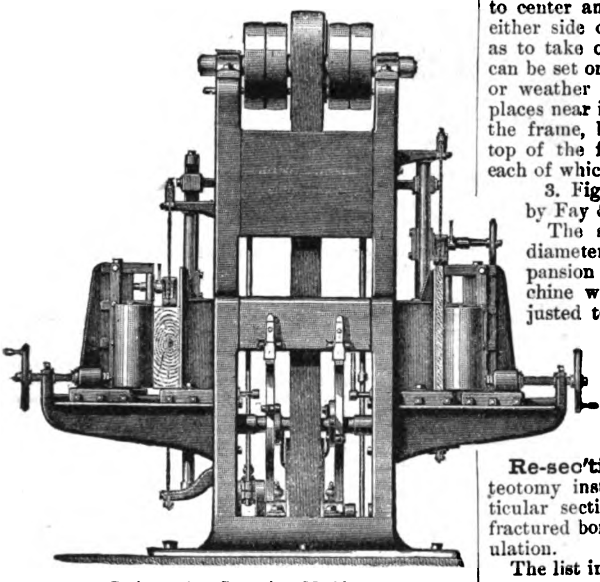
Fig. 2117.



"*Champion*" *Repressing Press.*

In Anderson's press, Fig. 2117, the mold is lined with sheet steel, and may be replaced when worn out. In the sectional view *A* is the mold in which the brick is pressed; *D*, the cap which slides sidewards to the right over the surface *b*, being driven in that direction by the lever *L*, when at the same time the bottom plunger *P* is raised by means of a toggle-joint which elevates the arm *H* by the turning of the cam *C* round its axis, while the projection *d*, fitting in a notch, moves the sliding piece *f* to the left, which acts on the lever *L* and cap *D* mentioned before. By this combined motion the mold *A* is simultaneously uncovered, and the plunger *P* moved to the top of the machine flush with the upper surface of the sides of the mold. When the brick is placed on the surface of the plunger *P*, by a reverse motion it descends with the brick, the cap *D* slides over the mold and is kept in place by proper grippers, secured with nuts shown in the large cut; and by continuing the motion of the cam *C* in the same direction, the arm *E* of another toggle-joint is put in operation, which lifts the plunger sufficiently to press the brick upwards against the cap *D*. The shaft *t* is moved with a long lever at its outer end, for producing the motions described. By throwing this lever backward, the plunger *P* descends, the cap *D* glides to the right, and by further motion of the same, the arm *H* lifts the plunger to the top of the mold, pushing the brick out, when it can be removed and another substituted.

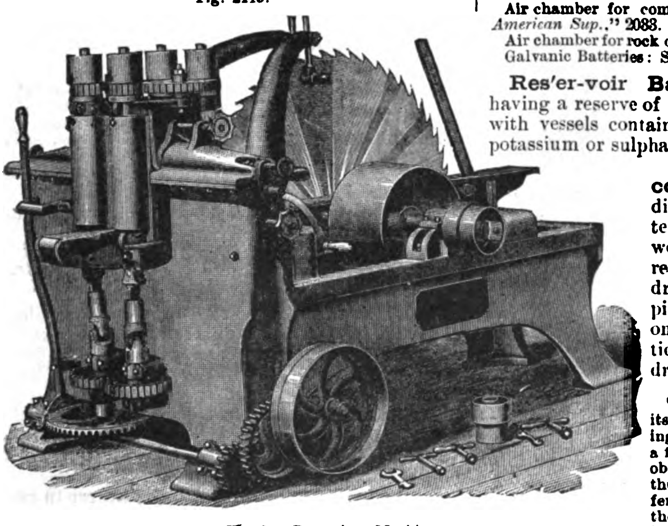
Fig. 2118.



Reciprocating Resawing Machine.

Re-pri'mer. An implement for setting a cap upon a cartridge shell. One of the set of RELOADING TOOLS, which see.

Fig. 2119.



Circular Resawing Machine.

Re-saw'ing Ma-chine'. A machine for sawing timbers and balks of lumber into dimension stuff.

They are of three kinds: *reciprocating, circular, band.*

1. Fig. 2118 is a double resawing machine of the reciprocating order, made by Richards, Loudon, & Kelly, for working on dry lumber up to 8″ thick and 30″ wide. The speed is 400 revolutions per minute. It stands on a stone foundation without top-bracing.

2. Fig. 2119 is a machine of the circular order, made by H. B. Smith. They are made for 24″, 48″, and 60″ diameter saws. They can be made to center any lumber from ¼″ to 8″ thickness; or either side of the feed can be made unyielding so as to take off any thickness required. The rolls can be set on a bevel so as to take off feather edge or weather boards. The saw is guided in three places near its circumference; as it rises through the frame, by arms near the top, and below the top of the frame. The feed is by four rolls, to each of which power is applied.

3. Fig. 2120 is a band-saw resawing machine, by Fay & Co.

The saw-kerf is 1-16″. The wheels 5′ in diameter. The feed rolls are connected by expansion gears operated by friction. The machine will split stuff centrally or can be adjusted to saw off boards or panel stuff of any thickness.

Fay & Co. * "*Manuf. and Builder,*" viii. 174.
Band-saw, *Richards & Co.*
* "*Min. & Sc. Press,*" xxxiv. 198.
Circular, *Joslin.*
* "*Manufact. & Builder,*" xii. 77.

Re-sec'tion In'stru-ments. (*Surgical.*) Osteotomy instruments, for the removal of the articular section of a bone or of the portions of a fractured bone of difficult apposition or false articulation.

The list includes bone-drills, periosteotome, subcutaneous, chain, or Hey's saws, bistouries, etc.

Res'er-voir. A chamber of supply as in —

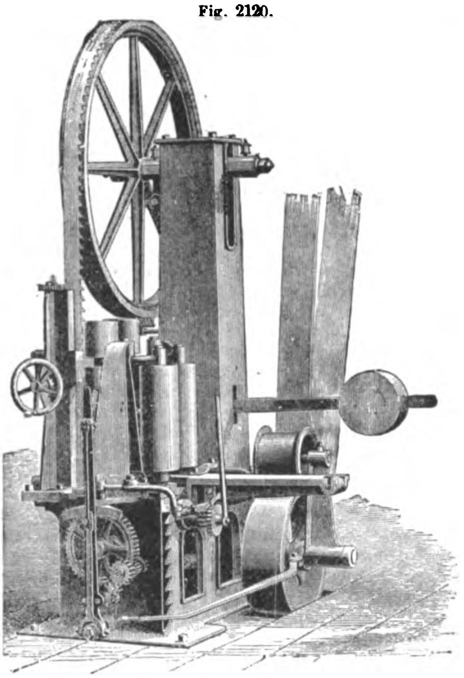
Reservoir stove; with a large boiler attached.
Reservoir blow-pipe, with air chamber. *Ross*, * "*Scientific American Sup.,*" 4041.
Air-chamber for pumps; Fig. 24, p. 13, *supra.*
Air chamber for compressed air. *Siemens*, * "*Scientific American Sup.,*" 2088.
Air chamber for rock drills. Plate X., p. 602, "*Mech. Dict.*"
Galvanic Batteries: See RESERVOIR BATTERY.

Res'er-voir Bat'te-ry. (*Electricity.*) One having a reserve of material, as in the case of those with vessels containing crystals of bichromate of potassium or sulphate of copper.

Res'er-voir Lev'el Re-cord'er. An instrument to indicate the fluctuations of the water in the reservoirs of water works. The drum performs a revolution once a week, being driven by a small turret time-piece, and the clock beats seconds. A friction clip in connection with the set dial enables the drum to be set to the true time.

The diameter of the drum is 12″, and its length is 3′, a fluctuation of 6′ being recorded, thus giving a scale of 6″ to a foot. This reduction of scale is thus obtained: The float pulley upon which the chain is fixed is double the circumference of the pulley which actuates the pencil, which is guided by the two horizontal brass bars over the top of the

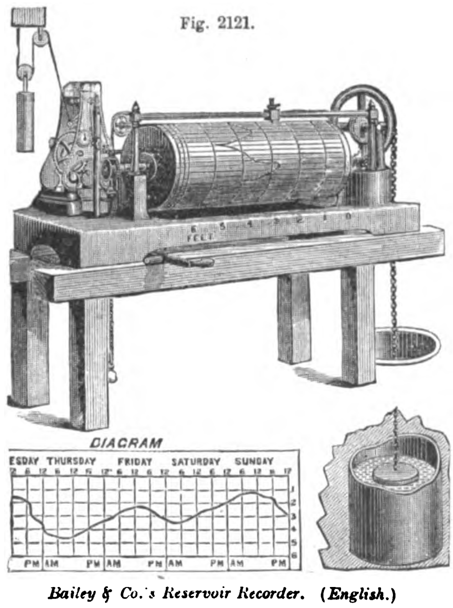
Fig. 2120.



Band Resawing Machine.

drum, in order to prevent any possible error from backlash of the mechanism, or by wear and tear in the ordinary course of use. The float is balanced by a small weight attached to a chain which is fastened to the pencil block; this enables a

Fig. 2121.



Bailey & Co.'s Reservoir Recorder. (*English.*)

very sensitive diagram to be taken. The illustration at the bottom of the engraving shows a portion of a diagram. See:

"*Engineer*" . . . . xlv. 3).
* "*Scientific American*" . . . . xxxviii. 130.

An electrical reservoir level recorder, used at Nottingham, England, is shown in —

"*Telegraphic Journal*" . . . . * vii. 193.

Re-sid'u-al Mag'net-ism. (*Electricity.*) Magnetism which remains in the core of an electro-magnet after cessation of current. *Remanent Magnetism.* — *Ganot.*

Re-sist'ance. (*Electricity.*) The opposition presented by the metal composing the circuit, to the passage of the current.

Balance, *Fleming*, Br. . . * "*Engineering*," xxix. 15.
Coil, *Wheatstone* . . . . * "*Telegraphic Journal*," iv. 12.
Measurer, Differential.
Wheatstone . . . . . * "*Telegraphic Journal*," iv. 90.
Liquids, inst. for measuring,
Wheatstone . . . . . * "*Telegraphic Journal*," iv. 70.

Re-sist'ance He'lix. A member in a voltaic arc light apparatus, the duty of which is to preserve a constant regulated distance with the carbons.

The constant tendency is to an unequal action, inasmuch as the carbons burn away the positive much faster than the negative.

Such unequal action is remedied by the provision of a high resistance helix shunting the arc: through which current is diverted in proportion to the relative resistances of said high resistance helix and of the arc; the energy of said high resistance helix always acting in opposition to that of said suction core. The resistance of said high resistance helix is so fixed that when the arc is of normal length the forces centered on the electrode movement are in equilibrium.

The two conditions of abnormal arc-length adjust themselves as follows: —

(*a.*) When the arc-resistance is below normal so little current is diverted through the high resistance helix that its energy is inappreciable and the suction core action is unopposed in its duty of lengthening the arc.

(*b.*) When the arc-resistance is above normal, the energy of the high resistance helix is increased sufficiently to overcome that of the suction-core and to reduce the arc to its normal condition. When this adjustment has taken place, the lamp in question resumes its normal resistance. Each lamp adjusting itself in the manner described ensures normal current-flow and equal illuminative action throughout the series.

Re-sist'ance Tube. Clerac's (of the French telegraph administration) tube is a wooden tube containing powdered carbon, with means for giving variability of resistance by compression, constituting a variable resistance rheostat.

* "*Telegraphic Journal*" . . . . vii. 52, 92, 121.

To Count du Moncel we owe the discovery, in 1856, of the variability of the resistance of powdered carbon; which seems to have its first practical application by Clerac.

The telephone transmitter of Edison depends on the same property.

Res'o-na-tor. 1. An invention of Helmholtz for facilitating the analysis of compound sounds.

See Fig. 4270, 4271, p. 1922, "*Mech. Dict.*"
See also . . . . . "*Manufact. & Builder*," ix. 132.
"*Scientific American*," xliii. 80.
* "*Scientific American*," xxxvi. 263.
Brass wind instru., as . "*Scientific American Sup.*," 2112.

(*Add.*) 2. (*Surgical.*) The resonator which intensifies sounds of a given pitch while diminishing the distraction of others, has been applied to auscultation instruments.

Holden's resonator, Fig. 31, Supplement, *Tiemann's* "*Armamentarium.*"

3. A regulating apparatus in piano sounding-boards, which, by means of screws and iron frame, prevents the sounding-board (as a whole) from making transverse vibrations. — *Steinway*, *Paul's* "*Vienna Exposition Report*," i., Sec. B, p. 388.

Res'pi-ra'tor. A protector covering the mouth; a box furnished with fine gold-plated wire gauze to intercept dust, either in traveling or working in manufactories.

Watson's respirator, to enable the wearer to penetrate carbonic oxide, and other gases, left in collieries after explosions of fire-damp, contains a

Fig. 2122.

Respirator.

solution of caustic potash in a tube, as devised by Mitscherlich and modified by De Koninck. Air containing a dangerous proportion of carbonic oxide is fit for respiration after passing through the potash solution. A valve arrangement ensures inspiration of the cleansed air through the mouth, and expiration through the nose.

The Denayrouse respirator, to enable firemen to enter and remain in places filled with smoke or gas, consists of a tube, having inserted near one end a small tin case containing two peculiar India-rubber valves, — one for inhaling and the other for exhaling air. The end of this tube, which has a mouthpiece, is cast over the fireman's shoulder, the other being left in the open air; and an India-rubber spectacle mask, capable of being molded to fit any features, having been placed over the eyes so as to compress the nostrils, the fireman may enter without fear the most vitiated atmosphere. See also Fig. 4272, p. 1923, "*Mech. Dict.*," in which the fireman carries a sack of vital air.

See also Galibert's apparatus, Fig. 2677, p. 1185, *Ibid.*
See also Aërophore, Fig. 17, p. 8, *supra.*

Fireman's		"*Scientific American Sup.*," 1111.
Respirator, for engineers	*	"*Engineer*," xlvi. 293.
in tunnels, *Galibert*, Fr.		"*Scientific American*," xxxviii. 99.
Ronquayrol	*	"*Scientific American*," xxxviii. 99.
Respirator for reduction works	*	"*Min. & Sc. Press*," xxxviii. 249.
Schultz, aërophore . .	*	"*Scientific American*," xxxviii. 99.
High pressure aërophore	*	"*Scientific American*," xxxviii. 99.
Respiration of plants. *Deherain & Vesque* .	*	"*Scientific American*," xxxvi. 70.

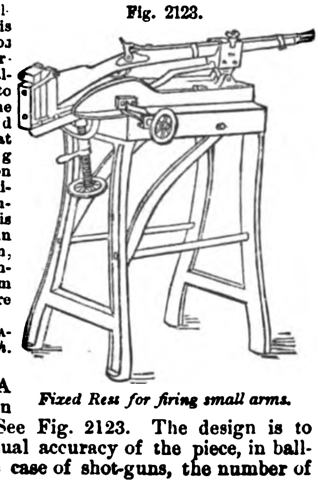
See also Inhaler, p. 1184, "*Mech. Dict.*"
See also Respirometer, *infra.*

Res-pi-rom'e-ter. The name adopted by Mr. Fleuss for his diver's apparatus for supplying air to a person beneath the surface of the water.

It is a modified form of diver's dress and helmet. The latter, which is no larger than that ordinarily used, has a close circular chamber of about ½ cubic foot capacity, and in this is stored a supply of oxygen under a pressure of 240 pounds per square inch, from a suitably charged reservoir. This affords him sufficient air-food for about five hours. The expired air from the lungs is passed, by means of a flexible tube, to a closed receptacle of vulcanite, which is attached to the yoke-piece carrying the usual rubber dress, which receptacle is filled with spongy rubber saturated with caustic soda. The expired breath is filtered through this soda, which absorbs every trace of carbonic acid, and allows the nitrogen to pass. The air in the diver's lungs and about his somewhat capacious clothing when he first puts on his suit, contains nitrogen enough for indefinite use, and is used again and again to dilute the oxygen, as the latter is constantly supplied from the compressed store in the helmet.

See also * Respirator, p. 1923, "*Mech. Dict.*"

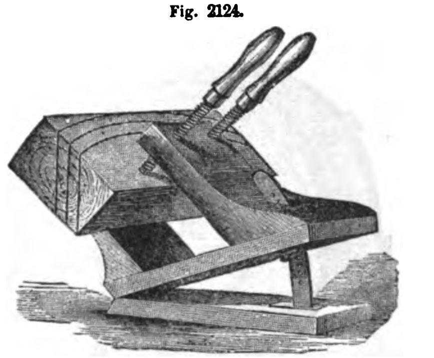
Fig. 2123.



Fixed Rest for firing small arms.

Rest. 1. A support for a gun in test-firing. See Fig. 2123. The design is to ascertain the actual accuracy of the piece, in ball-firing; or, in the case of shot-guns, the number of pellets of a given size, which strike a target of a given area, the piece being at a stated distance. A

Fig. 2124.



Rest for Bevel-cutting with Band-saw.

certificate of the firing of each barrel is furnished with all first-class guns.

2. A support or a guide for stuff fed to a saw.

Re-tain'ing Ring. (*Railway.*) A metallic ring which secures the wheel-center to the tire.

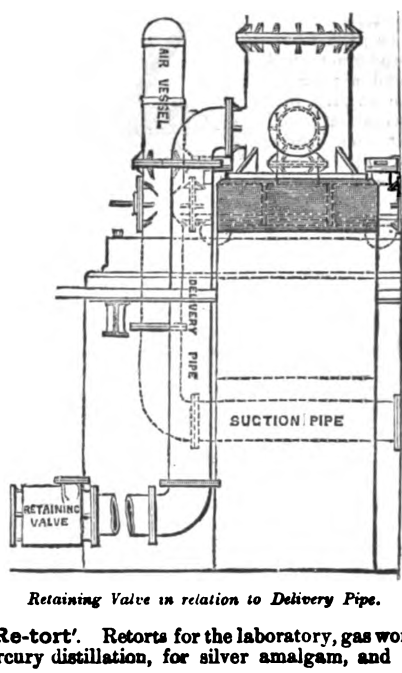
Re-tain'ing Valve. A check-valve, to prevent reflux of water or steam. Placed sometimes at the bottom of a pump-stock to prevent water leaving during cessation of pumping. Fig. 2125 shows a retaining valve for deep well-pumps.

Fig. 2125.

Foot Valve of Pump.

Fig. 2126 shows the position of a retaining valve placed near to the air-vessel of a heavy pumping engine to prevent any water leaking back through the pumps when the engine is stopped. It also admits of the pumps being examined without emptying the up-take.

Fig. 2126.

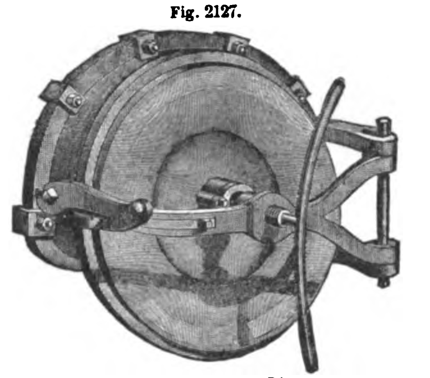


Retaining Valve in relation to Delivery Pipe.

Re-tort'. Retorts for the laboratory, gas works, mercury distillation, for silver amalgam, and distillation of acids are mentioned in * pp. 1924, 1925, "*Mech. Dict.*"

Fig. 2127 is an illustration of a self-sealing gas retort for gas works. The lid is secured by a central screw plug to a

Fig. 2127.



Self-sealing Retort Lid.

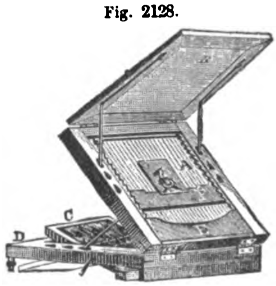
hinged frame, which also carries a latch-bar. The lid being swung shut and latched, the screw plug is rotated by the lever handle to tighten the closure of the lid and prevent leakage of gas.

Furnace	"*Am. Man.*," Sept. 12, 1879, p. 12.
Price	* "*Eng. & Min. Jour.*," xxi. 166.
Self-sealing lid, *Collinson*	* "*Am. Gas Light Jour.*," July 3, 1876, p. 14.
Retort settings .	* "*Scientific American Sup.*," 1551.
Retort setting, gas . .	* "*Scientific American Sup.*," 678.
Retort stoking machinery. *Rowland*, Br. . . .	* "*Engineering*," xxiv. 182.
Retorts, vertical, distilling shale, *Rennie*, Britain	* "*Scientific American Sup.*," 904.

Re-touch'ing Frame. A desk with glass pane on which a negative or positive is placed and viewed by transmitted light in order to repair defects, soften shadows, etc.

The pane A has a ground-glass shade, B, and a mirror, C. The stand D has drawers for pencils, paint, and brushes. E is a sliding-board as a hand-rest.

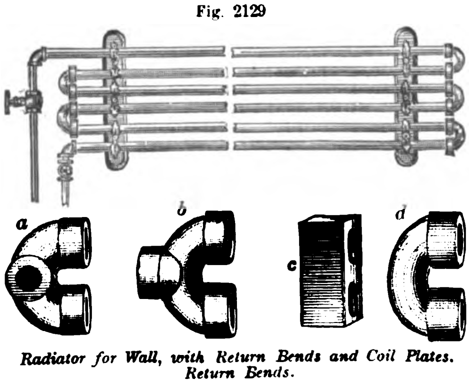
Fig. 2128.



Retouching Frame.

* "*Scientific American*"	xxxvi. 226.
"*Scientific American Sup.*"	2211.

Fig. 2129



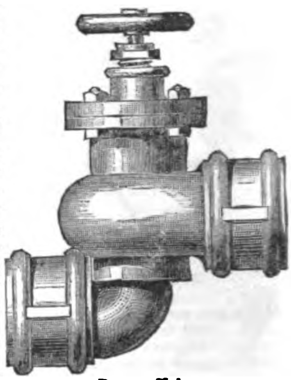
Radiator for Wall, with Return Bends and Coil Plates. Return Bends.

a. Side-outlet return bend. *c.* Square return bend.
b. Back-outlet return bend. *d.* Ordinary return bend.

Re-turn' Bend. A U-shaped pipe coupling for uniting the ends of pipes. It may be *open* or *closed*; in the former the branches being some distance apart, as in the letter U. See Fig. 2129.

Re-turn' Valve. A valve in a main or pipe having two functions; one as a reflux or back-pressure valve to prevent the return of the contents of the pipe; the other condition is when the valve is raised by the screw spindle to allow the re-flow of the contents. Also called an *end* valve. See also REFLUX VALVE, *supra*.

Fig. 2130.



Return Valve.

Re-ver'ber-a-to-ry. A furnace with domed ceiling which reflects the flame and heat downward upon the metal on the hearth. See Fig. 4283–4286, pp. 1926, 1927, "*Mech. Dict.*"

* *Laboulaye's* "*Dict.*," "*Combustible*," Fig. 559–560.

Furnace, *Cassel* . . .	* "*Iron Age*," xx., Nov. 1, p. 5.
Chisholm	* "*Iron Age*," xvii., April 6, p. 5.
Kirk	* "*Iron Age*," xxi., March 7, p. 5.
Morrison	* "*Iron Age*," xx., Nov. 8, p. 5.
Nichols	* "*Iron Age*," xx., Nov. 15, p. 5.

Re-verse' Jaw Chuck. One with jaws capable of inversion in the face plate to enable it to grasp upon the exterior or interior of the object. Instances under LATHE CHUCK, pp. 528, 529, *supra*.

Re-ver'si-ble Com-pres'sor. (*Microscopy.*) A form of slide with compressor which is capable of inversion to expose either side of the object.

Re-ver'si-ble Saw. A bow saw with a blade each edge of which is toothed, and either capable of being presented in working attitude.

Re-ver'si-ble Boil'er. One on trunnions, so as to alternate ends, removing scale by bringing the end at which sediment has collected to the action of steam in the new position.

Re-ver'si-ble Street Car. (*Railway.*) A street car mounted on its running gear so as to swivel thereon and turn end for end, dispensing with a turn-table.

Re-vers'ing Cyl'in-der. In the Westinghouse air brake arrangement. A small cylinder placed in the steam cylinder head and in which the reversing piston works. — *Forney's "Car Builder's Dictionary,"* Figs. 665–683.

Re-vers'ing En'gine. While all locomotives have facility for reversing steam, the term reversing is particularly applied to such engines as have but lately been fitted to run at will in either direction.

Such are rolling mill engines intended to pass a loop or bar back and forth between the same rolls, which are run in one or the other direction alternately. See ROLLING MILL ENGINE.

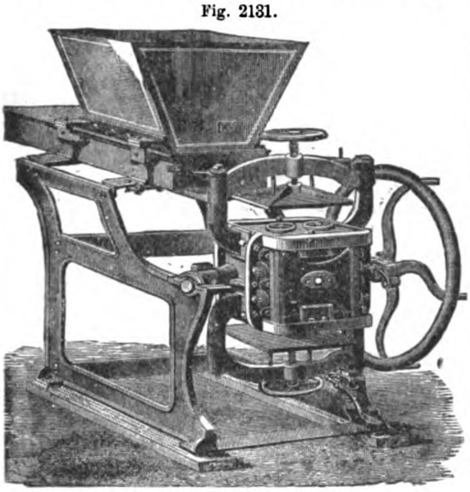
* "*R. R. Gazette*," xxiii. 386, 398.
* "*Scientific American Sup.*," 2163.

Launch engine *Tipping*, Br. . .	* "*Engineer*," l. 165.
Rolling mills, *Claridge*, Br. . . .	* "*Engineering*," xxix. 285.
Steam, *Stirling* . . .	* "*Scientific American*," xxxiv. 98.
Link for steam engine. *Smith*	* "*Van Nostrand's Mag.*," xxi. 123
Rolls, Friction clutch for *Kloman*	* "*Iron Age*," xxi., June 6, p. 1.

Re-vers'ing Ma-chine'. (*Founding.*) A form of molding machine in which the flask is carried on trunnions so as to be tipped over and the sand rammed from either side.

The operation is as follows: The patterns and followers being properly adjusted, the drag part of the flask is placed on top of sand box; the bridge piece of drawer bottom is let down, when it makes connection between the hopper and flask; the drawer is then pulled out with the sand, dropping it into the flask; then the drawer is taken back into the hopper; the bridge piece is then raised, the binder bar is brought over and fastened down on flask; then the power is applied

Fig. 2131.



Reversing Machine.

which forces the patterns and follower with the sand up into the flask; then the part of the machine with flask on is turned over in its trunnions, thus bringing the flask to lower side of machine with mold up; the power is again applied, which draws the patterns up, leaving the mold complete; the binder is loosened, which leaves the flask resting on the binder plate, which is then swung out and the flask carried away. The cope part of flask is then molded in a similar manner, but taken off from the top.

Re-vert'ing Flue Boil'er. One in which the gaseous products revert on their former course; traversing twice through the boiler, in distinct and successive series of flues.

An instance is shown in Fig. 5638, p. 2329, "*Mech. Dict.*"

Re-vet'ment. See definition of varieties, p. 1928, "*Mech. Dict.*"

Among the forms of revetment for preventing the erosion of river banks may be mentioned the following: The woven brush revetment, the continuous mat, or brush blanket, made of brush, sewed together with wire, and the willow screen made by laying the willows as nearly as possible in juxtaposition and securing them with wire.

The manner of using either of these devices is the same. The bank to be protected should first be graded to a slope of about 2 upon 3 or less, an operation that can be very cheaply performed by the use of hydraulic force-pumps, after which the revetting should be put on so as to extend from the ordinary high-water limit down the bank and out along the river-bed sufficiently far to protect the slope should any unusual scour take place. The total width is usually in the neighborhood of 100′ on the lower Missouri. To sink that portion which is under the water, a small quantity of rock is sometimes necessary, but usually the current itself and the sediment that collects on the brush will suffice for this. See plate opposite p. 1455, "*Report of United States Engineers,*" 1880.

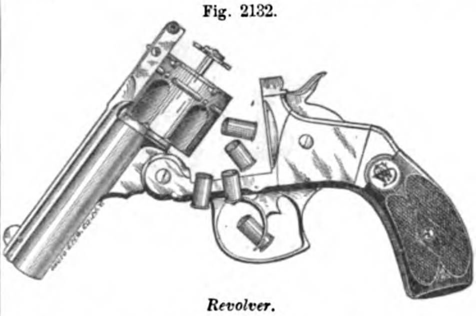
Canal bank revetment, *Ibid.*, 1876, vol. ii., part 2, Plate V., p. 417.

(*Hydraulic Engineering.*) For view and description of the building of the revetment mattress at Council Bluffs on the Missouri River. See "*Report of the Chief of Engineers, U. S. Army,*" 1880, * ii. 1436.

Re-vol'ver. For history and varieties, see pp. 1928–1930, "*Mech Dict.*"

Fig. 2132 is the latest Smith & Wesson revolver with automatic discharge of the spent cartridge capsules. The discharge is moved rearward by the rocking of the barrels on

Fig. 2132.



Revolver.

the hinge to uncover the breach, and throws the capsules clear of the barrels. The discharger then returns automatically into place.

The bull dog revolver is a pocket weapon with short barrel and large bore.

For revolving ordnance see MACHINE GUN, *supra*.

Colt. *	*Adams.*
Devisme.	*Lefaucheux.*

Article "*Revolver,*" *Laboulaye's* "*Dict. des. Arts et Manufactures,*" iv., ed. 1877.

See also *Martin's* patents	222,065, 220,066.
Wesson's	222,167, 222,168.
Schofield's	227, 449.
Revolver factory.	
Smith & Wesson . .	* "*Scientific American,*" xlii. 47.
Revolving cannon.	
Hotchkiss	* "*Engineering,*" xxvii. 3, 23, 25, 63.

Re-volv'ing Boil'er Steam En'gine. The invention of Fred. Siemens, of Dresden. It has no valves nor pistons. The boiler itself revolves, and from it power is transmitted to the machinery to be driven.

"It consists of a steam-boiler of approximately cylindrical form, carried on an inclined axis about which it rotates. Inside this boiler is a worm or screw composed of sheet-metal, and having such form that each portion of the screw having a length equal to its pitch, closely resembles a funnel which has been slit down one side and slightly separated to unite with others above and below it.

"The lower portion of the boiler has a double bottom, and the upper is surrounded by a spiral of gas-pipe, having a direction the reverse of the funnel-like spiral below.

"Water is placed in the lower portion of the boiler and in the space between it and the external jacket, a communication being established between them by means of small holes.

"Surrounding the whole lower portion of the apparatus is a jacket of non-conducting material, and between it and the boiler is a space through which circulate the gases from the furnace, or, in this case, from the gas-burner by which it is heated, passing off by a small chimney at its upper end.

"The heat being applied, steam is formed, which rises through the water, impinging on the immersed funnel-like spirals, producing a tendency to rotation. Above the water it enters the helix of gas-pipe, and, condensing, flows back into the boiler, its reaction causing further effort to rotate the boiler.

"The boiler being once filled, requires no further attention, as there is no loss of the liquid." — *Vienna Report.*

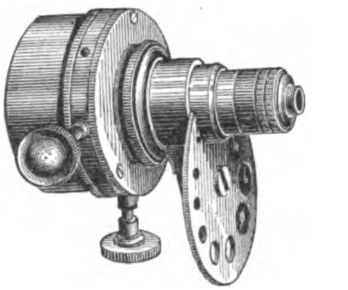
Re-volv'ing Can'non. See MACHINE GUN, Figs. 1647, 1649, pp. 569, 570, *supra.*

Report on trial of the Hotchkiss revolving cannon, in "*Ordnance Report,*" 1877, Appendix O, p. 609 *et seq.*, with 4 plates, and *Ibid.*, Appendix I [4], 1879, p. 143, *et seq.*, with 17 Plates.

Report on trial of the Gatling gun 45′′ (English model), *Ibid.*, 1879. Appendix I [12], p. 190 and 15 plates.

Re-volv'ing Di'a-phragm. (*Optics.*) The diaphragm is used in optical instruments to exclude some of the marginal rays of a beam of

Fig. 2133.



Revolving Diaphragm.

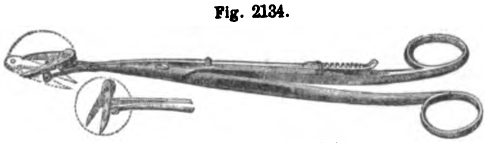
light. It is a means of contracting the aperture. The revolving diaphragm has a number of apertures of varying sizes, either of which can be brought coincident with the optical axis of the instrument.

Re-volv'ing Scis'sors. (*Surgical.*) An instrument for deep operations in cavities of the body.

The blades revolve upon their own axis as shown by the dotted lines. The blades can be presented anteriorly, posteriorly, or laterally.

The blades being short and firm, will cut strong or delicate tissues The rotation of the blades is produced by the in-

Fig. 2134.



Stohlman's Revolving Scissors.

dex finger of the same hand which operates. By depressing the lever near the handles and sliding it forward or backward, the scissors are placed in any required position, and held firmly by allowing the lever to snap into one of the notches; in the same manner the position can be constantly changed at pleasure.

Re-volv'ing Scra'per. A road scraper which revolves completely on its axis; not merely tipping. Fig. 4695, p. 2058, "*Mech. Dict.*"

Re-volv'ing Head-saw Ma-chine'. A screw-cutting machine which contains a number of dies on a head which can be revolved so as to bring either to the work.

Fig. 4734, p. 2067, "*Mech. Dict.*"
A TURRET CUTTER, Fig. 6824, p. 2665, *Ibid.*

Re-vul'sor. (*Surgical.*) An apparatus to apply heat and cold alternately as a therapeutic agent.

McLane's revulsor has two vessels containing hot and cold water, which are passed along the spine or over a paralytic muscle so as to succeed each other rapidly. — *Philadelphia* "*Medical Times,*" * Sept. 4, 1875.

Rhe'a Fi'ber Ma-chine'. For operating upon the China grass, Malay *ramie*, the *Bœhmeria nivea*. See RAMIE MACHINERY.

Greig, Br. . . . . . . * "*Engineer*, xliv. 887.

Rhé E-lec-trom'e-ter. A device by Mariani to investigate electrical discharges between the atmosphere and the earth.

It has a copper wire coiled upon a pasteboard tube, and carrying a traversing magnetic needle upon a pivot above the coil. A small iron bar is inserted axially within the coil. The apparatus is placed with the coil east and west. A spark of high tension passing through the coil magnetizes the bar, which deflects the needle east or west, according to the spark's direction. The iron bar must be de-magnetized by heating before using again.

"*Scientific American*"	xxxiv. 308.
* "*Scientific American Supplement*" . .	456.
de Vos, "*Telegraphic Journal*" . . .	iv. 108.

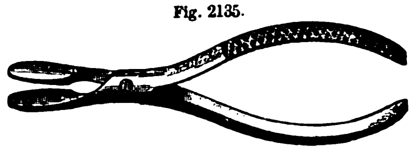
Rhe'o-phore. (*Electricity.*) An electrode.

Rhe'o-stat. (*Electricity.*) An instrument for regulating the current, by offering more or less resistance to its passage. See Fig. 4311, p. 1934, "*Mech. Dict.*"

Butler	* "*Scientific American*," xli. 147.
Carbon, *Edison* . . .	"*Telegraphic Journal*," vi. 408.
Groves	* "*Telegraphic Journal*," iv. 172.
	* "*Scientific American Sup.*," 574.
Machine, *Planté* . . .	* "*Telegraphic Journal*," v. 309.
Wheatstone	* "*Telegraphic Journal*," iv. 10.
	* "*Scientific Amer.*," xxxix. 296.
Machine	* "*Scientific Amer.*," xxxviii. 169.

Rhi'no-plas-tos. A species of flat nosed pinchers for straightening the bones of the *septum narium* deformed by accident or violence.

Fig. 2135.



Dr. Adams' Rhinoplastos.

Rhinoscope . .	* "*Scientific American Sup.*," 1722.
	"*Mech. Dict.*," p. 1935.

Rib. (*Add.*) 7. (*Fire-arm.*) One of the plates above and below, which connect the two tubes, forming the double barrel.

Ribbed Boil'er. One with corrugations or projecting ribs to add to the surface exposed to the fire. Used for greenhouse boilers.

Rib Fab'ric Ma-chine'. A knitting machine adapted to make the rib stitch. It has peculiar adjustments in the power and hand machines, and in some has various capabilities, for making *polka rib*, *one-and-one rib*, etc.

See description by Mr. G. W. Gregory. "*Centennial Exhibition Reports,*" Group XXII., vol. vii., pp. 53-59.

Rib Shears. (*Surgical.*) See COSTOTOME.

Rib'-top Ma-chine'. A knitting machine adapted to make rib-tops of hosiery; with, in some cases, an adaptation to make broad-rib hose throughout.

One by Gisuson and Coltman, of Leicester, England, was shown at the Centennial, capable of making from 200 to 250 dozen pairs of tops per week of 60 hours.

It is arranged to make rib tops with welt and slack course, and is fitted with three carriers: also a pattern wheel, which can be altered at pleasure to make any pattern. The length of top can be varied as desired, and the self-acting winding tackle for receiving the work is as effective as it is simple, only requiring the work of a few moments to take off the fabric and proceed with further productions. This machine can be changed in action, whilst running, to make the royal rib stitch; it will also make the two-and-one rib socks, with welt; it can be worked by steam or by hand. A dial indicating the amount of work done is supplied.

When making broad-rib hose a cylinder pattern wheel is fitted, and this is so adapted that the patterns can be varied through the whole length of hose. It will make 36 dozen pairs of hose legs in the week of 60 hours.

Rice Drill. A force-feed machine for drilling rice. See GRAIN DRILL. WHEAT DRILL, "*Mech. Dict.*"

Rice machinery . . .	"*Scientific Amer.*," xxxvii. 137.
Huller	"*Scientific American Sup.*," 1510.
Decorticator, *Coromandel*	"*Technologiste*" xli. 364.

Ridge Har'row. (*Agric.*) One hinged longitudinally so as to be capable of lapping upon the sides of a ridge over which it passes. Fig. 1318, p. 440, *supra*.

Riepe Steel. (*Metallurgy.*) Steel made by a process of adding to a bath of pig-iron in a reverberatory, iron-slag, salt, clay, and oxide of manganese. The iron is worked below the scum and rolled into balls for the shingler.

Rif'fle Blocks. (*Mining.*) Wooden blocks set on end in a sluice with interstices for catching gold.

Ri'fle. A fire-arm with barrel grooved spirally to give a rotation on its axis to the projectile.

See history, pp. 1939-1943, "*Mech. Dict.*," and illustrations of —

* *Sharps.*	* *Maynard.*
* Creedmoor rifle range.	

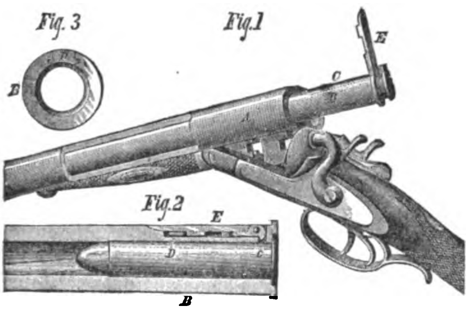
See also Fire-arm, pp. 850-860, where are illustrations of

Martini.	*Richards.*
Prussian needle gun.	*Roberts.*
Merrill.	*Hall.*
Laidley.	*Burnside.*
Snider.	*Puckles.*
Peabody.	*Elliot.*
Allen.	*Springfield.*
Sharps.	*Ward-Burton.*
Chassepot.	*Remington.*
Maynard.	*Dodge.*
Spencer.	Swiss.
Berdan.	*Winchester.*

See also Revolver.

Fig. 2136 shows Stevens' plan for converting a shot-gun to a rifle by slipping a rifle barrel into that of the shot-gun.

Fig. 2136.



Converting Shot-gun to Rifle.

Fig. 1 is a perspective view.
Fig. 2 is a longitudinal section.
Fig. 3 shows the breech of the rifle (enlarged).

The rifle-barrel *B* slips into the rear end of the shot-gun barrel *A*, the flange formed on the end of it occupying the recess made in the shot-gun barrel for the reception of the flange of the cartridge. The rifle barrel has a longitudinal recess for receiving the slide *D* on which is pivoted a lever *E* having at its rear end a short projection, *C*, extending inward.

After the discharge the barrel of the gun is tilted down, and the extractor starts the rifle barrel out of the shot gun barrel; this operation moves the slide *D* slightly, and starts the cartridge shell. Should this prove insufficient the rifle barrel is drawn out far enough to admit of raising the lever *E*, which operation moves the slide *D* and ejects the shell.

Statement of the number of machines, fixtures, small tools, and gages necessary for the manufacture of 200 Springfield rifles per day of 10 hours: —

Names of Parts of Rifle.

Barrel.	Cam latch.
Receiver.	Thumb piece.
Breech screw.	Firing-pin.
Breech block.	Extractor.
Breech-block cap.	Extractor spring spindle.
Guard plate.	Cap with 2 rivets.
Guard bow.	23 screws for parts.
Trigger.	5 springs.
Butt plate.	2 pins.
Lower bands.	2 studs.
Upper bands.	2 washers.
Lower band-springs.	Stock.
Upper band-springs.	Lock plate.
Upper band swivel.	Hammer.
Guard bow-swivel.	Main spring.
Ramrod.	Sear.
Ramrod stop.	Sear spring.
Tip.	Main-spring swivel.
Front sight.	Tumbler.
Rear-sight base.	Bridle.
Rear-sight spring.	Hinge pin.
Rear-sight leaf.	Bayonet.
Rear-sight cap.	Bayonet clasp.

	Cost.
37 machines for making the stock	$60,000
81 machines for making the barrel	54,000
51 machines for making the receiver	23,500
17 machines for making the breech screw	6,600
37 machines for making the breech block	18,100
5 machines for making the breech-block cap	1,800
12 machines for making the cam latch	5,600
10 machines for making the thumb piece	3,800
8 machines for making the firing pin	1,060
9 machines for making the extractor	2,950
1 machine for making the extractor spring spindle	425
14 machines for making the guard plate	4,800
9 machines for making the guard bow	2,900
11 machines for making the trigger	3,600
13 machines for making the butt plate	5,400
10 machines for making the upper and lower bands	5,800
10 machines for making the upper and lower springs	3,300
10 machines for making the upper and lower swivels	3,000
7 machines for making the ramrod	2,570
8 machines for making the ramrod stop	2,735
5 machines for making the tip	1,585
4 machines for making the front sight	1,565
18 machines for making the rear sight base, and spring	6,650
34 machines for making the rear-sight leaf, cap, and pins	15,070
15 machines for making the lock plate	6,100
16 machines for making the hammer	5,800
12 machines for making the main spring	3,490
8 machines for making the sear	2,750
7 machines for making the sear spring	2,050
4 machines for making the main-spring swivel	1,225
12 machines for making the tumbler	4,500
8 machines for making the bridle	2,730
4 machines for making the hinge-pin	1,300
46 machines for making the bayonet	19,575
8 machines for making the bayonet clasp	3,870
13 machines for making screws, pins, and studs	6,120
13 polishing machines, stands, wheels, etc.	2,200
51 forging machines, drop hammers, and presses	89,000
2 sets of forging dies	22,000
18 water-front forges	2,700
4 annealing furnaces	1,600
2 hardening furnaces	1,000
2 blowers (fan blowers)	400
2 sets of gages, 1 working and 1 inspection set	45,000
1 set of fixtures and 2 sets of small tools	115,000
32 machines for tool-making, repairing, etc.	13,600
696 Total for machines, tools, and gages	$532,770

For running the above machines and tools it would require a condensing engine of 32″ × 60″, 300 horse-power; 4 tubular boilers, 16′ × 5′; 2 tubular boilers, 16′ × 5′, reserve. Cost about $25,000.

Floor-space occupied by using all above machines, tools, etc., 125,000 square feet.

Compiled for this work by C. J. Ehbets, of Hartford, Conn.

Breech loading, *McAlpine*	* "*Scientific American*," xxxix. 230.
Browne & Sharpe, Shops	* "*Scientific American*," xli. 271.
Greener, Br.	* *Laboulaye's* "*Dict.*," iv., "*Armes à Feu.*"
Hair-trigger, *Leonard*	* "*Scientific American*," xxxv. 325.
Hammerless	* Fig. 1298, p. 432, *supra*.
Hammerless, *Greener*, Br.	* "*Scientific American*," xliii. 274.
Martini-Henry	"*Iron Age*," xx., Aug. 30, p. 1.
Military	* "*Scientific American Sup.*," 74.
Military, French service. *Gras*	* Fig. 1028, p. 335, *supra*.
Needle, *Pieri*	* "*Engineer*," xlv. 334.
	* "*Scientific American Sup.*," 2086.
Repeating, French	"*Van Nostrand's Mag.*," xx. 449.
Repeating, French navy (20 Figs.)	* "*Engineer*," xlvii. 223.

Revolver	See *infra.*
Rifling cannon, on *Zalinski*	"*Scientific American Sup.*," 410.
Shot-gun	See *infra.*
Soper, Ger.	* "*Engineer*," xlv. 35, 46.
	* "*Scientific American Sup.*," 1825.
Steyer, Austria	"*Iron Age*," xxiv., Sept. 18, p. 15.
Whitworth	"*Van Nostrand's Mag.*," xiv. 199.

"*Report of Chief of Ordnance U. S. Army*," 1877, has descriptions and drawings of the following foreign small arms. See Appendix L: —

Werndl	Figs. 101, 102, pp. 537-570.
Tabatière	Fig. 91, p. 558.
Snider	Fig. 92, p. 558.
Kruka	Fig. 93, p. 558.
Albini-Brandlin	Fig. 94, p. 559.
Martini-Henry	Figs. 97 to 97 *w*, p. 560.
Werder	Figs. 100 to 100 *p*, p. 568.
Turnwurth	Fig. 104, p. 572.
Vetterlin	Fig. 105, p. 573.
Mauser	Fig. 106, p. 575.
Chassepot	Fig. 107, p. 577.
Russian	Fig. 108, p. 580.

See also BREECH LOADER; MAGAZINE GUN; HAMMERLESS GUN: NEEDLE GUN; REVOLVER, etc.

Ri'fling Ma-chine'. A machine for making the spiral grooves in the barrels of guns.

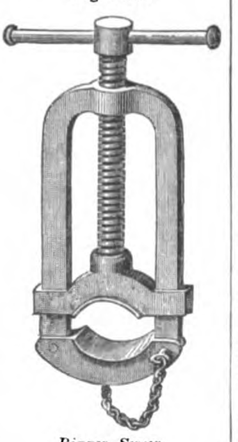
As used in the U. S. armories it is a machine in which the barrel is firmly held while a mandrel carrying a cutting tooth is drawn through it, the mandrel making one and a half revolutions during its passage through the barrel. The barrel makes a third of a revolution between each cut, and the result is a barrel with three *grooves* and three *lands*. The groover is worked automatically, expanding to make the groove deeper as it repeats the cut in the same place, until the groove is deep enough. The barrel is drenched with oil all the time.

The Pratt & Whitney rifling machine gives from one turn to the grooves in 20″ to one in 36″. The cutter-rod carries from 1 to 3 cutters, as the rifling is 4, 5, or 6 to the circumference. An adjustable feed-stop gages the depth of the rifling, and the racks, which are of steel, are double, to take up all back-lash, so that the cutters cannot ride on the lands. An oil-pump feeds automatically at each end of the stroke. The carriage is gibbed on the outside of the long slide, allowing free access to its working parts.

Rig'ging Cut'ter. An apparatus invented to cut the rigging of sunken vessels as a means of removing the masts, etc., which form an impediment to navigation.

"Grosser Kurfürst" . . * "*Engineer*," xlviii. 375.

Fig. 2137.



Rigger Screw.

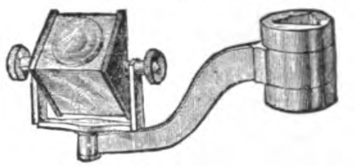
Rig'ger Screw. A clamp for setting up shrouds and stays, one portion being made fast, the part to be hauled taut is lashed to the other, and the parts then approached by means of the screw.

Rig'ging Stop'per. (*Nautical.*) A hold-fast or preventer-rope acting as substitute when a shroud or stay is shot away or stranded in a gale. It may have a knot and laniard at each end, or dead-eyes and tails.

Right-and-Left Coup'ling. A turnbuckle. The link having right-and-left nuts at either end, rods inserted are drawn together or apart by rotation of the link. See TURN-BUCKLE, Fig. 1694, p. 2659, "*Mech. Dict.*"

Right'an-gle Prism. (*Optics.*) An attachment to the microscope stand for throwing light upon an object. It is rotatable on its horizontal axis, and also on a vertical axis, in order to direct the light in the requisite direction.

Fig. 2138.



Achromatic Right-angle Prism.

Rig'id Sus-pen'sion Bridge. A bridge with catenary suspension members, of such form and so braced as to form an unyielding truss.

See Paper by *Fuller* . . * "*Engineering*," xxi. 183.

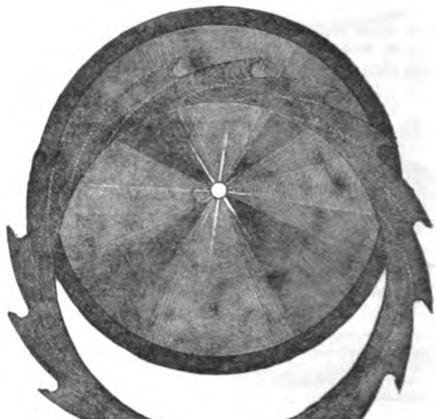
Rim Pla'ner. A machine for dressing the rims of carriage-wheels.

See RIM-PLANING MACHINE, Fig. 4330, p. 1944, "*Mech. Dict.*"
FELLY PLANER, Fig. 1016, p. 331, *supra.*
FELLY DRESSER, Fig. 1940, p. 832, "*Mech. Dict.*"

Rim Saw. A saw the cutting portion of which is annular and mounted upon a central circular disk.

See also RING SAW, *infra.*

Fig. 2139.



Rim Saw.

Ring Boot. (*Manége.*) A caoutchouc or rubber ring on the fetlock to induce the horse to travel wider and prevent interfering. See INTERFERING STRAP, Fig. 2089, p. 1192, "*Mech. Dict.*"

Ring Bush. A socket with anti-friction rings on its interior perimeter, as in some descriptions of rope blocks. See Fig. 263, p, 119, "*Mech. Dict.*"

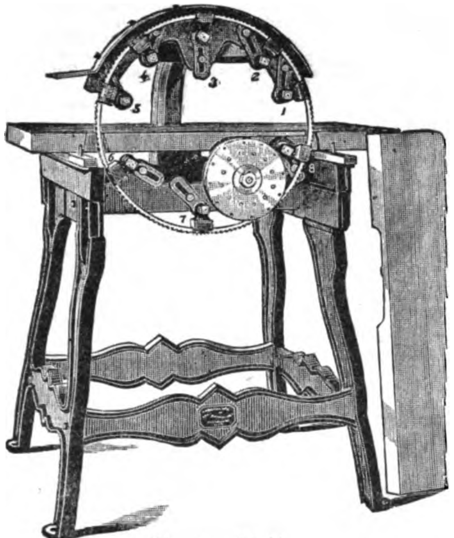
Ring Mal'let. One the head of which is strengthened by rings driven upon it. See *y*, Fig. 3032, p. 1379, "*Mech. Dict.*," where are also shown other forms.

Ring Plate. A ring in a plate attached to a wall to support a steam radiator pipe or coil. See COIL PLATE, Fig. 656, p. 208, *supra.*

Ring Saw. A narrow cylindrical saw with serrated edge running upon guides which strain it and keep it in circular form.

It is a form of scroll saw. The clearance is effected by setting the teeth or making the blade thinner towards the back.

Fig. 2140.



Ring Saw Machine.

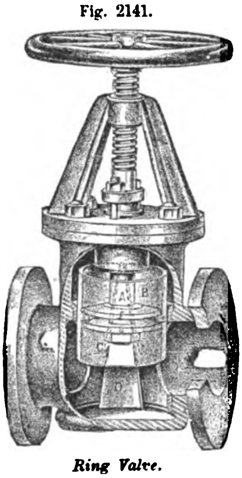
The inside of the saw fits into a groove on the driver which revolves the saw, so that the greater the amount of work on the saw, the tighter the friction holds it; and when the saw is not at work, the friction is only sufficient to revolve the saw. On the opposite end of the driving shaft from the friction wheel are two pulleys, tight and loose, to receive a 2½″ driving belt. The saws can be used from ½″ to 1″ wide. See Fig 4334, p. 1945, "*Mech. Dict.*" See also RIM SAW, *supra*.

Ring Splice. (*Nautical.*) A loop made in a rope by splicing the end to the standing part as in *f*, Fig. 5435, p. 2279, "*Mech. Dict.*"

Ring Top Fur′nace. A charcoal furnace for smoothing irons, etc., having an annular top and cross bars, removable at pleasure.

Ring Valve. A valve of cylindrical shape sliding in a chamber which has a similar form but has apertures which afford a through way when the valve is lifted.

Fig. 2141.



Ring Valve.
A. Valve stem.
B. Ring valve.
D. Wedge.

The valve has a vertical slit on one side and is expansible as the screw forces it down upon a wedge which occupies an axial vertical position within it.

Rins′ing Ma-chine′. 1. A centrifugal machine in which clothes from the rinsing tub are placed in order to remove the water as far as possible by mechanical means, before placing the clothes in the drying closet. See LAUNDRY, Plate XXV., opp. p. 532, *supra*.

2. A machine for passing calicoes, etc., through water to remove superfluous color, etc., acquired in the dyeing or bleaching processes. Fig. 4336, p. 1945, "*Mech. Dict.*"

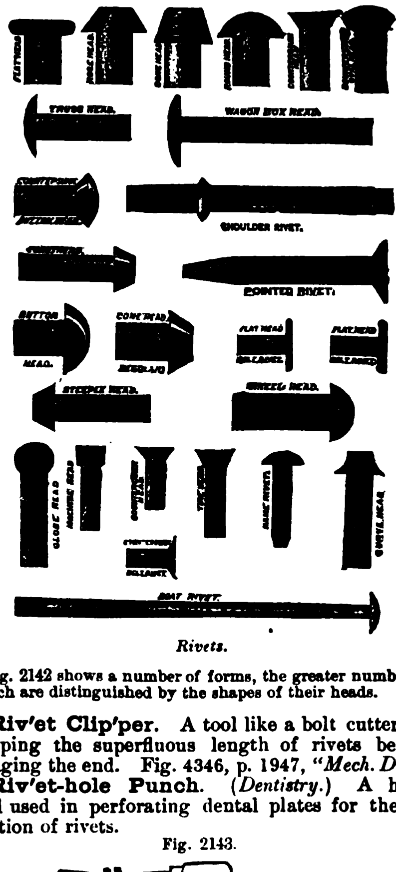
Rip′-Rap. Loose stone pitched around a subaqueous foundation to prevent erosion by water.

Many of the most important railroad bridges have their piers founded on timber cribs filled in with stone, the timber work being carried up to within a couple of feet of lowest water mark before starting the masonry. On bottoms subject to erosion, a plentiful supply of rip-rap is dumped around the foundation and replenished from season to season till well solidified.

This is the usual system in America when the river bottom is of such a nature that a solid bearing on stone, hard-pan, or gravel can be insured. When a soft material overlies a hard bottom, loose stone, *rip-rap*, is thrown in to form a foundation for the crib work or masonry.

Riv′et. A short bolt the end of which is swaged to prevent retraction.

Fig. 2142.



Rivets.

Fig. 2142 shows a number of forms, the greater number of which are distinguished by the shapes of their heads.

Riv′et Clip′per. A tool like a bolt cutter for clipping the superfluous length of rivets before swaging the end. Fig. 4346, p. 1947, "*Mech. Dict.*"

Riv′et-hole Punch. (*Dentistry.*) A hand tool used in perforating dental plates for the reception of rivets.

Fig. 2143.

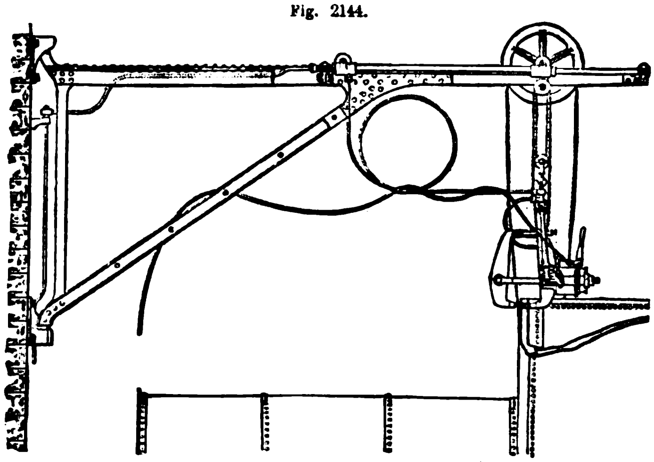
Rivet-hole Punch.

Riv′et-ing Bur. A washer placed on a rivet and upon which the end is swaged down. Used only in small affairs, from 1-10″ to ¼″ holes.

Riv′et-ing Knob. A cup-faced swage for closing down the rivet end upon the object or upon the bur, as the case may be.

Riv′et-ing Ma-chine′. Several forms of riveting machine are shown in Figs. 4349–4354, "*Mech. Dict.*," operating by pitman, cam, steam, hydraulic power, etc.

Fig. 2144.



Tweddell's Suspended Hydraulic Riveter.

Fig. 2144 shows the Tweddell portable hydraulic riveter and crane, for riveting locomotive-boiler foundation rings, wheel-tires, girders, crane-work, boilers, etc. The riveter is suspended from a specially designed hydraulic crane by means of which the riveter is made to command a considerable area without disconnecting a pipe-coupling or breaking a pipe-joint.

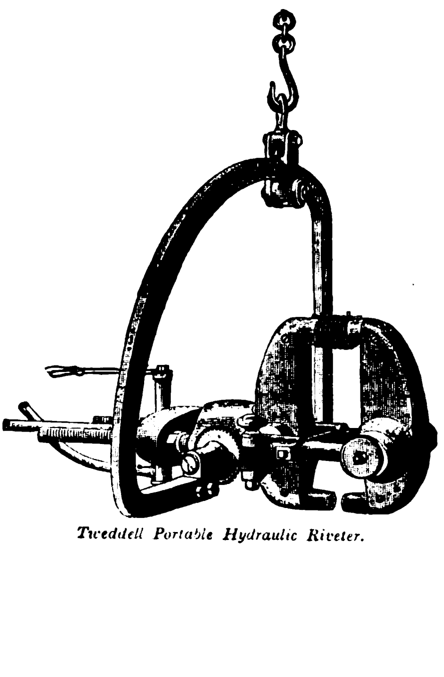
A slightly modified form of the same is shown more in detail in Fig. 2145.

It consists of two levers or arms abutting at one extremity, and carrying at the other two cupped dies, used to form the head of the rivet. Upon one of these levers rests the bottom of a hydraulic cylinder, in which works a plunger, carrying a crosshead furnished with tension bars, which, after passing through guides on each side of the cylinder, are fastened to the other lever, as shown in Fig. 2145. The fulcrum is not situated at the center of the length of the levers, but at a point distant about one third of that length from one end.

The riveter may be adjusted in its hangings to act on seams, oblique, horizontal, or vertical.

One man raises and lowers the riveter, adjusts it to the rivets, and then closes the dies on the rivets. Boys drop the red-hot rivets into place with the head of the rivet uppermost in horizontal work. With a skillful operator, as many as 6 to 10 red-hot rivets may be put in place ahead of him, and he can, on beam work, drive from 10 to 16 rivets per minute.

Fig. 2145.



Tweddell Portable Hydraulic Riveter.

The machine is used with an accumulator which maintains an equable pressure adjustable from 250 to 2,000 pounds per square inch.

See also FIRE-HOLE RING RIVETER, Fig. 1036, p. 338, *supra*.

Small riveting machines are used for closing rivets on small articles of wear and convenience, such as brogans, boots, shawl-straps, valises, etc.

A hydraulic riveting machine driven by pump, and accumulator, is shown under ACCUMULATOR, Fig. 2, p. 2, *supra*.

Adt . * "*Iron Age*," xxii., Oct. 24, p. 1.
Allen * "*Iron Age*," xviii., Oct. 5, p. 1; xxi., Apr. 18, p. 1.
Pneumatic. *Allen*.
* "*Engineer*," xlviii., 12; xlvi. 210.
Bement.
* "*Iron Age*," xxii., Oct. 3, p. 1.
Arrol, Br.
* "*Engineer*," xlvii. 82.
Maccoll, Br.
* "*Engineer*," xlv. 288.
McKay & Mc George, Br.
* "*Engineer*," xlvii. 82.
Muir, Eng. . . . . . * "*Scientific Amer. Sup.*," 2033.
Steam, *Pusey, Jones, & Co.* * "*Iron Age*," xvii., June 1, p. 1.
* "*Scientific Amer.*," xxxiv. 342.
Portable. *Sellers* . . . . * "*Scientific Amer.*," xli. 259.
Hydraulic, *Tweddell*, Br. . * "*Engineering*," xxi. 493; xxi. 115; xxvi. 61–64.
* "*Engineer*," xlvi. 230; xliv. 98.
* "*Railroad Gazette*," viii. 563.
* "*Man. & Builder*," xii. 106.
* "*Scientific Amer.*," xxxiv. 226; xlii. 146.
* "*Scientific Amer. Sup.*," 2225.
Plant (hydraulic) at Indret arsenal, *Tweddell*, Fr. . . . . * "*Engineering*," xxii. 3.
Suspended (hydraulic), *Tweddell*, Br. . . . . * "*Engineering*," xxvii. 66.
Rivet-heating furnace, Fr. . . . . * "*Scientific Amer. Sup.*," 1046.
Rivet-joints of steam boilers, *Cawley*. . . . * "*Scientific Amer. Sup.*," 1527.
Rivet-making machine, *Collier*, Br. . . . . . * "*Engineer*," xliv. 57.
* "*Scientific Am.*," xxxvii. 150.

Road Grad'er. See ROAD LEVELER.

Road Lev'el-er. A scraper for leveling heaps of dumped earth thrown up to form a road; and for rounding the earth towards the center of the road. It is a board, steel-shod, and traversing obliquely with the line of the direction of the road. Shown in *b*, Fig. 4693, p. 2058, and Fig. 4365, p. 1954, "*Mech. Dict.*"

Road crossing, standard * "*Railroad Gazette*," xxiii. 655.
Roadway of Kharran, Babylon to Egypt.
Builder . . . . . "*Van Nostr.'s Mag.*," xxiii. 290.
Road making . . . . * "*Scientific American*," xxxiv. 275.
Road plane. *Lafetree* . * "*Scientific American*," xl. 390.
Roads, Impt. of prairie.
Nicholl . . . . . * "*Scientific American Sup.*," 2399.

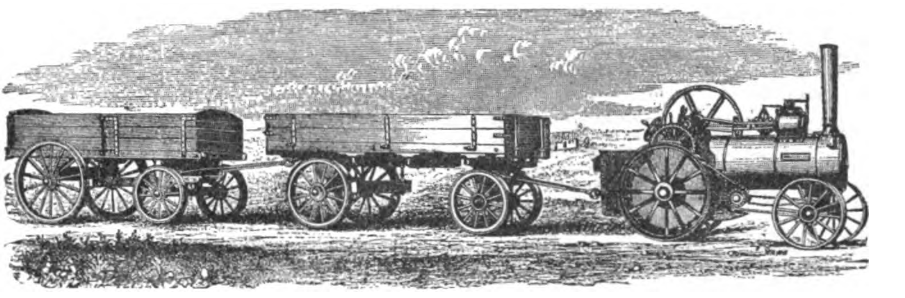
Road Lo'co-mo'tive. Notices of the early road locomotives, which preceded the railway locomotives, are given on pp. * 1951, 1952, "*Mech. Dict.*" The modern forms of road steamers, made by Thomson and by Ransomes (Br.), are also shown in Figs. 4360, 4361, *Ibid.*

Fig. 2146 shows the Aveling & Porter road locomotive with two of the standard forms of wagons, made to carry 4 and 6 tons respectively. They are with iron or with wooden wheels and with sides and ends to let down or detach; in the latter case to make a platform truck.

See * "*Mech. Dict.*," pp. 1952, 1953.

History, machines and results . . . . . . * Prof. Thurston's report. "*Vienna Exhibition Rep'ts*," 1873, iii., p. 83, *et seq.*
Road locomotive.
Marshall & Co., Engl. * "*Scientific American Sup.*," 886.
Trials, Wisconsin . . . "*Iron Age*," xxii., Aug. 1, p. 24.
Road steamer, Berlin . * "*Scientific American*," xliii. 406.

Fig. 2146.



Aveling & Porter's Road Locomotive.

Road roller, steam.
Aveling & Porter, Br. * "*Engineering*," xxvii. 564.
* "*Engineer*," xlviii. 80.
* "*Scientific Amer.*," xxxvii. 162.
Green, Br. . . . . * "*Engineer*," l. 245.
Lindelof . . . . . * "*Eng. & Mining Jour.*," xxi. 103.

Road Ma-chine'. A scraper mounted on wheels and used to excavate earth, transport it, and dump it *in situ*. Used in making road by excavating ditches at the side and throwing the earth into a rounded ridge to form the road. — *Pennock.*

See EXCAVATOR, p. 814; ROAD SCRAPER, pp. 1953, 1954; Fig. 4694, p. 2058, "*Mech. Dict.*"

Road Plow. A strong plow used for throwing up embankments, excavating ground to be moved by the scraper, etc.

Road Scra'per. 1. A horse shovel for moving earth. See Figs. 4366, 4367, p. 1954, and Figs. 4693-4695, p. 2058, "*Mech. Dict.*"

2. An implement with a long oblique blade which is drawn on the ground to level it, or to gently round it for a road bed. Fig. 4365, p. 1954, and *b*, Fig. 4693, p. 2058, "*Mech. Dict.*"

Roast'ing Fur'nace. A furnace for calcining ores to remove sulphur, phosphorus, arsenic, as the case may be. The forms and names are various: subliming, reverberating, shaft, cylinder, etc. See descriptions and illustrations on pp. 1954, 1955, "*Mech. Dict.*"

See list of Furnaces, p. 926, *Ibid.*

Brewster . . . . . . "*Iron Age*," xxii., July 11, p. 20.
Brodie . . . . . . "*Iron Age*," xxiii., Mar. 27, p. 15.
Calcining furnace ore.
Westman . . . . . * "*Iron Age*," xx., Aug. 23, p. 1.
Reverberating, Mining,
Cal. . . . . * "*Engineering*," xxviii. 464.
Freiberg . . . . . *Painter's* report, "*Vienna Exposition Report*," iv. 40.
Revolving, *Manes* . . * "*Scientific American*," xxxiv. 79.
Rotary, *Bruckner* . . . * "*Eng. & Min. Jour.*," xxiv. 38.
Rotary cylinder.
Howell-White . . . * "*Min. & Sc. Press*," xxxvi. 209.
Shaft, *Gerstenhofer* . . *Painter's* report, "*Vienna Exposition Report*," iv. 35.
For silver ores, *Bruckner* * "*Engineering*," xxii. 575.
Process, *Holloway*, Br. . * "*Engineering*," xxviii. 38.

Rock Drill. These are of two kinds, working by blows and by rotation. The former have steel tools and the latter black diamonds.

See DIAMOND DRILL, Fig. 1631-1633, pp. 696, 697, "*Mech. Dict.*"; ARTESIAN WELL, *Ibid.*; ROCK DRILL, Figs. 4375-4380, pp. 1956-1958, *Ibid.*; ARTESIAN-WELL MACHINE, Fig. 114, p. 48, *supra*.

Rock breaker . . . . * "*Scientific American Sup.*," 605.
"New Blake" . . . * "*Iron Age*," xxiv., Nov. 20, p. 1.
American Diamond Rock Drill Co. . . . . . * "*Eng. & Min. Jour.*," xxiii. 150.
Barlow, Engl. . . . . * "*Scientific American*," xxxiv. 150.
* "*Scientific American Sup.*," 770.
Bartlett . . . . . *Laboulaye's* "*Dict.*," iv. "*Perforator.*"
Rock boring machinery, hydraulic, *Brandt*, Gr. "*VanNostrand's Mag.*" xvii. 567.
Brossman, Ger. . . . * "*Engineering*," xxx. 344.
"Kainotoman," *Dryden & Davidson*, Br. . . * "*Engineer*," xli. 209.
Bryer . . . . * "*Scientific American Sup.*," 856.
* "*Scientific American*," xliii. 179.
* "*Eng. & Min. Jour.*, xxviii. 416.
Burleigh . . . . . . * "*Scientific Amer. Sup.*," 753, 1718.
Caré . . . . *Laboulaye's* "*Dict.*," iv., "*Perforator.*"
Diamond . . . . . . * "*Eng. & Min. Jour.*," xxii. 233.
"Union" . . . . . * "*Eng. & Min. Jour.*," xxii. 327.
Dubois & Francois, St. Gothard . . . . . * "*Engineering*," xxi. 44.
Cranston . . . . . . * "*Engineering*," xxi. 85.
Fellot . . . . *Laboulaye's* "*Dict.*," iv., "*Perforator.*"
Ferroux, Fr. . . . . * "*Engineering*," xxi. 272.
"*Scientific American Sup.*," 811.
Frolich, Ger. . . . . * "*Engineering*," xxvi. 381.
Ingersoll . . . . . . * "*Man. & Builder*," viii. 153; xi. 153.
Rock Crusher, *Gardner* "*Min. & Sc. Press*," xxxiv. 19.
Hand power, *Jordan*, Br. * "*Engineer*," xliv. 394.
"*Scientific American Sup.*," 1857; 1761.
Kainotoman . . . . * "*Scientific American Sup.*," 856.
Knider, China . . . . * "*Engineer*," l. 230.
Leschot . . . . . . *Laboulaye's* "*Dict.*," iv., "*Perforator.*"
Mershon . . . . . . * "*Scientific American*," xxxvi. 358.
Penrice . . . . . . *Laboulaye's* "*Dict.*," iv., "*Perforator.*"
Rand, "Little Giant" . * "*Scientific American*," xxxvii. 319.
* "*Scientific American*," xliii. 399.
* "*Eng. & Min. Jour.*," xxvi. 448.
Sach, Ger. . . . . . * "*Engineering*," xxx. 434.
Shaw & Clark, Br. . . "*Scientific American Sup.*," 1538.
Rock borer (St. Gothard) * "*Scientific American Sup.*," 188, 374, 1392.
List of machines . . . "*Scientific American Sup.*," 2121.
Paper on, by *Darlington* Br. . . . . * "*Scientific American Sup.*," 1634.

Rock'er. (*Railway.*) A curved iron casting on which the body of a tip-car rests and rocks in discharging.

Rock'et. An illuminating or incendiary projectile.

The various kinds are cited and described on p. 1959, "*Mech. Dict.*"

Boxer's life-saving, rope-carrying rocket, for communicating with stranded vessels, is shown and described in "*Ordnance Report*," 1878, Appendix P, p. 314 and Plate XLI.

Illuminating . . . . "*Scientific American*," xxxviii. 72.

The rocket harpoon is one projected, in whole or in part, by the issuing at the rear of the gaseous results of the explosive.

See list of U. S. Patents, which also includes bomb harpoons and bomb lance, under HARPOON.

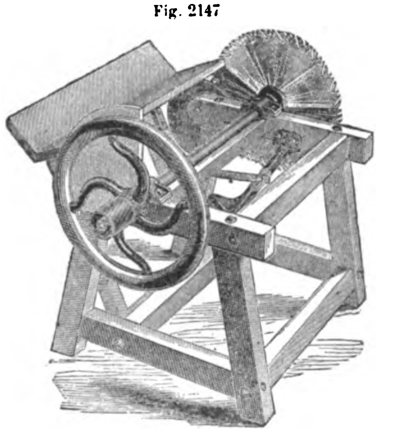
Rock'ing Bar. A bar in a stove or furnace on which the grate rocks, and in some cases tips.

Rock'ing Pier. A bridge pier for supporting a railway track or iron truss across a ravine or valley, its upper end having a motion longitudinally of the said truss as the same contracts or expands. It is a substitute for supporting the end of the truss upon rollers on a rigid pier.

It is used on the Dysdal Viaduct on the Christiana & Fredrikshald Railway, Norway.

The piers which support the superstructure are of wrought iron with lattice-work web. In the longitudinal direction of the viaduct, which is 608′ in length, there is only a single column between each span, possessing no stability in itself, and the upper end is allowed to move along with the superstructure when the latter expands and contracts The lower end of each pier rests on a hinged shoe, so that breaking strains are avoided, and the load is always rendered central to the pier columns. The movement of iron work in a longitudinal direction is transferred to the one abutment on which are the necessary bed-plates, provided with rollers; on the other the superstructure is kept in place by a fixed shoe.

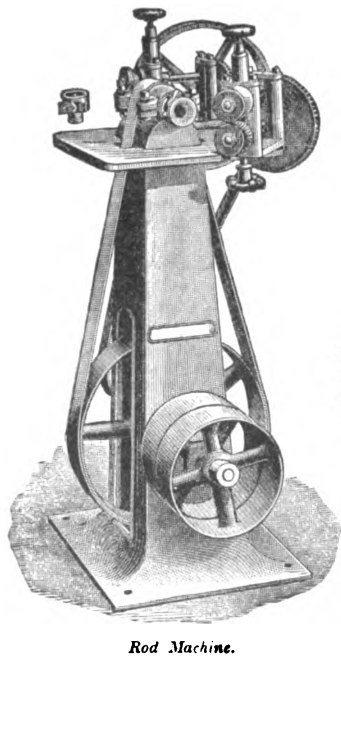
Fig. 2147



Rocking Saw-table.

Rock′ing Saw′-ta-ble. A form of cross-cutting machine in which the stuff is laid on a table which rocks on an axis. The table is counter-balanced by a pendulous weight, and the thrusting forward of the table brings the stuff to the action of the saw, and conversely. Fig. 2147.

Fig. 2148.



Rod Machine.

Rod Ma-chine′. A machine for making round sticks, such as dowels, pins, stretchers, broom-handles, etc.

The revolving head is on the principle of a hollow auger, and is mounted upon a column. A chuck of the proper size is fitted into the hollow arbor on which is the pulley driven by band from the countershaft beneath.

The feeding mechanism consists of two pairs of rollers; the receiving rollers are grooved to receive the square stick; the discharging rollers, circular grooved, to receive and feed out the finished rod. The rollers are geared and driven from one belt; are adjusted to the required pressure for feeding the stuff, and removable for different sizes. The receiving rollers are turned out of the way when changing the chucks or clearing them of broken rods. It will turn from 15′ to 25′ per minute. Three sizes are made: to work 1″ and under, 1½″ and under, 2″ and under, respectively.

Fay . . . . * "*Engineer*," xlv. 435.

Rolled Plate Glass. Rolling glass has been to some extent substituted for casting on tables, in England, France, and Belgium.

" Instead of being cast with the costly apparatus necessary for plate glass of large sizes, this glass is cast in a very simple manner. A basin or dipper is introduced into the glass and filled up: this dipper is suspended upon a hook placed in front of the pot, to enable the workmen to dip and withdraw it with facility when it is full. This dipper is carried over an iron table, and by giving a blow upon it all the cooled filaments and pieces attached to the outside fall off. The dipper is now emptied over the casting table, the thickness of the glass being regulated by metallic pieces or rules. The roller is passed over the mass by the workmen, back and forth. These plates are sometimes imprinted with quadrangular ribs, very close to one another, in order to hide the defects or air bubbles which are likely to occur with this mode of dipping glass. These plates are usually cast about one eighth of an inch thick. They are used for covering hot-houses, for door panels, and for windows." — *Colné.*

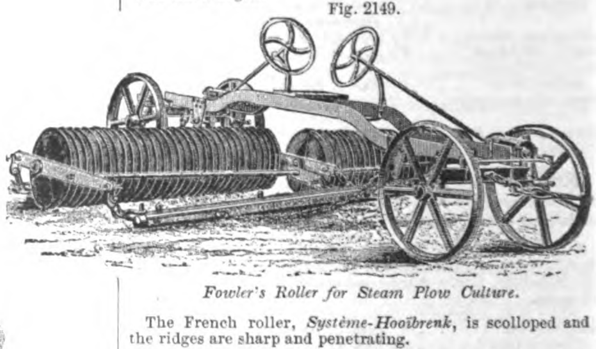
Rol′ler. 1. Land rollers and clod crushers are considered on pp. 572, 1962, 1963, "*Mech. Dict.*," and p. 201, *supra*.

Fig. 2149 is the roller adapted to steam plow culture.

The implement has a width of 15′, and may be fitted with any description of roller, smooth, corrugated, or sectional. The suspended frame is hinged in the middle and can be readily taken to pieces, so that in moving from field to field the two halves are pulled one behind the other, and pass conveniently along an ordinary or a farm road or through gateways.

The French *Tombereau-rouleau* (cart-roller) has a cart body on a pair of iron rollers, for use on soft and treacherous soil. *Guilleux à Segre.*

Fig. 2149.



Fowler's Roller for Steam Plow Culture.

The French roller, *Système-Hooïbrenk*, is scolloped and the ridges are sharp and penetrating.

2. Poole's calender rolls are shown in Fig. 499, p. 152, *supra*.

Manufacture of chilled "*Scientific American Sup.*," 533.
Poole & Co. . . . . . * "*Scientific American Sup.*," 668.
French calendering machine, Fig. 500, p. 153, *supra*.

Rol'ler Bar. The sharp-edge bar, or knife, in the bed of a rag-cutting machine.

Rol'ler Bear'ing. A socket for a roller journal, having anti-friction rollers on its interior perimeter. Fig. 263, p. 119, "*Mech. Dict.*" A *ring bush.*

Higley . . * "*Scientific American Supplement*," 1412.

Rol'ler Grip. The device for clutching the traveling rope in that system of traction of cars used on London and Blackwall railway in 1844. See ROPE RAILWAY, p. 1983, "*Mech. Dict.*"; INCLINED PLANE, *Ibid.*

The plan adopted in San Francisco and Chicago, and proposed for the East River Bridge, N. Y., consists in grasping the rope between sheaves or grooved steel rollers and applying brakes to the periphery of the rollers opposite the point where they come in contact with the rope. This permits perfect control of the movements of the car, as has been demonstrated on the Silver Street Railway in San Francisco, where there is a two-mile cable on a steep grade.
See WIRE ROPE RAILWAY, Fig. 7293, p. 2795, "*Mech. Dict.*"

Rol'ler Mill. 1. Specifically: a mill in which wheat is made into flour by a cracking process, by passing between rollers consecutively arranged in pairs.

The wheat passes through five sets of rollers, each set closer than the former. These rollers are 30" long and 10" in diameter. After passing between each set of rollers it is bolted. The last rollers have hardly anything but wheat hulls and the waxy germs which do not crack up, but smash together. The first rollers crack the kernels of wheat into say six pieces. The starchy substance which rattles out drops through the cloth sieves or bolting cloths.

These six pieces are broken between the next rollers into thirty-six pieces. Then the white starch crumbs are sifted out again, and the thirty-six pieces are passed between still tighter rollers, which crack them into 216 pieces; another set of rollers multiply each of these particles into six more, making them aggregate 1,293. Another set of rollers screwed together with tremendous pressure makes 7,776 pieces.

The numbers of course are only approximate, and are given merely to make the description of the process more clear.

See also CYLINDER MILL; HIGH MILLING, *supra*; ROLLER MILL, Fig. 4404, p. 1964, "*Mech. Dict.*"

See the following references: —

On	* "*Am. Miller*," iv. 7, 23, 49, 61, 84.
Allis & Co.	* "*American Miller*," v. 169.
Granite roll, *Brinjes & Goodwin*, Br. . . .	* "*Engineer*," xlvii. 4.
Bucholz	* "*Engineer*," l. 90.
Buda Pesth	"*Scientific American Sup.*," 1891, 2179.
Carter, Br.	* "*Engineer*," xlvi. 403.
Controversy and suits. .	"*Scientific American*," xlii. 265.
Daverio, Switz. . . .	* "*Engineering*," xxx. 250.
	* "*Engineer*," xlvi. 258.
Downton, middlings .	* "*American Miller*," iv. 48.
Escher, Wyss & Co. . .	* "*Scientific American Sup.*," 617.
Frauenfeld, Pesth . .	* "*American Miller*," viii. 40.
Ganz & Co., Buda-Pesth	* "*Engineering*," xxviii. 29.
	* "*Scientific American Sup.*," 2634.
Gray	* "*North Western Miller*," viii. 169.
Mechwart, Austria . .	* "*Engineer*," xlvi. 105.
	"*Engineer*," l. 90.
Namur	* "*Scientific American Sup.*," 617.
Stevens	* "*American Miller*," viii. 324.
Wegmann	* "*American Miller*," v. 101, 105.
Austria	* "*Engineer*," xlviii. 61, 64.
Switz.	* "*Engineer*," xlvi. 258.

2. Generally: the term includes various forms of mills for coarse grinding of grain for feed. See GRINDING MILL, *supra*, and references *passim.*

See list under MILL, p. 604, *supra*.
See also CANE MILLS; OIL CAKE BREAKERS; CALENDERING MACHINES, etc., and ROLLING MILL.

Rol'ler Skates. A long series of illustrated articles on this subject may be found in "*Engineer*," vol. xli., pp. 85, 102, 121, 129, 159, 167, 185, 208, 223, 241, 263, 287.

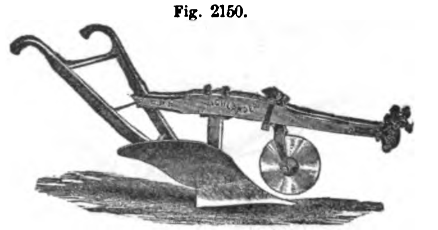
Roller skate, *Plimpton* .	* "*Engineer*," xli. 121.
Saladee	* "*Iron Age*," xix., May 17, p. 1.
Roller skate rink, N. Y.	"*Scientific American*," xl. 112.
Paris	* "*Scientific American Sup.*," 943.

Rol'ling Bridge. One whose roadway traverses longitudinally on piers as in the proposed Thames bridge. "*Engineering*," * xxi. 188, or on rails, as in Figs. 4407, 4408, p. 1985, "*Mech. Dict.*"

* "*Scientific American Sup.*" . . . . . . 312.

Rol'ling Col'ter Plow. One having a circular sharp-edged disk rolling in advance of the mold-board to cut the sod.

Fig. 2150.



Rolling Colter Plow.

Rol'ling Mill. History, varieties, and patterns of rolled plates and bars, * pp. 1966–1969, "*Mech. Dict.*"

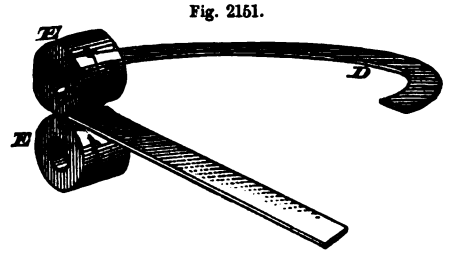
See also ARMOR PLATE, *Ibid. et supra.*

A rolled turret armor plate 13′ 10″ long, 8′ 6″ wide, and 2′ 7″ thick, weighing 65 metric tons, was shown at the Paris Exposition, 1878.

The rolling mill for sole-leather has a small brass roller, driven by steam-power and passing over a concave bed covered with brass, to which any degree of proximity may be given by a system of compound levers, thus giving any desired pressure. It is used for rolling sole-leather.

Japlin's process for making flat rings for lamp-shade and similar purposes consists in passing a strip between tapering

Fig. 2151.



Rolling Mill for Flat Rings.

rolls which expand the exterior perimeter more than the interior, giving a play to the strip which results in a flat ring. This is subjected to pressure in dies to give it any required form.

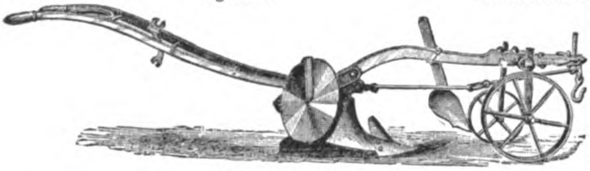
Rolling mill, first in Am.	"*Scientific American*," xlii. 291.
Mill and Engine, Bethlehem, Pa.	* "*Engineering*," xxiv. 320.
Rolling mill, Borisoglebsk, Russia . . .	* "*Engineering*," xxix. 6.
Carnegie Bros.	* "*Scientific American*," xlii. 143.
Phœnix Iron Co. . .	* "*Engineering*," xxix. 108.
Clutch, *Weston*, Br. .	* "*Engineer*," xlviii. 159.
Continuous, *Jenkins*. .	* "*Iron Age*," xxiii., March 20, p. 1.
Eye bars, *Kloman* . .	* "*Iron Age*," xxiii., April 24, p. 1.
Continuous, *Lauth* . .	"*Iron Age*," xxiii., March 27, p. 20.
Eye-bars, *Kloman* . .	* "*Iron Age*," xxxiii., April 24, p. 1.
Engine, *Brotherhood*, Br.	* "*Engineering*," xxi. 341.
Crewe, Br.	* "*Engineering*," 359.
Plate-rolling	* "*Iron Age*," xxv., Jan. 22. p. 1.
Reversing engine, Br. .	* "*Engineering*," xxv. 388, 430.
Reversing apparatus.	
Christie, Br.	"*Iron Age*," xix., May 10, p. 15.
Reversing gear, *Christie*	* "*Engineer*," xlii. 60.
Reversing-engines, Cleveland, Engl.	* "*Iron Age*," xix., Feb. 15, p. 1.
Reversing engine.	
Eston, Br.	* "*Engineer*," xliii. 41.

Reversing, Farnley, Br. * "*Engineering*," xxii. 377.
Engines, Farnley, Br. . * "*Engineering*," xxii. 381.
Reversing, *Kloman* . . * "*Engineering*," xxvii. 19.
Reversing engine.
Kolpina, Russia . . * "*Engineering*," xxiii. 108.
Three-high for steel ingots
Billings . . . . . * "*Scientific American Sup.*," 396.
Wire-rod train.
Cambria Iron Co. . . * "*Engineering*," xxvi. 41.

Report by *Holley*, Group I., "*Centennial Reports*," vol. iii., p. 42.
Tanner on "Roll Turning."

Rol'ling-mold Plow. A plow in which a curved-faced roller is substituted for the rear portion of the mold-board. It is designed to lessen friction in turning over the furrow-slice.

Fig. 2152.



Rolling-mold Plow.

Ron'geur. (*Surgical.*) A bone-gnawing or gouging forceps. *Post's* rongeur is specifically for the mastoid bone.

Roof. References to structure, Figs. 4420–4423, and Plates III., LII., "*Mech. Dict.*"

Particulars of recent improvements: —

Bituminous . . . . . "*Manufact. & Builder*," viii. 10.
Corrugated metal.
Brenton, Br. . . . . * "*Engineer*," xlvi. 21.
Iron . . . . * "*Iron Age*," xix., May 10, p. 7.
For iron structures, zinc, lead, felt, glass . . . * "*Iron Age*," xx., Aug. 30, p. 5.
Lining, mineral wool . * "*Manufact. & Builder*," x. 108.
Materials, on . . . . "*Iron Age*," xxiii., April 3, p. 7.
(Northern Ry. of France) * "*Scientific American Sup.*," 663.
(Liverpool St. Station, London) . . . . . * "*Scientific American Sup.*," 663.
Railway Station, Engl. * "*Scientific American Sup.*," 920.
Sheet-iron, *Hyndman* . * "*Eng. & Min. J.*," May 3, xxvii.
Northrup . . . . . . * "*Manufact. & Builder*," xii. 222.
Wide span . . . . . "*Scientific American Sup.*," 745.
Wooden, *Brown* . . . "*Scientific Amer.*," xxxix. 358.

Roofs and roof-trusses: * *Laboulaye's* "*Dict. des Arts et Manufactures*," vol. iv., ed. 1877, article "*Charpente*," Figs. 3389–3405.

"*Paving and roofing compositions*" is the subject of a volume containing a digest of the United States and British patents, by L. W. Sinsabaugh, Washington, 1875, and a subsequent supplement.

Campin. "*On the Construction of Iron Roofs, a Theoretical and Practical Treatise.*"

Fig. 2153.

Hornsby's Root Cutter.

Root Cut'ter. A machine for slicing roots for feeding to live stock.

There are various types: conical, cylinder, and disk, plain, toothed, shredding cutters, stepped cutters, double sets of cutters.

Several forms are shown in Figs. 4430–4432, pp. 1975, 1976, "*Mech. Dict.*"

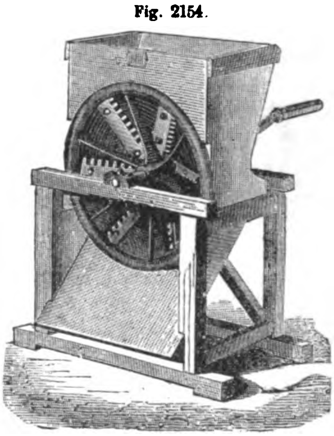
Fig. 2153 is the Hornsby root cutter (British). It cuts the root into finger pieces the whole length of the root. By the disposition of the hopper and curve of the knives the roots are not rolled in the hopper, but drawn toward the center of the disk, the result being that the finger pieces are delivered unbroken.

Fig. 2154 is Pinet's conical disk root cutter (French). The teeth of the knives project beyond the periphery of the cone and remove slices equal to the width of the teeth and of a thickness equal to the distance of their projection beyond the face of the cone. The weight of the roots in the hopper keeps them against the cone. The slices escape into the hollow cone.

Variations in the knives for the purposes of feeding cattle, sheep, etc., are found in several machines, otherwise similar in all features. Such machines are said to rasp, pulp, shred, mince, cut (*émincer*, *râper*, *couper*, etc.), as the case may be.

See * Beet-rasping Machine, Figs. 262–264, *supra.*
Decauville (Fr.), * for beets in alcohol factory.

Fig. 2154.



Pinet's Root Cutter.

Laboulaye's "*Dict. des Arts et Manufactures*," vol. iv., ed. 1877, article "*Distillation.*"
See also *Ibid.*, iii. "*Sucre.*"
Stammer, French * Dept. Agriculture, Special Report No. 28, Washington, Plate XXII.
See also Knight's report on Group 76, Paris Exposition, "*U. S. Commissioner's Reports*," vol. v., pp. 206–212, embracing those of —

Bodin	France.
Hunt & Tawell	England.
Perkley, Sims, & Co.	England.
Malden Iron Works	England.
Pinet	France.

Root Dig'ger. A machine for lifting roots from the ground. Specifically for beets and potatoes.

Dr. Knight's report of Class 76 at the Paris Exposition of 1878 contains views and descriptions of the following implements ("*Paris Exposition* (1878) *Reports*," vol. v., pp. 49–52):

Potato-digger (simple effet)	France.
Potato-digger (double effet)	France.
Potato-digger, *Penney*	England.
Potato-digger, *Spear*	United States.
Beet-pullers, *Delahaie-Tailleur*	France.

Root-digger, Beet, *Eveloy*, "*French Dept. Agric. Sp. Rept.*," No. 28, Plates VII., VIII.
Delahaie-Tailleur, "*French Dept. Agric. Sp. Rept.*," No. 28, Plates VII., VIII.
Wahlkoff, "*German Dept. Agric. Sp. Rept.*," No. 28, Plate VIII.
See Beet Root Digger, Figs. 265–267, *supra;* Potato Digger, *supra.*

Root Ex-tract'or. (*Dental.*) A fine pronged forceps. A gouge or claw.

Root Fil'ler. (*Dental.*) A tool for plugging cavities of carious teeth. See PLUGGER, *supra.*

Root For'ceps. (*Dental.*) An extracting forceps with narrow jaws. See list under FORCEPS, p. 354, *supra.*

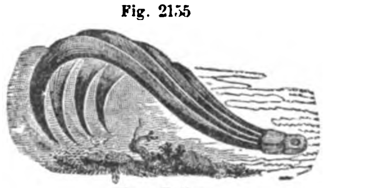
Root Ma-chine'. See under the various heads, ROOT CUTTERS, ROOT WASHERS, etc.; also BEET RASP; BEET ROOT DIGGER; POTATO DIGGER, etc.

Dr. Knight's report on Agricultural Implements (Class 76), at the Paris Exposition of 1868, gives views and descriptions of the following machines for treating roots for food: —

Root-washer, *Bodin*	France.
Root-washer, *Pernollet*	France.
Potato-assorter, *Penney & Co.*	England.
Root-cutter, *E. Bodin*	France.
Root-cutter, *Hunt & Tawell*	England.
Root-cutter, toothed knife	England.
Double-acting root-cutter, *Picksley, Sims & Co.*	England.
Root-shredder, *Maldon Iron Works*, Maldon	England.
Root-cutter, *Pinel*	France.
Root-cutter, frusto-conical cutter	France.
Portable cooking apparatus, *Beaume*	France.
Agricultural caldron, *Fouché*	France.
Agricultural boiler, *Bodin*	France.
Steam-cooking apparatus, *Richmond & Chandler*	England.

Root Pul'ler. 1. A machine for lifting roots from the ground. See ROOT DIGGER, *supra.*

Fig. 2155



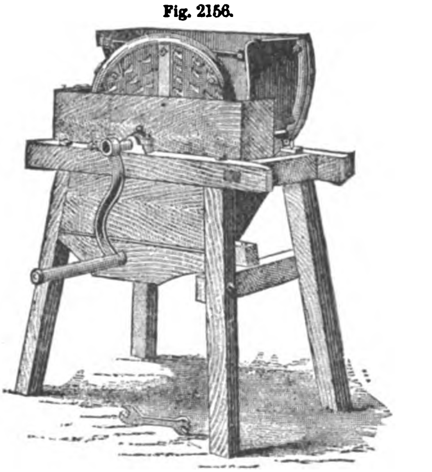
Root Puller.

2. A claw to which horses or oxen are hitched to drag roots from the soil in clearing land.

Root Rasp. A machine for pulping roots. See BEET ROOT RASP, Figs. 262-264, pp. 89, 90, *supra.*

Root Shred'der. A machine for reducing roots to shreds for feeding to stock. The machine shown in Fig. 2156 has a disk occupied by a multitude of tearing points in the sectors between the radial knives. The points tear the cut surfaces of the roots, and then the knife removes the ragged surface.

Fig. 2156.



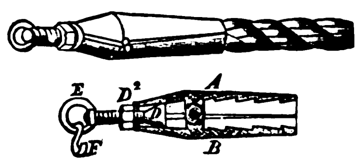
Root Shredder.

Albaret's root-cutter (Fr.), for slicing the beets used in the manufacture of sugar and alcohol, has six notched knives on a disk, and the slices of root pass into the case, and so to the floor below.

Rope Clamp. A device to secure the end of a cord, as in the case of a round lathe belt; or a connector for the signal rope of railway cars.

The clamping jaws, as shown in the engravings, are formed by two semi-tubes, *A* and *B*, made with teeth on their inner faces to hold the rope and prevent its slipping out. A pin passes through lugs on each to form a hinge

Fig. 2157.



Rope Clamp.

joint. This pin may be removed to attach the end of the rope by placing it on one jaw, when the other is laid upon it and the pin inserted. An inclined groove is cut in the solid ends of the clamping jaws, above the hinge, to receive a wedge, *D*, which is formed on the edge of the spirally threaded stem, on which is a nut, resting against a washer. *E* is a swivel ring on the end of the stem *D*, and *F* a hook on the ring for an attachment. The wedge is tightened by turning the nut D^2.

Rope-dri'ving Gear. A means of transmission of power from a driver to machinery. A substitute for belting.

In a notable case, in Manchester, England, the fly-wheel is made to serve as driving drum also; it is 22′ in diameter, and weighs about 20 tons. It is grooved for the reception of 12 hempen ropes, each 6″ in girth, six of the ropes being intended to drive one line of shafting, and six the other. The rope drums or pulleys on the shafting are 5′ in diameter; the rims are made heavy and are grooved, as is the driving drum, but for only six ropes. The width of the grooves is 2 7-16″; total depth, 3¼″; the radius of the bottom curve, ½″; and the inclination of the two sides to each other is about 49°. It will be apparent from these particulars that the ropes do not, even when pressed somewhat out of shape when doing full duty, rest upon the bottom of the grooves, but on the sides, and the wear is, therefore, at the points of contact. The wear, after 18 months' use, was tolerably uniform all around the section, thus indicating that the ropes do not present the same parts of their circumference to be continuously gripped in the grooves.

See also CABLE CARRIER, Fig. 494, p. 150, *supra.*
WIRE WAY, Figs. 7306, 7307, pp. 2798, 2799, "*Mech. Dict.*"
WIRE ROPE, Fig. 7291, p. 2795, *Ibid.*

Gear		"*Scientific American*," xxxvi. 42.
Rope clamp, Page	*	"*Scientific American*," xxxv. 99.
Rope driving gear.		
Goodfellow	*	"*Scientific American Sup.*," 1268.
Smith, Br.	*	"*Engineer*," xliii. 444.
		"*Iron Age*," xxi., April 25, p. 7.
Ropes, power transmission by	*	"*Iron Age*," xvii., Feb. 24, p. 1.
Rope transmission in mills, *Pearson*	*	"*Engineering*," xxi. 76.

Rope-mold'ing Ma-chine'. A machine for scroll-turning stuff for balusters, stretchers, etc.

The molding is cut by a revolving cutter head, with cutters to suit the style or size of work. The stick being first turned round by a rod machine or lathe, is fed in, and at the same time revolved by the feed attachment, the feed and guides being adjustable to the different sizes. The machine works any size, from 3″ down, making a very smooth finished molding, requiring little or no after finish. By an arrangement for working the stick at an angle with the cutters, the style of the twist can be altered, and made close or open, as desired. — *Rogers.*

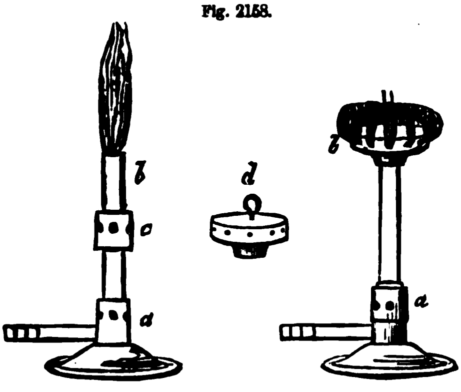
See also BALUSTER LATHE, p. 71, *supra.*
CARVING ATTACHMENT FOR LATHES, Fig. 555, p. 174, *supra.*

Rose Burn'er. Or *Rosette Burner.* A form of gas burner in which the gas issues at a circular series of openings, the jets resembling petals. See BUNSEN-BURNER FURNACE.

See also *b c*, Fig. 5924, p. 2411, "*Mech. Dict.*"

The burner shown in Fig. 2158 gives a single flame for crucibles, and a circle of flames when liquids are to be heated in vessels of glass or porcelain. The burner *a b* is similar to

Fig. 2158.



Rose Gas Burners.

Bunsen's; *c*, a regulator to control the entrance of the air into a box, *a*, and thus prevent the flame from blowing down; *d*, the rose, which divides and spreads the flame when put on the top of tube *b*. *e* shows the single or igniting flame; *b*, the spread or evaporating flame.

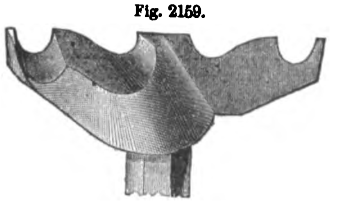
Rose Glass. A celebrated French glass, prepared in a special manner.

A certain quantity of auriferous glass is prepared beforehand, and run in thin plates, and fragments of these plates are used by the glass blower to fuse upon his work, and thus give it a superficial coloration. It often happens that the same composition of auriferous crystal gives plates of very different shades, some colorless, others tinged more or less deeply with rose or red, and some almost black; these differences being due to two causes, namely, the temperature of the furnace in which the fusion has been effected, and the temperature of the mold into which the melted metal is run. For light colored plates the temperature of the furnace is made low, and the mold very cold; blue plates are sometimes produced under the same circumstances, which, if reheated, take the normal color, as do also the colorless and very pale rose glasses. Crystal colored with gold is merely a vitreous matter, holding in suspension metallic gold in a state of very fine subdivision. It is stated that on attentively examining the red plates, it is easy to recognize in the mass a multitude of most brilliant specks of metallic gold, forming a sort of aventurine (which see).

Ro-sette′. (*Nautical.*) A form of knot. See 32, Fig. 2777, p. 1240, "*Mech. Dict.*"

Ro-sette′ Cut′ter. A steel cutter of inverse form for forming a circular ornament of wood.

Fig. 2159.



Boult's Rosette Cutter.

Ros′in Core. A dry-sand core in which rosin has been used for the purpose of increasing the adhesiveness and strength of the sand when dried.

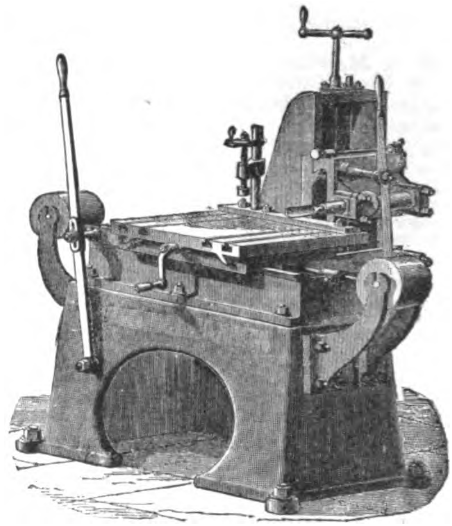
Ros′in Oil. (*Leather.*) A compound of melted rosin and linseed oil.

Ro′ta-ry-bed Pla′ning Ma-chine′. One with a continuously moving bed. See TRAVERSING-BED PLANING MACHINE, Fig. 6627, p. 2620, "*Mech. Dict.*"

Ro′ta-ry En′gine. See ROTARY STEAM ENGINE.

Ro′ta-ry Mor′tis-ing Ma-chine′. A form of mortising machine in which the cutter revolves and works by a routing action; as distinct from the ordinary form, in which the cutting is done by a reciprocated chisel.

Fig. 2160.



Mortising, Routing, and Recessing Machine.

The work is dogged or chucked to a table which has a compound movement and subjected to the action of a rotary router.

Ro′ta-ry Plow. A rotary plow which acts as a spader is shown in Fig. 4464, p. 1988, "*Mech. Dict.*" See also SPADING MACHINE, p. 3252, *Ibid.*

The rotary plow shown in Fig. 2161. The piece acting as share and mold-board is a circular disk or conical frustum

Fig. 2161.

Rotary Plow.

which penetrates the soil, lifts a slice and turns it over. The cut shows a double or two-furrow plow.

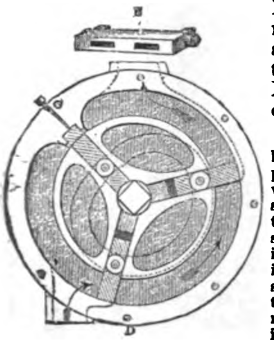
Ro′ta-ry Pump. A pump which acts by a rotary, in contradistinction to a reciprocating action.

Under the caption ROTARY PUMP, pp. 1988, 1989, "*Mech. Dict.*," 24 illustrations are given of rotary pumps of various kinds: single and double pistons and centrifugal.

In the illustration of the Douglas pump, Fig. 2162, the shaded portion with arrows indicates the water and its direction. The pistons are three in number, and operated by a scroll race in which the rollers of the pistons work. By this means the pistons are held against the inner perimeter of the cylinder in which they work, and withdrawn to pass the abutment. Passages through the slides balance the water pressure on their respective sides.

Samain's pump (French) is shown in Fig. 2163. It has four palettes, arranged in pairs and moving in slots in the cross of the arbor. They are so arranged that when one is out, abutting against the interior perimeter of the chamber, the other is in, passing its lowest position in contact with the abutment. The arrows show the direction of the water.

Fig. 2162.

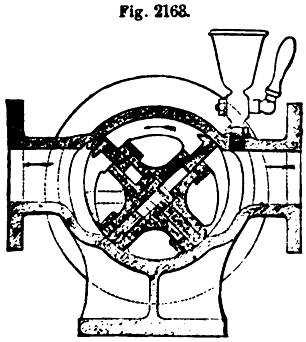


Douglas Rotary Pump.

Fig. 2164 is the Bagley and Sewall rotary pump in which an eccentric ring rotates in the cylinder. It is shown by vertical section.

A is the main case or body of the pump in one piece, on the interior of which is the ring *B*; the space outside of *B* being the cylinder or water space. This cylinder is inclosed by a disk which is attached firmly to the shaft. To the disk is attached eccentrically a ring *E*, a portion of which is always in contact with the outside of casing *A*, and also with the ring *B*, at a point exactly opposite; so that the eccentric ring *E* is really the piston of the pump; the disk and ring being rotated by the shaft driven by pulleys. *I* is the suction port, and *J* the discharge. These ports are separated by the sliding abutment *H*, which moves back and forth on its seat with the throw of the eccentric ring *E*. The tumblers fitted to this abutment adjust themselves to the ring, and as the pressure is constant upon them from above, they effectually pack the ring and prevent any escape of water below.

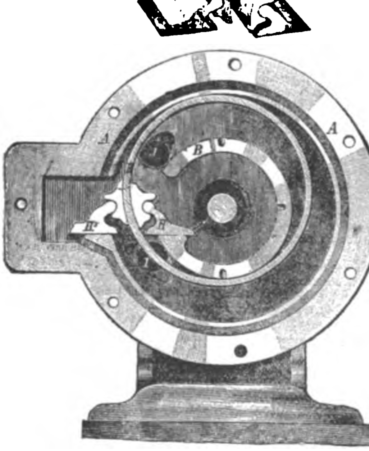
Fig. 2163.



Samain's Pump (Fr.).

The water enters at *I*, and as the piston ring rotates, it is forced before and between it and the casing, around to the upper portion of the latter and out at the port *J*. As the ring rotates it opens a space between its inner periphery and the fixed ring *B*, into which space the water from port *I* enters, filling the interior of the piston, to be forced out as before. The center ring *B* is made enough deeper than the casing *A*, to exactly equalize the contents of the inside and outside of the piston ring *E*, thus securing a perfectly steady flow of water from the discharge. *F* is the cover or outside case. Holes are made through the disk *D* to allow the water to pass through and between it and the outer case, thereby balancing the working parts, and equalizing the pressure upon them. One end of the shaft has a closed bearing in this outer case; the other bearing is in the case *A*. On the shaft, and being a part of the disk *D*, is a collar which is fitted to the seat *K*, making a perfect water-tight joint, by which all "packing" of the pump is avoided. In the center of the seat *K* is a circular groove, which connects by a drilled channel with the suction port. Should there be any tendency to escape of water at the seat *K*, the force of the suction keeps the port closely to the seat, and absolutely sealed against air or water.

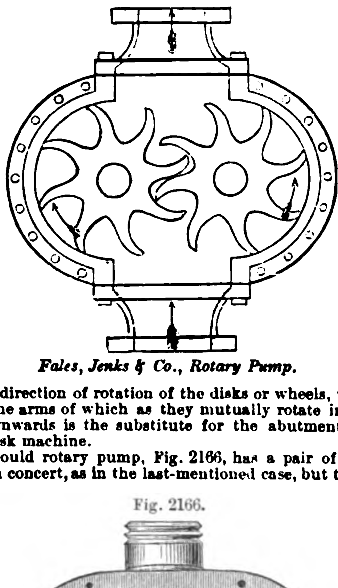
Fig. 2164.



Bagley & Sewall's Rotary Pump.

Fig. 2165 is the double wheel pump of Fales, Jenks & Co. The arrows show the direction of the water, and thus indicate the direction of rotation of the disks or wheels, the contact of the arms of which as they mutually rotate inwardly and downwards is the substitute for the abutment in the single disk machine.

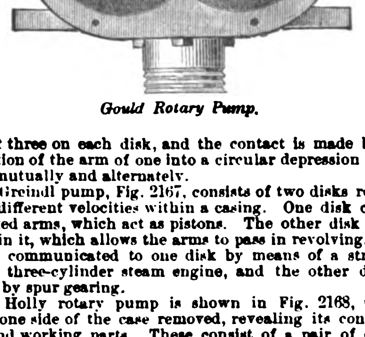
Fig. 2165.



Fales, Jenks & Co., Rotary Pump.

The Gould rotary pump, Fig. 2166, has a pair of pistons acting in concert, as in the last-mentioned case, but the arms are but three on each disk, and the contact is made by the projection of the arm of one into a circular depression in the other mutually and alternately.

Fig. 2166.

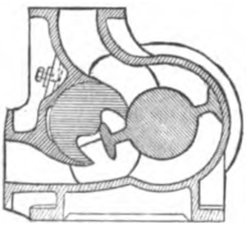


Gould Rotary Pump.

The Greindl pump, Fig. 2167, consists of two disks revolving at different velocities within a casing. One disk carries two fixed arms, which act as pistons. The other disk has a recess in it, which allows the arms to pass in revolving. Motion is communicated to one disk by means of a strap or patent three-cylinder steam engine, and the other disk is driven by spur gearing.

The Holly rotary pump is shown in Fig. 2168, which shows one side of the case removed, revealing its construction and working parts. These consist of a pair of corrugated cams working together within an elliptical case, the ends of the long teeth being packed by blocks of metal inserted into the grooves and pressed out by springs, thus insuring a perfect vacuum and the taking up of any little wear there may be after years of pumping. The water enters at the

Fig. 2167.



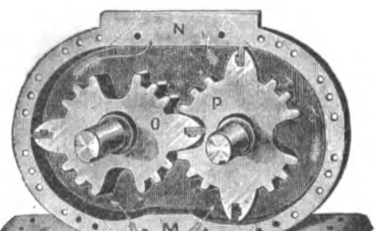
Greindl's Rotary Pump.

bottom through the suction *M*, the stream dividing and filling the chambers made by the long teeth, passing around the cams *O* and *P*, and discharging from the top through the outlet *N*. The motion of the pump is equable, continuous, and rotary, the cams working together inwards from the top. Thus, when one chamber has just discharged, another is discharging, another one is on its way, and still another one is just filling, so that the stream is always uniform and steady.

The Silsby rotary pump is shown in Fig. 1031, p. 337, *supra*.

Lift pump, *Bamford & Sons*, Engl. . . . . * "*Scientific American*," xl. 51.
"Comet," *Bartrum & Powell*, Br. . . . . * "*Engineer*," xlvi. 148.
 * "*Scientific American Sup.*," 2374.
Crocker . . . . . . * "*Scientific American Sup.*," 182.
Doremus . . . . . . * "*Scientific American Sup.*," 298.

Fig. 2168.



Holly Rotary Pump.

Greindl's Nijni-Novgorod, Rus. . . . . . * "*Engineering*," xxx. 341.
Greindl . . . . . . * "*Eng. & Min. Jour.*," xxiii. 103.
Hougoux . . . . . * "*Scientific American*," xxxvi. 182.
Rotary steam circulating engine and pump, *Manley*, Br. . . . . * "*Engineering*," xxv. 451.
Rotary pump, *Newcomb* * "*Scientific American*," xliii. 50.
Force pump, *Newcomb* . * "*Scientific American*," xxxviii. 358.
Ortman . . . . . * "*Scientific American*," xli. 6.

Ro'tary Sha'per. See Shaper.

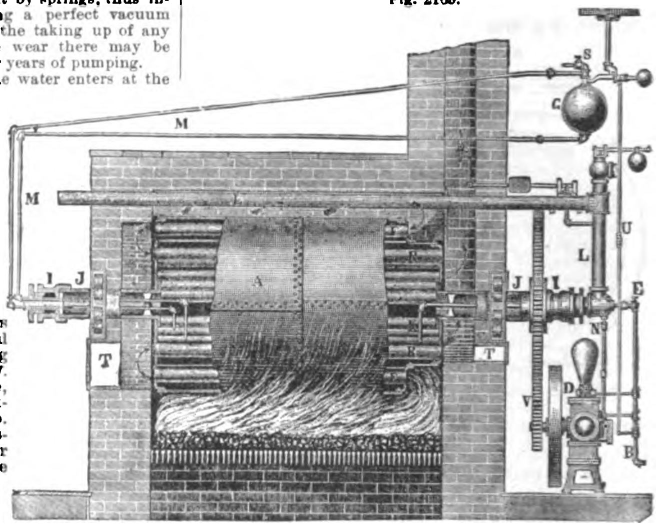
Ro'tary Steam En'gine. (*Steam.*) The name is applied not alone to the rotary piston engine, but also to those reciprocating engines — of which there are numerous examples in water-works engines — which have a fly-wheel and crank shaft.

The class of steam engines ordinarily known as *rotary*, are exhibited in 28 illustrations, pp. 1690–1694, "*Mech. Dict.*"

See also the following references: —

Apperley . . . . . "*Scientific American Sup.*," 1617.
Behren . . . . . *Deschamel's* "*Natural Philosophy*," l. 481.
Coomber, Br. . . . . * "*Engineer*," xli. 42.
Coomber . . . . . * "*Scientific American Sup.*," 165.
De Groat . . . . . * "*Scientific American*," xlii. 310.
Dexter, Br. . . . . * "*Engineer*," l. 218.
Gallahue . . . . . "*Scientific American*," xxxv. 1.
Hajni . . . . . "*Engineering*," xxvi. 491.

Fig. 2169.



Pierce Rotary Tubular Boiler.

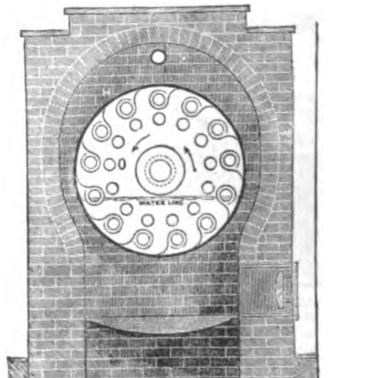
Henderson . . . . . * "*Scientific American*," xl. 326.
High-speed, *Hoason*, Br. * "*Engineer*," l. 417.
Lawrence . . . . . * "*Engineer*," xlviii. 163.
Lawrence . . . . . * "*Scientific American*," xl. 259.
Lidgerwood . . . . . * "*Scientific American*," xxxv. 182.
Noteman . . . . . * "*Amer. Man.*," Dec. 31, 1880, p. 9.
Noteman . . . . . * "*Scientific American*," xl. 406.
Silsby Man. Co. . . . * "*Thurston's Vienna Report*," ii. 105.
Stiles . . . . * "*Min. & Sc. Press*," xxxvi. 401.
Titus . . . . . "*Scientific American Sup.*," 292.
Weigho (Ger.) . . . . "*Manufact. & Builder*," viii. 193.

Laboulaye's "*Dict. des Arts et Manuf.*," iv., ed. 1877, article "*Machines à vapeur*," shows the engines of —

Watt. *	*Behrens.* *	*Girard.*
Cochrane. (2) *	*Pecquerer.* *	
Thomson. *	*Hicks.* *	

Ro'ta-ry Tu'bu-lar Steam Boil'er. The Pierce rotary tubular boiler (Figs. 2169, 2170) is a cylindrical rotary tubular steam boiler, with two circular rows of tubes running from end to end. The outer rows of tubes are surrounded by buckets or elevators which are so arranged as to nearly encircle them, and to cover the inner surface of the

Fig. 2170.



Pierce Rotary Tubular Boiler.

boiler-shell with water at each revolution. The inner row of tubes act as superheaters for drying as well as generating steam. The boiler is incased in brick-work and is supported upon trunnions at each end in such a manner that it is rotated by gearing actuated by the steam pump that supplies the boiler with water, or other motor power.

The boiler is at all times one-quarter full of water, which amount is unchangeable, being regulated by an automatic feed-water regulator.

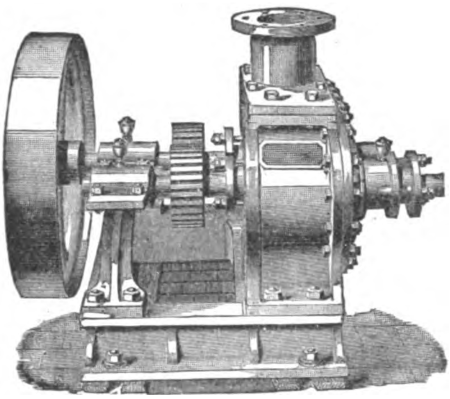
The feed-water is introduced through one trunnion, and the steam withdrawn through the opposite trunnion.

The grate has an area equal to the entire inner base of the brickwork surrounding the boiler.

The flame and heated gases arising from the grate completely surround the boiler, thence pass through the outer row of tubes to the opposite end, emerging into a chamber, thence returning through the inner or superheating row of tubes, en route to the stack or chimney.

Ro'ta-ry Wa'ter En'gine. Behren's rotary water engine (English) is a simple form of motor having but few moving parts. It consists of a casing bored out to receive two piston blocks, which furnish an alternate abutment to each other. The pistons are connected by spur wheels, and their motion is therefore perfectly uniform and continuous.

Fig. 2171.



Appleby Bros. Rotary Water Engine. Behren's Patent.

No power is lost in overcoming the inertia of reciprocating, and no fly-wheel is required. It is the rotary engine common in the domain of steam, but in this case driven by water pressure. The same set of pistons moved by mechanical connection from an exterior motor may constitute a rotary pump. See pp. 1991 and 1988, 1989 respectively, "*Mech. Dict.*"

Ro-ta'tor. An apparatus for producing iron by the direct process.

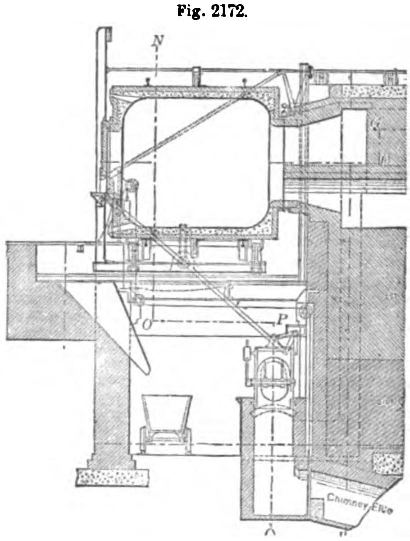
"The apparatus, or 'rotator,' Figs. 2172, 2173, consists of a revolving furnace, lined with oxide of iron. Gas from producers and air from one pair of regenerators enter at one end of the furnace, burn and reverberate within it, and pass out at the same end into the other regenerator. There is a large charging and discharging door at the other end of the furnace.

"At Dr. Siemens' Works, at Towcester, the small rotator, 9½' long by 8½' in diameter, takes a charge of 30 cwts. of ore mixed with 8 cwts. of small coal. In about 2½ hours the reduction of the ore is completed; the slag is tapped off, and the heat and speed of rotation are increased to form the mass into an elongated ball, which is hammered into a bloom. An average of 43 consecutive charges at Towcester gave the following results: —

Iron in ore charged, lbs.	1,274
Coal, lbs.	728
Time for operation	3.12
Blooms made, lbs.	1,113
Loss, per cent.	12.6
Coal in producers per ton of blooms, tons	2

"The particles of iron forming the blooms, if perfectly separated from the slag, are practically pure, however impure

Fig. 2172.

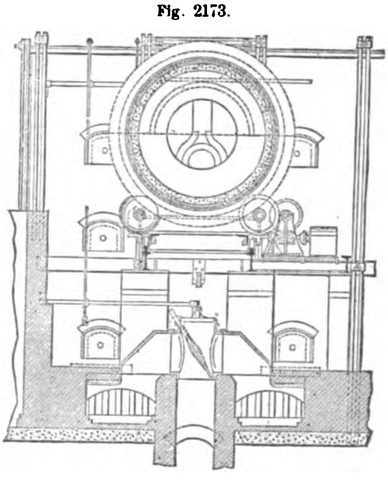


Siemens' Rotator.

the ore may be. The slag contains sometimes 6 per cent. of phosphoric acid and one to two per cent. of sulphur. The pure iron will alone remain in the open-hearth bath, although some few hundredths of phosphorus may be taken up from the slag at the highest temperature.

"The first trial of the process in the United States was at Park Bro. & Co.'s Works, in Pittsburg. There were no serious difficulties, except the oxidation referred to, in the manufacture of the balls into wrought iron. Within the last few months a large rotator, 11' long by 11' in diameter, has been started at Tyrone Forges, Pa., by Mr, Robert J. Anderson, of Pittsburg, to make material for his open-hearth furnaces. Although the operations have purposely been experimental, with various ores and lining materials, enough has been done to show that a product of excellent quality may be got from any ore, and that linings (necessarily oxide) may be adapted to any ore, although a very silicious ore requires the use of so much lime that the repairs of linings are proportionally increased.

Fig. 2173.



Siemens' Rotator.

"In an average week's work at Tyrone, with Robinson ore and the highly silicious Pennington ore, the mixture having about 50 per cent. of iron, the charges were: Ore, 4,000 lbs.; reducing coal, 600 to 700 lbs.; limestone, 250 lbs.: scale and cinder, 800 lbs. The yield of blooms was 1,600 to 1,700 lbs. per charge, or 80 to 85 per cent. of the iron in the ore. The producer coal was 3,800 lbs. per ton of blooms. The week's work was 19 operations, producing 14 tons of blooms.

"The cost of blooms, with ore averaging about $8 and coal $2.15, and with labor charged at the very high rate of $10 per ton, was a little over $25 per ton. Experimental labor is of course excessive, and in this case the men could have just as well run four furnaces as one. Labor should not exceed $2.50 to $3 per ton in a plant of four rotators. The output has been gradually increasing and has reached five operations per 24 hours. The producer coal has also been gradually decreased. Of course working costs can be only approximately determined from experimental costs, but it seems safe to say that blooms can be produced at a small advance over the cost of pig from the same ore.

"The cost of a plant of four rotators, ore crushers, hammer or squeezer, etc., exclusive of building, is about $40,000, and its output with existing appliances only, in regular rather than in experimental work, is estimated at 125 tons per week. This looks at first like a small output, but it must be remembered that the entire blast furnace plant is dispensed with. An obvious improvement, not in any way experimental, is about to be introduced. It is calcining the ores in any suitable kiln and running them red hot into the rotator. As about half the time of the operation is now occupied in getting the charge up to a reducing temperature, it is obvious that the calcining — a cheap operation — will nearly double the output of a rotator plant.

"Charcoal blooms are at present the best material in the market for making fine open-hearth steel; they are used together with the smallest possible bath of Bessemer pig for the finest fire-box plates. If Siemens direct blooms (even should they have more mechanical impurities) are not as good as charcoal blooms for open-hearth steel, the reason is not obvious. Such practice as there is seems to prove them equally good. As I have similarly stated in previous papers describing new processes, the object of these notes on the Siemens' process is not to compare it commercially with other preparatory processes, but simply to state its existing *status* and the probable course and means of its further development." — *Holley.*

Roth'er-nail. (*Shipwright.*) A large headed nail used for fastening the rudder-irons of ships.

Rough'ing Hor'ses. A simple mode of roughing horses, practiced in Russia, consists in punching a square hole in each heel of the shoe, which, in ordinary weather, may be kept closed by a piece of cork. When the ground is slippery, the cork is removed, and a steel spike inserted. If this steel rough be made to fit the hole exactly, it remains firm in its place, and is not liable to break off short at the neck like some of the screwed spikes.

Round Bar Spi'ral Spring. A spring of round steel coiled around a mandrel; as distinguished from a *flat-bar* coiled spring. See illustrations of each in Fig. 1143, p. 483, "*Mech. Dict.*"

Round'ing Ma-chine'. 1. A wood-working machine, also known as a cornering machine, used in chamfering off the corners of stuff; especially in implement and carriage work. See CHAMFERING MACHINE.

2. A machine for making round rods and spindles. See ROD MACHINE, PIN MACHINE, and DOWEL MACHINE.

3. A machine to round book backs. See BOOK-BACKING MACHINE, Fig. 381, p. 120, *supra.*

4. A machine for giving the rounded depressions in blanks for shoe soles. A sole-stamping machine.

Rough Point'ed Stone. (*Stone Cutting.*) When it is necessary to remove an inch or more from the face of a stone, it is done by the pick or heavy points until the projections vary from ½" to 1". The stone is then said to be rough pointed. This operation precedes all others in dressing limestone and granite.

See POINTED WORK.

Fig. 2174.

Round Iron.

Round Iron. The plumbers bulbous iron used in smoothing solder joints of lead pipe.

Round Scut'tle. (*Nautical.*) A scuttle with a circular frame suitable for iron ships, with brass door for glass, brass screw fastening, painted iron frame, and hinged iron dead-door complete.

Round Seiz'ing. (*Nautical.*) A loop made in rope by a single turn on itself, and seizing the crossing. See *c, e,* Fig. 4825, p. 2091, "*Mech. Dict.*"

Round Swage. (*Blacksmithing.*) A form for shaping iron.

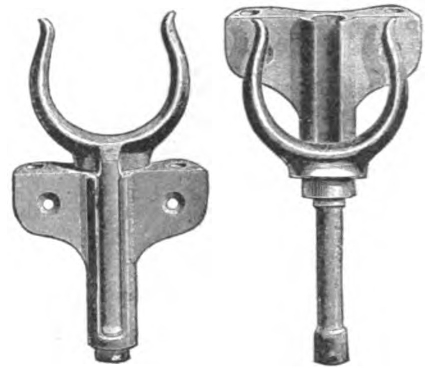
Row'ing Gear. Outriggers and various devices to assist the oarsman. See OAR, Fig. 1824, p. 637, *supra.*

Lyman . . .	* "*Engineer*," xliii. 340.
	* "*Iron Age*," xix., April 12, p. 5.
	* "*Scientific Amer.*," xxxiv. 343.
Rowing sled, *Dennis* .	* "*Scientific Amer.*," xlii. 387.
Rowlock, *Spelman* . .	* "*Scientific Amer.*," xxxvii. 70

Davis rowing gear (Courtney's mysterious rig), Patents Nos. 231,016, 231,017.

Fig. 2175.

IN POSITION. OUT OF POSITION.

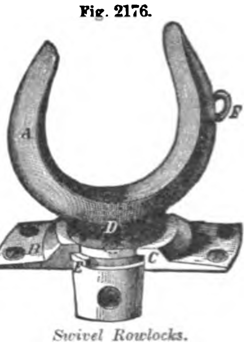


"*Acme*" *Rowlock.*

Row'locks. (*Boat*). Spaces in the gunwale for the oars to rest in rowing; or contrivances on the gunwale for the same purpose.

The Acme rowlock is used without a laniard; and, instead of removing the horns from the sockets when along side of vessels or wharves, as is required with most other rowlocks, simply turn them half way around, and they fall of their own gravity below the gunwale, obviating the necessity of removal from the sockets, except when it is desired to do so.

Fig. 2176.



Swivel Rowlocks.

In Fig. 2176 the rowlock plate *B C* is firmly fastened on top of the gunwale, and does not weaken it like the cutaway swivel rowlock, with sockets.

Fig. 2177 shows an outrigger rowlock wood-lined.

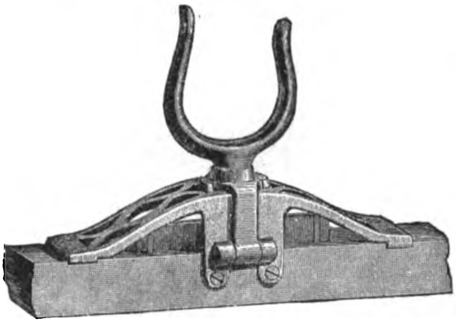
The Navy rowlock, Fig. 2178, is instantly changed from its position to a hanging one, or can be detached from the boat. To detach, turn long horn aft, draw up, and turn out. It is automatic in its motion, adapting itself to the motion of the oar, and always in position to receive it, *i. e.*, "fore and aft" the boat.

Fig. 2177.

Outrigger Rowlock.

Row Mark'er. (*Agric.*) An implement for marking out ground for planting in rows. See MARKER, Fig. 1681, p. 584, *supra.*

Fig. 2178.



Navy Rowlock.

Rubbed Stone. (*Stone-cutting.*) In dressing sandstone and marble, it is very common to give the stone a plane surface at once by the use of the stone saw. Any roughnesses left by the saw are removed by rubbing with grit or sandstone. Such stones, therefore, have no margins. They are frequently used in architecture for string courses, lintels, door jambs, etc., and they are also well adapted for use in facing the walls of lock chambers, and in other localities where a stone surface is liable to be rubbed by vessels or other moving bodies.

Rub'ber. Caoutchouc; a vegetable gummy substance obtained from a number of plants and trees, and entering as an element very extensively into mechanical productions.

The coast region north and south of the Congo is becoming quite an important source of caoutchouc. It is produced by a giant tree creeper (*landolphia*), which grows principally along the water-courses. It covers the highest trees, and frequently considerable extents of forest are festooned down to the ground, from tree to tree, in all directions with its thick stems, like great hawsers. Sometimes its stem is as thick as a man's thigh. Above, the trees are nearly hidden with its large, glossy leaves of dark green hue, and studded with beautiful bunches of pure white star-like flowers, most sweetly scented. Its fruit is of the size of a large orange, yellow when ripe, and perfectly round, with a hard, brittle shell; inside it is full of a soft reddish pulp of an agreeable acid flavor, much liked by the natives. It is not easy to obtain ripe seeds, as the creeper is a favorite resort of a villainous, semi-transparent, long-legged red ant — with a stinging bite, like the prick of a red-hot needle — which is very fond of the pulp and the seeds distributed through it.

Every part of the creeper yields a milky juice when wounded; but, unlike the juice of the American rubber tree this milky sap will not run into a vessel placed to receive it. It dries so quickly that a ridge is soon formed over a cut, and the flow arrested. When collecting it, the natives make long cuts in the bark with a knife, and as the sap gushes out they wipe it off continually with their fingers and smear it on their arms, shoulders, and breasts, until a thick covering is formed. Then they peel it off and cut it into small squares for transportation.

A good cement, that will render india rubber in any form adherent to glass or metal, is oft-times a desideratum with photographers, and in the "*Polytechnisches Journal*" there is a simple recipe given for the preparation of such a compound. Some shellac is pulverized, and then softened in ten times its weight of strong ammonia, whereby a transparent mass is obtained, which becomes fluid after keeping some little time, without the use of hot water. In three or four weeks the mixture is perfectly liquid, and, when applied, it will be found to soften the rubber. We are told that the rubber hardens as soon as the ammonia has evaporated again, and thus becomes impervious both to gases and to liquids. For cementing the rubber sheet, or the material in any shape, to metal, glass, and other such surfaces, the cement is strongly recommended.

The use of the salts of barium for adulterating goods sold by weight is on the increase. Some rubber goods have been found with these salts in the material, which on combustion left as much as 60 per cent. of ash, pure rubber leaving only 2.5 or 3 per cent. The adulterated goods cracked and lost their elasticity.

Rubber over-shoe making . * "*Scientific Amer.*," xxxv. 262.
Solvents . . . . "*Scientific Amer.*," xxxv. 325.
Rubber stamps, making . "*Manuf. & Build.*," ix. 119.
* "*Manuf. & Build.*," ix. 143.

Rub'ber Cen'ter Spring. A car or vehicle spring with a caoutchouc cylinder or block inclosed in a spiral spring, or otherwise associated; as seen in several forms and instances in Figs. 1142–1144, pp. 482, 483, "*Mech. Dict.*"

Rub'ber Dam. (*Dentistry*). A shield of sheet rubber clasped around a tooth to exclude saliva during operation upon the tooth. See DAM, 3, *supra.*

Rub'ber Dam Clamp. See DAM CLAMP, Fig. 776, p. 245, *supra;* DAM CLAMP FORCEPS, Fig. 777, p. 245, *supra.*

Rub'ber Mop. The mop-head has a plate of thick rubber which is used as a scrubber or squeezer.

Rub'ber Pack'ing Ring. An annular gasket acting as a packing in many forms of pistons.

Rub'ber Spring. A spring of caoutchouc, in whole or in part. See instances in Figs. 1142–1144, pp. 482, 483, "*Mech. Dict.*"

Rub'ber Tu'bing. Impervious rubber tubing; may be made entirely impassable to coal gas by painting it over with a solution of silicate of sodium; otherwise known as water glass.

Rub'ber Tread. A step covering of vulcanized caoutchouc.

Rub'ber Wheel. A wheel with noiseless rubber tire.

Rub'bish Pul'ley. A simple form of tackle-block, used with a rope in hoisting materials from a foundation or excavation. A *gin-block.*

Ru'by Glass. (*Glass.*) Red glass. Made by repeated meltings with the addition of brown oxide of copper, oxides of lead and tin, scales of iron, and borax. The color is developed by repeated heatings with added quantities of the above coloring agents.

Rud'der. The principles governing the proportions and the amplitude of the circle described during its evolution, considered in article "*Gouvernail,*" *Laboulaye's* "*Dict. des Arts et Manuf.,*" tome iv., ed. 1877.

Jury rudder, *Cagliesi* . * "*Scientific American,*" xxxv. 297.

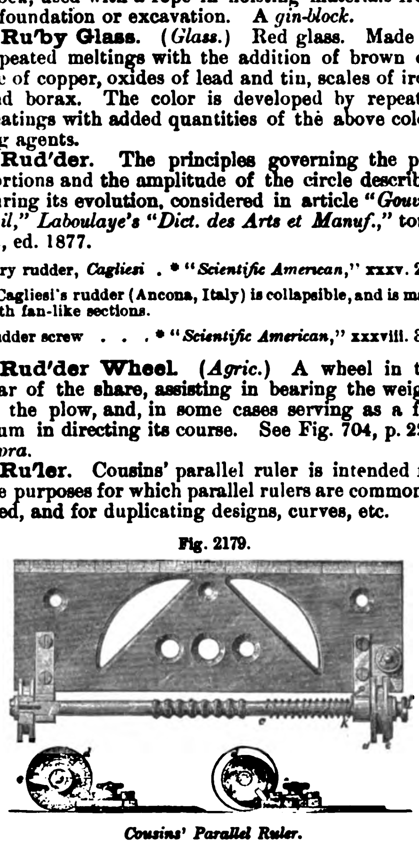
Cagliesi's rudder (Ancona, Italy) is collapsible, and is made with fan-like sections.

Rudder screw . . . * "*Scientific American,*" xxxviii. 306.

Rud'der Wheel. (*Agric.*) A wheel in the rear of the share, assisting in bearing the weight of the plow, and, in some cases serving as a fulcrum in directing its course. See Fig. 704, p. 225, *supra.*

Ru'ler. Cousins' parallel ruler is intended for the purposes for which parallel rulers are commonly used, and for duplicating designs, curves, etc.

Fig. 2179.



Cousins' Parallel Ruler.

The plate *a*, which forms the body of the ruler, has formed in it two oppositely disposed segmental openings, whose straight sides form an angle of 45° with the beveled edges of the ruler. It has also several small circular apertures, which may be utilized in forming curved lines.

Parallel with one of the edges of the plate *a*, a shaft, *c*, is journaled in suitable supports. On the ends of this shaft and outside of the bearings there are grooved wheels, *d*, which do not quite touch the surface on which the plate *a* rests.

To one of the wheels, *d*, is an arm, *e*, secured by the screw *f*, as shown in Fig. 2, and in the groove of the same wheel there is a pin that strikes the stop which is secured to the plate *a* by the screw *i*. This stop is arranged to engage the arm *e* also.

On the shaft *c* is placed a spiral spring, *k*, which returns the pin in the groove of the wheel to the stop on the plate *a*, as indicated in Fig. 3.

The side of the wheel *d* is graduated so that the arm *e* may be adjusted at any required distance from the pin in the groove. This distance governs the space between the lines formed along the edge of the ruler.

In drawing parallel lines the arm *e* having been adjusted as already described, the shaft *c* is pressed down until the wheels *d* touch the paper on which the lines are to be made: this tips up the beveled edge of the plate *a*. The instrument is now moved forward, by rolling the milled portion of the shaft under the fingers, until the arm *e* strikes the stop on the plate *a*, when the plate is allowed to regain its former position and the line is drawn. In drawing the successive lines the operation is repeated.

Section lining is done along the straight edges of the segmental openings, and curved lines are formed along the curved sides of the openings. Various designs may be duplicated by fastening patterns to the plate *a*, so that they will move with it.

Pattern makers use a rule whose divisions are made a certain per cent. longer than standard measure. Iron castings shrink in cooling about 1 per cent. or ⅛ of an inch to the foot. The patterns require to be made proportionately larger. By using the rule ⅛ of an inch in a foot longer than the standard, every measurement of the pattern is made proportionately larger without the trouble of calculation.

Desk rules are either flat, round, or hexagonal. The flat rulers have a beveled edge to avoid blotting the paper with ink flowing from the side of the pen. For adjustable and parallel rulers, see "*Mech. Dict.*," Figs. 4497, 4498, p. 2001.

An instrument for guiding a pen or pencil in drawing straight or curved lines.

Rule, spiral, *Fuller*, Br. . . .	* "*Engineering*," xxvii. 257.
Parallel, *Cousin*	* "*Scientific Amer.*," xl. 118.
Kempe	* "*Teleg. Jour.*," v. 268.
Ruling pen, *Hoffman* . . .	* "*Scientific Amer.*," xl. 150.
Drawing a straight line, *Kempe*	* "*Sc. Am. Sup.*," 1340, 1352, 1364, 1383.

Rule Cut′ter. A machine for cutting to lengths rules and leads used in the composition of rule, column, or table matter.

Fig. 2180.

Rule and Lead Cutter.

The front gage is for cutting narrow strips or spaces, and the back gage is reversible, so that it may be set to cut to 9″ in length.

Ru′ling Ma-chine′. William A. Rogers, of Cambridge Observatory, Mass., has a machine for ruling microscopic lines on glass. It will rule 80,000 parallel lines in an inch.

See paper by *Prof. Rogers*, in the "*Proceedings of the American Academy of Arts and Sciences*," where Nobert's plates are considered and the method of their production discussed. Also the modes of preparing diamond ruling-points. See NOBERT'S PLATES, p. 1581, "*Mech. Dict.*"

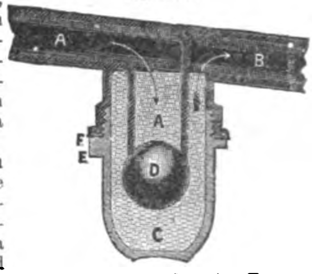
Run′ner. On the stick of an umbrella, the tubular piece to which the stretchers of the ribs are swiveled.

Higgins' automatic runner . .	* "*Engineer*," xlii. 165.

Run′ning Board. (*Railway*). A board placed over the ridge or center of a freight-car roof, and extending the whole length of the car, and which is provided for train-men to walk or run on, in going from one end of a train to the other. — *Forney*.

Run′ning Trap. A depressed bow-shaped section in a pipe, forming a U, through which water passes freely, but the depression remaining filled with water, affords a seal.

Fig. 2181.



Bower's Sewage Running Trap.

AA — Inlet pipe connecting directly with the wash-stand, sink, or other fixtures.

B — Outlet pipe connecting directly with the main waste-pipe.

C — Cup-shaped chamber which always remains filled with liquid up to pipe *B*, thereby floating the hollow rubber valve *D* firmly to the mouth of the pipe *A*, and making a perfect seal.

E — Is a small lug on the cup, to enable a person to screw and unscrew the cup easily.

F — Is a rubber gasket to prevent leakage from the joining of the cup to the body of the trap.

Rus′sian I′ron. The smooth, glossy-surfaced sheet-iron of Russia has been imitated in many quarters with varying success. Below we give one process, furnished by M. Koulibine, a Russian engineer: —

These polished sheets are manufactured from charcoal iron, produced in finery fires and brought into the form of blooms about one inch thick. These blooms are heated to cherry heat and rolled into leaves. Each of these leaves is cut into pieces corresponding to the weight of the sheets which are to be manufactured, and these pieces are piled upon one another and rolled together until the desired degree of thinness is attained. Thus the black sheets are manufactured. To transform these into polished sheets a certain number at a time are heated to red heat and piled one upon another, a black, impalpable powder, which is simply pulverized charcoal, being sprinkled between each two sheets. The bottom and the cover of each packet of sheets thus piled for polishing are formed by two sheets of greater thickness. This packet is then hammered for the purpose of reducing the sheets still further in thickness, under a hammer, the head of which weighs from 1,000 to 1,100 kilograms (say 2,200 to 2,400 lbs.). For giving polish and luster, the sheets, now almost cold, are brought under a second hammer with a large face, rounded at the edges and of the same weight. Finally they are allowed to cool completely, and are then clipped and classified into three classes, according to the perfection of their polish. The sheets of the first class ought to be like a mirror, without a spot upon their surface. The action of charcoal projected upon the red-hot surfaces, and inclosed between them without access of air, may be easily understood. It cements, and thus enables them to take a high polish, while rendering them at the same time less liable to rust. This cementation once having taken place, the sheet should not afterward be returned to the heating furnace. Whether the non-oxidizable quality is due to a carburation of the surface by cementation or by an oxidation which has been supposed to take place in the somewhat tedious process of manufacture, is not yet fully decided. The high quality of the iron used by the Russians has no doubt much to do with the merited popularity their final product enjoys. In the same category is the fact that, while we make most excellent wire from our own iron, we have not yet been able to produce an article quite equal to the Swedish rods for certain purposes. We have no doubt but that in time the American product, or "imitation Russia," which is now perfectly adapted to many uses, will eventually be made equal in all respects to the genuine Russian and exclude it from our markets; but this result will only be accomplished by greater care and skill in manufacture.

See "*Mech. Dict.*," p. 2005.

Rust. It has usually been supposed that the rusting of iron depends principally upon moisture and oxygen. It would appear, however, from the late Dr. Calvert's experiments, that carbonic acid is the principal agent, and without this the other agencies have very little effect. Iron does not rust at all in dry oxygen, and but little in moist oxygen, while it rusts very rapidly in a mixture of moist carbonic acid and oxygen. If a piece of bright iron be placed in water saturated with oxygen, it rusts very little; but if carbonic acid be present, oxidation goes on so fast that a dark precipitate is produced in a very short time. It is said that bright iron placed in a solution of caustic alkali does not rust at all. The inference to be derived is that, by the exclusion of moist carbonic acid from contact with iron, rust can be very readily prevented.

To take rust out of steel place the article in a bowl containing kerosene oil, or wrap the steel up in a soft cloth well saturated with kerosene; let it remain 24 hours or longer; then scour the rusty spots with brick-dust. If badly rusted, use salt wet with hot vinegar; after scouring, rinse every particle of dust or salt off with boiling hot water: dry thoroughly; then polish off with a clean flannel cloth and a little sweet oil.

Or brush with a paste composed of ½ oz. cyanide potassium, ½ oz. Castile soap, 1 oz. whiting, and water sufficient to form a paste. The steel should first be washed with a solution of ½ oz. cyanide potassium in 2 oz. water.

Rust Ce-ment′. Make a stiff paste with 2 parts of sal-ammoniac, 35 parts iron borings, 1 part sulphur and water, and drive it into the joint with a chisel; or, to 2 parts of sal-ammoniac and 1 part flowers of sulphur, add 60 parts of iron chips, and mix the whole with water, to which one sixth part vinegar or a little sulphuric acid is added.

Or mix 100 parts of bright iron filings or fine chips or borings with 1 part powdered sal-ammoniac, and moisten with urine; when thus prepared, force it into the joint. It will prove serviceable under the action of fire. All the above parts are by weight.

Rust, Preserving Iron from. Dodé's method is to coat the surface to be protected with a thin film of borate of lead, having a little oxide of copper dissolved in it, and having also suspended in it bright scales of precipitated platinum.

A red heat is employed to fuse the composition, which is applied by brush or bath. The effect is to cover the iron with a thin, glassy coating of a bright gray tint, unaffected by sewer gases, dilute acids and alkalies, and the heat of a fire.

See article by *Stoffel* in "*Jour. Soc. Arts*," Br., 1879, republished in "*Van Nostrand's Mag.*," xx., p. 13 *et seq.*

Or, paint with melted caoutchouc, to which some oil has been added. The caoutchouc must be melted in a close vessel to prevent its burning, and should be frequently stirred.

Dr. Sterling's plan is to impregnate the structure of the metal while heated with a non-oxidizable substance, — say paraffine or mineral oil.

Barff's plan is to convert the surface into magnetic or black oxide. *Journal Soc. of Arts.*

Barff . "*Van Nostrand's Mag.*," xvi. 300; xviii. 350; xx. 450.
"*Iron Age*," xxv. January 22, p. 7.
Perry . "*Van Nostrand's Mag.*," xviii. 583.
Bower . "*Van Nostrand's Mag.*," xix. 90, 378.
Dodé . "*Van Nostrand's Mag.*," xx. 178.

See Iron Preserving Process, p. 507, *supra*

S.

Sa-bot′. The iron shoe or point of a pile.

Sa-bot′ Ma-chine′. A machine for making the wooden shoes (sabots) extensively used in Europe.

The machines of M. Arbey, Paris, complete the shoe in three operations. The blanks first pass to the shaping machine, adapted to all sizes, where the shoe receives its shape. A second machine hollows the inside, while a third machine gives them the finishing touch and shapes the sole.

Sabot mach., *Arbey*, Fr. * "*Engineer*," xlvii. 255, 262.

Sac-char′i-fi-er. An apparatus for treating grain and potatoes by steam under high pressure, for converting the starch into sugar previous to the alcoholic fermentation.

The grain or potatoes are mixed in a boiler, with about three times their weight of water. Steam is then admitted in such a manner as to constantly stir the entire contents. When steam is admitted to the boiler, the air is allowed to escape through a valve. As long as the latter is kept open the water condensed within the boiler is allowed to run off. When the air has been forced from the boiler, all valves are closed. The material is then subjected to the combined action of heat and pressure for three or four hours, samples being taken from places provided, for inspection. At the end of that time the liquid is of a dark yellow color, and the starch has been completely converted into sugar, although the grains on the pieces of potatoes retain their original shape. Care must be taken to introduce the steam slowly, and to regulate the pressure carefully, or a portion of the sugar will be converted into caramel, unfit for the formation of alcohol. When this operation has been finished the mash is blown out, under pressure, into the mill, the solid particles crushed and the mashed formed into a thin paste possessing all the qualities necessary for the formation of alcohol.

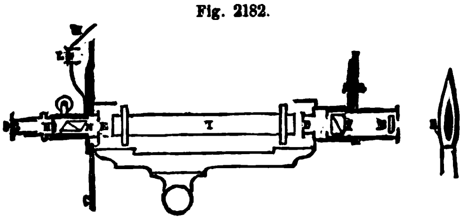
Sac′cha-rom′e-ter. An instrument for determining the value of sacchariferous juices.

The method of determining these values by means of the specific gravity will always find wide application because of its simplicity and satisfactory results.

The action of the saccharometer depends on the fact that ordinary light, when transmitted through or reflected by certain bodies, acquires certain properties which it did not before possess. Among other properties conferred upon the light is that of displaying gorgeous prismatic colors when caused to traverse certain liquids and crystals. These colors, when brought into view by means of a solution of cane sugar, are the more vivid as the solution is more concentrated.

In Laurent's new saccharometer the light from a fixed monochromatic yellow flame is passed through a diaphragm containing a plate of bi-chromate of potash, which absorbs the violet and blue rays. The yellow rays which pass it fall on a bi-refracting prism which turns on the longitudinal axis of the instrument, and in which the second image is diverged to one side and intercepted by diaphragms. One of these carries a thin plate of quartz parallel to the axis, which covers only one half of the diaphragm. Its thickness is one-half wave for the yellow rays. Between this diaphragm and a second one the testing tube containing the sugar solution to be tested is placed. In front of the second diaphragm is the Nichol analyzer, an objective and a concave eye-piece.

Fig. 2182.

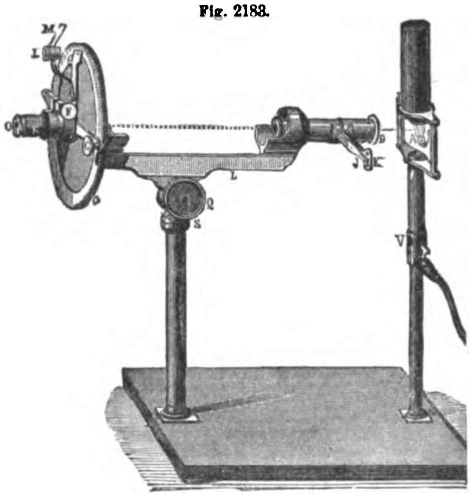


Saccharometer.

The latter three parts inclosed in a tube revolve, the angle through which they move being indicated on an alidade.

In Fig. 2182 *A* is a yellow monochromatic flame, placed at an invariable distance from the instrument. The burner is constructed so as largely to augment the intensity of the flame. *B* is a diaphragm containing a plate of bichromate of potash, which absorbs the violet and blue rays which exist in the flame, while allowing the useful yellow rays to pass. *P* is a bi-refracting prism, in which the second image is diverged to one side and intercepted by diaphragms. It turns on the axis *O E*. *D* is a diaphragm carrying a thin plate of quartz parallel to the axis, the thickness of which is one half wave for the yellow rays. This is fixed and covers but the half of the diaphragm. *E* is another diaphragm: *N*, the analyzing Nicol; *H*, the objective; *O*, concave eye-piece. The system, *O H N*, is mounted on an alidade, which turns on the disk *C* around the axis *O E*. *T* is the tube containing the solution to be tested. *C* is a graduated disk having one or two divisions; one especially for sugar, the other in half degrees of the circle for any rotary substances. *L* is a lens for reading the scale. *M* is a mirror throwing the light of the burner on the divisions and thus obviating the need of any

Fig. 2183.



Saccharometer.

additional light. The new optical disposition consists in the polarizing system, which is composed of two distinct parts — the bi-refracting prism *P* which turns, and the diaphragm *D* which with its half plate of quartz is fixed. In Fig. 2183 this diaphragm is represented enlarged, as it is seen on looking into the instrument. The left half is covered by the quartz plate, the axis of which is also parallel to the line of separation *O A*, and the right half being open allows of the passage without deviation of the polarized light from the polarizer *P*, Fig. 2182.

Thore	"*Technologiste*," xxxix. 38.
Laurent	* "*Scientific Am.*," xxxviii. 408, 181.
Dubosq	* "*Scientific American*," xxxix. 389.
Biot's polarizer . . .	* *Laboulaye's* "*Dictionnaire*," iii., "*Sucre*," Fig. 3, etc.
Saccharometer, *Balling*	"*Scientific American*," xli. 329.
Polarizing, *Laurent*, Fr.	"*Iron Age*," xxii., July 4, p. 19.

Sack'er and Weigh'er. A spout with sliding door admits the grain or material to be weighed from the receptacle above. The bag is clipped by a ring to the funnel which is suspended from the back end of a suspended steelyard. When the amount the steelyards are set for is received into the sack, the slide is closed and the flow cut off.

Sack Hold'er. An inclined frame, braced against the floor, forms a rest for the sack in filling while a ring holds the mouth of the sack open and forms a rest for the vessel used in filling.

Sack Emp'ti-er. A contrivance by means of which through a winch, ropes, and capstan, a frame which holds the sack in filling is elevated and tipped to empty the sack.

Emptier	* "*Scientific Amer.*," xl. 19, Fig. 5.
Filler	* "*Scientific American*," xl. 19.

See also BAG FILLER.

Holder . .	* "*Scientific Amer.*," xl. 20, Fig. 8.
Lifter	* "*Scientific American*," xl. 19.
Truck	* "*Scientific American*," xxxix. 323.

Sack Hold'ing Truck. One arranged to hold the sack in vertical position while being filled and having a hoop to hold the mouth open.

Sack Lift'er. 1. A sliding frame on which the sack rests, is elevated by means of a winch to the proper height to shoulder, when the sack is filled.

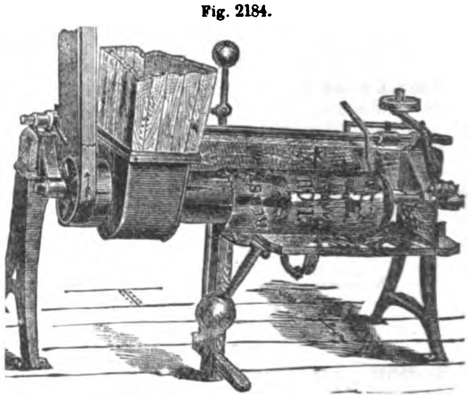
2. A clutch on the rope to catch the gathered end of a filled bag, and lift it up into the mill.

Sack lifters, emptiers, etc. . * "*Scientific American*," xl. 19.

Sack Pack'er. A machine for packing flour in sacks. See Fig. 2184.

The operator places the bag on the screw tube as shown in the engraving, and draws the piston head against the bottom of the bag. He then lifts the tumbling ball, by which movement the belt is shifted to the tight pulley starting the screw to packing the sack. While the bag is being filled the receding piston changes the belt to the loose pulley by means of the shifting rod, and thus stops the screw, enabling the operator to set the stop collar so as to put any amount of flour in the sack that may be desired. When the screw stops, the operator places his foot on the treadle, dropping the sack into an upright position ready for removal, and by this means catching the spill. The sack being removed, a weight returns the turning board to a horizontal position. When this

Fig. 2184.



Sack Packer.

device is used as a mixer, the conveyor flights on the screw pulverize the lumps and mixes in the passage through the horizontal screw tube, discharge being made into a bin below by means of muslin bag or hose.

By the use of reënforce rings on the end of the screw tube, bags of from 12 to 60 pounds' capacity can be packed without changing the tube. Its capacity is from 2 to 4 sacks per minute.

Fig. 2185.

Saddle.

Sad'dle. Fig. 2185 is a view of the saddle complete, with bag, used in the United States mounted service. No padding or raw hide is used. The round, smooth-cut pommel is made as low as possible to escape the highest withers, and the seat is long and flat, the cantle rounding very little. The trees are made by machinery to avoid inequalities, and the bearing surface made as long as possible to distribute the weight over the back of the horse, the whole length of the saddle.

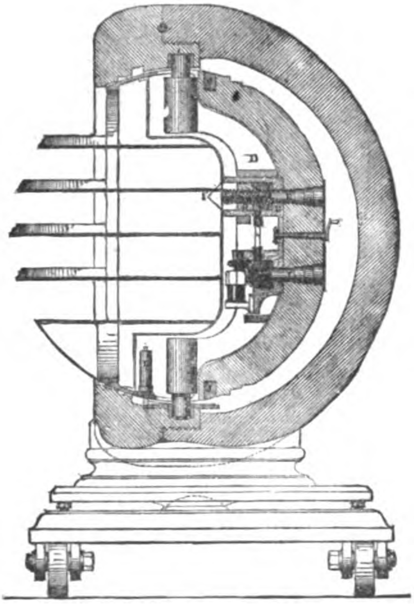
Sad'dle Brack'et. A bracket shelf in a stable or harness room to hold a riding saddle.

Sad'dle Clip. A clip which straddles the spring and axle, and the legs of which are secured by bolt nuts. Fig. 145, p. 61, *supra*, Fig. 150, p. 62, *Ibid.*

Safe. A receptacle where valuables may be deemed safe from attacks of fire, burglars, etc. Generally iron or steel cases, variously prepared. See "*Mech. Dict.*," pp. 2013, 2014, 2015.

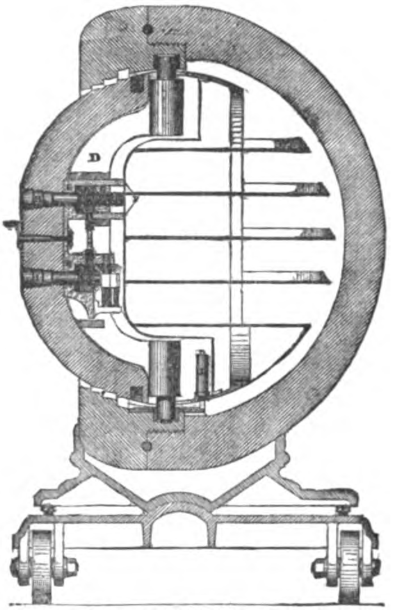
Figs. 2186, 2187, are sectional views of the Corliss spherical revolving safe composed of an outer and inner shell, the latter revolving within the former, forming both the door and the receptacle for valuables. The outer shell forms about two thirds of a sphere, and is made in two parts, so that the inner part, called the safe, can be placed within it; these parts are screwed together, as indicated in section, by a screw the whole diameter of the safe. The jointing surfaces of these two parts are ground to an accurate fit, and screwed together like hose coupling, leaving no space between them and making the shell practically one solid piece of metal. The interior swinging part is also one solid piece of metal about four inches thick. The outside diameter of this sphere corresponds with the inside diameter of the larger one, and the joint between the spheres is formed by a series of steps which increase in diameter towards the interior of the safe. The joint is circular and is made an accurate fit, the outside steps being made by grinding, and the inner ones bored and turned by machinery adapted to the purpose. To guard against accidents this safe is always provided with two locks, either of which will open it. The locks may be set on the same or different combinations, and in case either lock should fail from any reason to operate, the safe can be opened by the other. Either time locks, or the ordinary combination locks are employed. The drawings sufficiently explain the inside arrangement and workings.

Fig. 2186.



Corliss Safe, Open.

Fig. 2187.



Corliss Safe, Shut.

Safe, *Marvin*	* "*Scientific Amer.*," xxxviii. 82.
Safe alarm, *Koloseus* .	* "*Scientific American*," xxxix. 99.
Safe, fire-proof, submerged, *Gray* . . .	* "*Scientific American*," xxxv. 338.
Safe, provision, *Inman*	* "*Scientific American*," xl. 344
Safes, history, invention, and manufacture of .	"*Iron Age*," xxi., Jan. 24, p. 5.
Safes, marine	* "*Scientific American*," xxxv. 179.
To blow open . . .	* "*Scientific American*," xxxvi. 244.

Safe'ty Ap'pa-ra'tus. For cages in mines, etc., article "*Parachute*," *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," iv., ed. 1877.

Dobo.	*Fontanie* *
Claude-Perrault.	*Nyst* *.
Machecourt.	

Safety cylinder cock .	* "*Scientific American*," xliii. 86.
Disk	* "*Scientific American Sup.*," 1472.
Hook	* "*Scientific American Sup.*," 4011.
Lamp, *Coquillon* . .	"*Eng. & Min. Journal*," 23.
Stephenson	* "*Scientific American Sup.*," 742.
Davy	* "*Scientific American Sup.*," 742.
Odling	* "*Scientific American Sup.*," 2368.
Gildemeister & Kampe	"*Technologiste*," xli. 567.
Safety appar. for cages.	
Spitzberg Tunnel . .	* "*Engineering*," xxix. 395.
For mine cages.	
Cousin, Fr. . . .	* "*Engineering*," xxvi. 389.
Leonardt, Br. . .	* "*Engineering*," xxix. 58.
Safety catch for mine cages, *Cousin*, Fr. .	* "*Engineer*," xlvi. 223.
Elevator, *Burdon* . .	"*Manuf. & Builder*," ix. 121.
Lamps, *Davy*, . . .	"*Lampe de Sûreté*," *Laboulaye's* "*Dict.*," ii. * 1375-76.
Roberts	"*Lampe de Sûreté*," *Laboulaye's* "*Dict.*," ii. * 1377.
Mesnil.	"*Lampe de Sûreté*," *Laboulaye's* "*Dict.*," ii. * 1377.
Mueseler	"*Lampe de Sûreté*," *Laboulaye's* "*Dict.*," ii. * 1377.
Combes	"*Lampe de Sûreté*," *Laboulaye's* "*Dict.*," ii. * 1378.
Safety paper, bank checks	"*Scientific American*," xxxiv. 351.
Papier de Sûreté . .	*Laboulaye's* "*Dict.*," iii.
Safety Winch . .	See SAFETY CATCH; SAFETY HOIST; CAGE: ELEVATOR, etc.

Safe'ty Bolt. One in which the pin is locked in position by padlock or other device.

Safe'ty Brake. An attachment to a crane or other hoisting apparatus to control the rate of descent of an object. It usually consists of a band on a drum, which by pinching opposes the rotation of the latter. See SAFETY HOIST.

Safe'ty Catch. A device to prevent the falling of the cage in the event of the breaking of the rope. Safety catches attached to the cage are held away from the guides while the weight of the cage hangs on the rope, are released and spring against the guides as soon as the strain is taken from the rope, either by its being broken or otherwise. A safety hook detaches the cage from the rope if it is hoisted too far, and "landing dogs" prevent it from being accidentally lowered or dropped into the shaft, when it has been once hoisted above them at the pit-head. See Figs. 4539–4541, "*Mech. Dict.*"

In Cousin's counterpoise catch, used in the Bernissat pits in Belgium, a wedge is forced into the loop encircling the guide-rope by a spring as soon as the hoisting-rope breaks. The wedge is made of wood, and is provided with steel points to insure its taking a hold on the guide-rope in case of an emergency. In ordinary hoisting the wedge is withdrawn and the loop slides freely on the guide-rope. In the counterpoise arrangement, the guide-rope is attached at the bottom of the shaft, but its upper end runs over two pulleys and carries at its end a series of counter-weights placed one upon another, attached by chains. As soon as the winding rope breaks the wedge seizes the guide-rope, which is drawn downward by the weight of the falling cage. This causes the counter-weights to be lifted one by one until the cage has come to a stop, thus avoiding any injurious tearing strain upon the guide-rope.

Safe'ty Chain. (*Railway.*) A chain to attach certain parts to prevent their becoming entirely detached in case of the parting of the main connections.

Among such are coupling chains of platforms, of the brake-rods, etc. — *Forney's "Car-builders' Dictionary."*

Safe'ty Cyl'in-der Cock. A safeguard against injury to a steam cylinder by an accumulation of water. The water of condensation is let out of the cylinder without waste of steam.

Safe'ty Disk. A disk of light sheet-copper is placed across the boiler between the steam and an escape-pipe. An over-pressure of steam fractures the disk and allows the escape of the steam through the pipe.

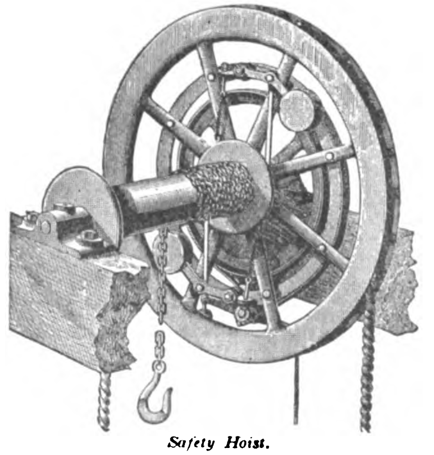
Safety disk for boilers, *Rowan*, Br. * "*Engineer,*" xliv. 148.

Safe'ty Hang'er. (*Railway*). A metallic loop to prevent the falling of a rod in case of breakage.

Among such are those for brake-rods, etc. — *Forney.*

Safe'ty Hatch. A form of safety hatch for elevators, to close the hatchway when the cage is not in the act of passing. The doors are automatic, being pushed aside by oblique bars above the cage in ascending, and by similar bars beneath the cage in descending. The doors are returned by counter-weights. The safety attachment may be seen in detail in CAGE, ROPE ELEVATOR, SAFETY STOP.

Fig. 2188.



Safety Hoist.

Safe'ty Hoist. In Fig. 2188 the safety brake is applied automatically by the governor within the rim of the sprocket-wheel, so that the load, once started down, it is left to itself while the operator gets the next load ready.

Safe'ty Hook. In mines, a hook arranged to clutch a support and hold the cage, should the hoisting rope break through overwinding.

Safe'ty Lamp. A lamp to prevent explosions from fire-damp. See "*Mech. Dict.*," p. 2016.

Coquillon utilizes the property possessed by palladium, of remaining red-hot in a mixture of gas and air at the expense of the compound, in the construction of miners' safety-lamps. The lamp cannot cause an explosion without the palladium giving timely warning.

Dubrulles has invented a lamp which cannot be opened without extinguishing the flame.

Safety lamp.	
Boullenot, Fr. . . .	"*Van Nostrand's Mag.*," xiv. 572.
Safety lamps, on, *Bagot*	"*Engineering*," xxvii. 423.
Davy, *	"*Engineering*," xxvii. 423.
Clanny, *	"*Engineering*," xxvii. 423.
Stephenson, * . . .	"*Engineering*," xxvii. 423.
Mueseler, *	"*Engineering*," xxvii. 432
Williamson, * . .	"*Engineering*," xxvii. 423.
Clanny, *	"*Engineer*," xlvii. 341.
Davy, *	"*Engineer*," xlvii. 341.
Stevenson, *. . . .	* "*Engineer*," xlvii. 341.
Mueseler, *	"*Engineer*," xlvii. 341.
Williamson * . . .	"*Engineer*," xlvii. 341.
Davy	"*Scientific American Sup.*," 1720.
Dinant, Fr.	* "*Engineering*," xxvi. 389.
Hydrostatic, *Kendall*	"*Scientific American*," xxxvi. 210.
Odling, Br.	* "*Engineer*," xlvi. 179.
Shakespeare, Br. . .	* "*Engineer*," xlix. 173.
Williamson	"*Scientific American Sup.*," 2149.
Williamson, Br. . .	"*Iron Age*," xxii., July 4, p. 19.
Miner's	* "*Scientific American Sup.*," 2718.

Safe'ty Link. A device, a substitute for the safety or check-chains which couple cars to their trucks. Invented by *Thompson*.

* "*Railroad Gazette*" . . . . viii. 117.

Safe'ty Loop. One of the loops by which the body-strap of a vehicle is attached to the body and perch to prevent dangerous rolling of the body.

Safe'ty Pa'per. In addition to what has been stated on page 2017, "*Mech. Dict.*," where about thirty distinctive processes are cited, an improvement in the manufacture of paper for bank notes, bonds, checks, etc., by Mr. Geo. W. Casilear, Superintendent of Engraving, U. S. Treasury Department, may be mentioned.

"This invention relates to the manufacture of bank-note and other commercial paper by coloring the pulp contained in separate compartments with different coloring matter, or by the use of different colored fibrous substances while in the pulp, contained in separate compartments.

"The pulp, having been prepared in the usual manner, is emptied into chests or tubs corresponding in number with the kinds or distinct colors of fiber desirable to be used in making the paper. From thence it is delivered into the compartment vats, each compartment being assigned for a color or alternate color, silk fiber, or other suitable material desirable for making distinctive paper. At the top of the vat is a series of gates, by means of which the flow of pulp is regulated as it passes over the trough and lip and falls upon the endless wire or web. The trough and lip is also subdivided by using thin partitions of brass, to correspond in number and to connect with the compartment-partitions of the vat. The operation being now apparent, the pulp of two or more colors passes over the lip or ledge in separate streams, the colors being divided by the thin partitions in their passage, and unite as they fall upon the endless wire, upon which it forms itself into paper of colored stripes or other material, composed of whatever character of pulp is used in the compartment-vat, desirable for making distinctive papers."

Bank-note paper, Br. . . "*Scientific American Sup.*," 1298

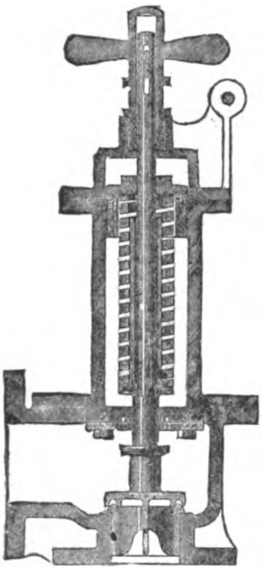
Safe'ty Pin. 1. A temporary pin in a percussion fuse, to prevent the plunger from striking accidentally against the percussion powder. It is held in place by a wire which is ruptured by a weight attached to it when the gun is fired. Fig. 17, p. 523, "*Ordnance Report*," 1877.

2. A garment pin bent on itself, and having a loop which retains the point shut and prevents pricking.

Safe'ty Valve.

Fig. 2189 is a form of valve much used on leading steamships. The peculiarity of the valve consists in the grooved seat V, which has the effect to augment the area at the moment the valve lifts. The result is the valve will blow off to its maximum capacity with an increase of but two or three pounds' pressure in the boiler, and will close tight the moment the pressure falls a couple of pounds below that to which the valve is loaded.

Fig. 2189.

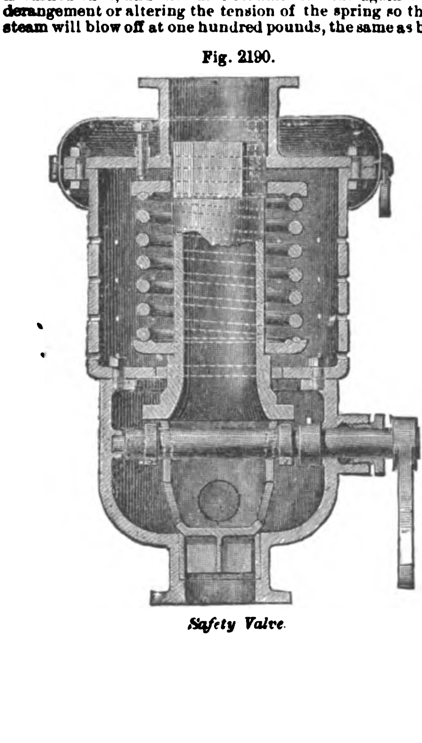


Safety Valve.

In Fig. 2190 the outlet for the steam is carried through the center, and the pressure is always perfectly fair on the valve, there being no side-action whatever, thus rendering the valve very sensitive, and equalizing the wear.

Fig. 2191 is especially adapted to steam fire-engines, where quick stoppages are necessary. Should the safety valve be set to blow off at one hundred pounds, and it be necessary to stop the engine with only fifty pounds of steam in the boiler, it will not be necessary to wait until the steam rise to one hundred pounds, but the wheel *h* is given a half turn up against the valve-spindle *g*, where it will remain and the steam blow off until the wheel *h* is turned back, and the valve resumes its seat again without derangement or altering the tension of the spring so that the steam will blow off at one hundred pounds, the same as before.

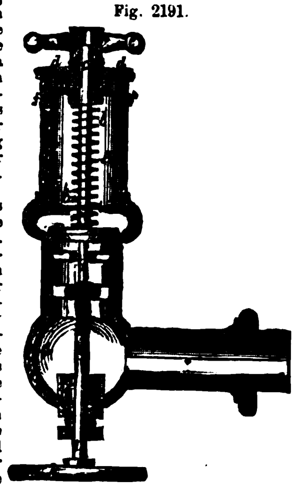
Fig. 2190.



Safety Valve.

Ashcroft's valve has a hollow semi-circular ring on the conical part. The lower seat of the valve has a corresponding annulus at its top, somewhat larger than the one in the valve proper. When the valve is lifted to a slight extent, the steam is momentarily arrested in this space, thus producing a greater pressure, and lifting the valve to a greater height, similar to Fig. 2189.

Fig. 2191.



Steam Fire Engine Valve.

Blake's safety valves are globular, and the orifices are annular. They require no guide-wings or pins, and can oscillate freely on their seats, and are not likely to stick, as they cannot wedge themselves down in the seatings, whilst it is claimed they have nearly double the discharging power of an ordinary valve of the same diameter, and that with a lighter weight on them. The usual size of valve made by Mr. Blake has a 3¼″ outside seating and a 2¾″ inner one. Thus the discharging power of this valve equals an ordinary valve, 6¼″ diameter, while the weight required to load it to 60 lbs. per square inch is only 220 lbs., whereas a 6¼″ valve would require 1,840 lbs. to load it.

Safety valve, 6 kinds . * "*Sc. American*," xxxvi. 99, 853.
* "*Manuf. & Builder*," xi. 65.
* "*Sc. American Sup.*," 1527, 3742.
Adams, Br. . . . . * "*Technologiste*," xli. 707.
* "*Scientific American Sup.*," 802.
Eaves . . . . . * "*Scientific American Sup.*," 2239.
Fletcher . . . . * "*Scientific American Sup.*," 690.
Schmid . . . . * "*Scientific American Sup.*," 690.
Test . . . . . * "*Scientific American Sup.*," 690.
Wilson . . . . . * "*Mech. Dict.*," Fig. 1622, p. 554, *supra*.
Stone . . . . . * *Ibid.*, 1623, p. 555.

See LOCK-UP SAFETY VALVE, * Fig. 2983, p. 1343, "*Mech. Dict.*;" SAFETY VALVE, *Ibid.*; TEST-SAFETY VALVE, *infra*.
Cf. Buel's "Safety Valves."

Safety valves, *Adams*, Br. * "*Engineer*," xlii. 254.
Blake, Br. . . . . * "*Engineer*," xlii. 273.
Japanese Corvettes,
Penn. . . . . . * "*Engineering*," xxiii. 286.
Klotz . . . . . . * "*Engineer*," xliv. 67.
Safety valve, *Ashcroft's* . * "*Manuf. & Builder*," xi. 244.
Eave, Br. . . . . . * "*Engineer*," xlvi. 57.
* "*Engineering*," xxvii 466.
Hudson . . . . . * "*Railroad Gazette*," viii. 263
Klotz . . . . . . * "*Engineer*," xlix. 358.
Martyn-Roberts, Br. . * "*Engineer*," xlviii. 163.
Melling, Br. . . . . * "*Engineering*," xxii. 510.
Schmid . . . . . * "*Engineering*," xxii. 214.
Schmidt . . . . . * "*Scientific American*," xliii. 386.
Schmidt, Switz. . . * "*Engineer*," xlvi. 209, 248.
"Sentinel."
Summerson, Br. . * "*Engineer*," xlii. 368.
Turnbull, Br. . . . * "*Engineering*," xxv. 522.
Lock-up, *Robey*, Lond. * "*Scientific American Sup.*," 2050.
Marine, *Fletcher*, Br. . * "*Engineer*," xlii. 147.
Bailey, Br. . . . . * "*Engineer*," xlii. 191.
Spherical.
Nasmyth, Br. . . * "*Engineering*," xxii. 393.
Spring, *Atcock*, Engl. * "*Scientific American Sup.*," 855.
Spring-loaded.
Atcock, Br. . . . * "*Engineering*," xxii. 363.
Test, "Rover."
Br. Navy . . . . * "*Engineer*," xlii. 145.
Form and principles . * "*Scientific Amer.*," xxxviii. 314.
Lubricator.
Pickering, Br. . . * "*Engineer*," xlii. 145.

Safe'ty Valve, Noise'less. Baird and Allen have patented an arrangement for obviating the noise of escaping steam.

The devices are an expansion chamber and an annular nozzle placed in the locomotive chimney, the effect of which is to produce a regular noiseless escape of steam, instead of an intermittent and sonorous one as at present. The steam from the cylinders, instead of passing directly through nozzles, is discharged into a chamber of ten times the capacity of the cylinders, which will allow the steam to expand in volume and greatly reduce its pressure, so that the noise of puffing will not be heard more than ten feet away.

The Ashton Noiseless Blow-back Safety Valve, is claimed to do away with the din of the steam escaping from ordinary locomotive pop valves, at the same time effecting a considerable saving of fuel. It is so arranged that when the boiler is eased from overpressure, the escaping steam is conducted either to the feed water in the tender, to a muffler, or to the smoke-stack.

Sa'fre. (*Glass.*) The usual French name for the crude oxide of cobalt used as a blue in glass-making. See ZAFFER; COLORED GLASS.

Sail Sew'ing Ma-chine'. A large-sized sewing machine with extensive table for sewing widths of duck to form sails. Used also for sewing sack, bags, tarpaulins.

Sews straight or zig-zag stitch, with dry or tarred twine. Is made single or double, in the latter case to run two seams at once.

Sal'a-man'der. 1. A mass of waste metal from a break in a metallurgic furnace.

2. A cooled mass of metal and cinder in a blast furnace in which the contents have proved refractory and the fire has died out.

Account of blasting a salamander with dynamite. "*Iron Age*," xvii., April 20, p. 9.

Sal Am-mo'ni-ac Bat'te-ry. (*Electricity.*) One in which chloride of ammonium is used as an exciting liquid. See LECLANCHÉ BATTERY.

A *bagration* battery is one in which the elements are immersed in a jar filled with earth sprinkled with sal ammoniac.— *De la Rive.*

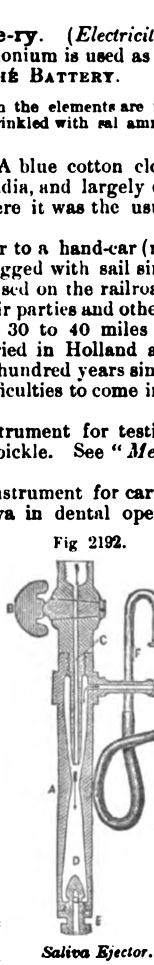
Sa-lam'pore. (*Fabric.*) A blue cotton cloth formerly made at Nellore in India, and largely exported to the West Indies, where it was the usual slave cloth.

Sail'ing Car. A car similar to a hand-car (minus the operating devices), is rigged with sail similar to that of an ice-boat and used on the railroads on the plains, by telegraph repair parties and others, have attained a speed of from 30 to 40 miles an hour. Sailing chariots were tried in Holland and other countries, more than two hundred years since, but labored under too many difficulties to come into common use.

Sal'i-nom'e-ter. An instrument for testing the strength of a brine or salt pickle. See "*Mech. Dict.*," page 2022.

Sa-li'va E-jec'tor. An instrument for carrying off the accumulating saliva in dental operations. In Fig. 2192, the end of the saliva tube *F* is inserted in the mouth of the patient, and a jet of water under pressure passed through the narrow throat of the instrument in the direction of the arrows, drawing the saliva into the vacuum chamber *D*, and out through the end. The check valve *E*, sets the water back in such manner as to close the throat to the external air and produce a vacuum in the chamber above.

Fig 2192.



Saliva Ejector.

Sa-li'va Pump. For withdrawing saliva from the mouth during dental operations. See "*Mech. Dict.*," p. 2023.

Salt Man'u-fac'ture. The manufacture of salt and bromin is carried on very extensively in the Ohio Valley. The salt is shown by chemical analysis to be the purest in America, and its perfect freedom from lime renders it very desirable for dairy use. The salt water is obtained by boring wells from 800 to 1,000 feet through a variety of soil, solid rock, and usually two stratas of coal. It is first pumped into a wooden cistern to settle, then run into iron pans, and boiled until ready for crystalizing, then drawn off into wooden grainers, through which copper pipes of 3 or 4 inches in diameter, filled with steam, pass the entire length of the grainer, heating the brine to an equal temperature. The salt crystals form on the surface, and are prevented from adhering firmly by mixing a small quantity of butter or tallow, which separates them, and they gradually fall to the bottom of the grainer and become salt proper. It is then lifted on platforms by workmen, and left to dry for 12 hours, after which it is packed into barrels, weighed, and ready for market. The salt analyzed shows: Sodium chloride, 97.5; Moisture, 2.0; Foreign matter, .5.

From the waste, or mother-water of the salt works, bromin is extracted, and forms an extensive article in trade, selling at one time for $9 per pound, the specific gravity being about three times that of water. There are six bromin factories in this locality, and when all are in operation they control the price of the foreign market. However, bromin, like all other merchandise, has shared in the decline, and is now sold for 34 cents per pound. The increasing demand for the article for medicinal purposes, and by chemists, dyers, and photographers, has made it a source of immense profit. Large quantities are annually exported.

For apparatus, see "*Mech. Dict.*," 2023, and *Laboulaye's* "*Dictionnaire des Arts et Manufac.*," tome iii., article "Sel."

Salt manufactory, Mich. * "*Scientific American Sup.*," 1621.

Salt Mill. For pulverizing the coarse salt into table salt.

Salt-pe'ter Man'u-fac'ture. The process of securing the saltpeter from the crude nitrate of potash.

Saltpeter manufacture . "*Scientific American*," xxxiv. 5.

Salt-pe'ter and Sul'phur Grind'ing Mill. (*Gunpowder.*) A machine for grinding and incorporating these ingredients in the manufacture of gunpowder. It consists of two edge wheels in an annular pan: the Chilian mill.

See "*Ordnance Report*," 1879, Appendix I.: Plate I., Fig. 2, and description on p. 98.

Salt-pe'ter, Sul'phur, and Char'coal Mix'ing Reel. (*Gunpowder.*) An inclined cylindrical reel, like a flour bolt, used to sift the combined materials.

See "*Ordnance Report*," 1879, Appendix I., Plate I., Fig. 3, and description on p. 99.

Sam-mi'er. (*Leather.*) A machine for pressing water from skins in the process of tanning.

Sam'ple Case. A case for carrying and displaying quality of goods to be inspected.

Sample case, *Davis* * "*Scientific American*," xl. 372.

Sam'ple Cut'ter. A species of rotary shears. A sharp edged disk on a table rolling against an edge and cutting narrow strips of cloth from the roll, to form tailor's or traveler's samples. *Dartois*, French.

Sam'ple Scale. A finely balanced lever scale weighing one pound by $\frac{1}{10000}$. Used for weighing articles in bulk by accurately weighing small proportional quantities.

Sam'ple Spig'ot. A small faucet in the head of a cask.

Sand Band. (*Vehicles.*) A metallic ring on the inside of the hub, extending over a portion of the axle and designed to keep sand and mud from entering the axle-box.

Sand Bar. A bank formed by the settling of sand or silt when one stream empties into another, or a river into the sea. Mode of removing, *Boulogne sur Mer*, * "*Scientific American Sup.*," 1554.

Sand Ap-pli'ance.

Sand auger	* "*Min. & Sc. Press*," xxxvii. 305.
Sand blast, *Tilghman*	* "*Manuf. and Builder*," viii. 160, * 181, * 205, * 229.
Sand brake. *Wiseman*, India.	"*Engineer*," xlviii. 73.
Sand and cinder sifter. *Chambers*	* "*Manuf. & Builder*," ix. 5.
Sand and gravel separator, *Chambers*	* "*Scientific American*," xxxv. 163.
Sand distributor. *Chambers*	* "*Engineer*," xlix. 488.
Sand-drying furnace	* "*Engineering*," xxiii. 502.
Sand-papering machine, Flexible, *Fay*	* "*Engineer*," xlv. 435.

Sand Bat'te-ry. (*Electricity.*) A battery in which the elements are imbedded in cells filled with silicious sand saturated with dilute sulphuric acid.

Sabine, London, 1867 . . . . 228.

Sand Brake. An automatic method of stopping a train when the speed exceeds a desired rate, or when cars are detached accidentally.

In Wiseman's automatic sand brake on the axle of every wheel of the train is placed a cylinder, in which a circular plate, keyed to the axle and bearing a number of small blades, revolves whenever the train is in motion. The blade compartment surrounds a cylindrical compartment, which, being filled with sand, is called the sand-box. The upper and the lower portion of this box are in communication with the blade-box by a number of parts, of which the lower can be opened and closed by means both of an electrical mechanism and automatically, while the upper ones, which are smaller, are always open. A plate, keyed to the axle, opens the lower sand-ports with every revolution, but the sand thus escaping is so small in quantity that it is immediately swept back by the blades into the sand-box through the upper ports. As soon, however, as the electrical circuit, which also controls this sand valve by means of an electro-magnet, is broken, the sand flows from the box very quickly, and, packing the blade-box, stops the train. The same will occur as soon as the train moves too rapidly, or when one or more cars are left behind. It is therefore automatic, and its effect increases with the velocity of the train.

Sand Dry'er. For evaporating the moisture.

Two perforated cylinders, one inside of the other. The inner cylinder is perforated at an angle of 45°, and inclosed with a conical top. The outside cylinder is perforated at about 40°, and both cylinders set perpendicular. A blower forces hot air into the inner cylinder, which, striking the conical top, is forced through the perforations, and passes through the sand placed between the cylinders. The outside perforations permit evaporation.

Sand Fence. (*Hydraulic Engineering.*) An obstruction to a current, made of stakes placed A-shaped and driven, and having brush lashed or wired thereto.

Sand-hold'er. A chamber in a pump-stock in which the sand carried by the water is allowed to deposit before reaching the pump-bucket or plunger.

Sand-pa'per-ing Ma-chine'. 1. (*Boot and Shoe Making.*) A drum covered with sand-paper for giving the desired surface to shoe-soles.

2. (*Wood-working Machinery.*) A machine for scouring, finishing, and polishing flat surfaces of wood.

Sand-papering mach., *Fay & Co.* * "*Scientific Am.*," xl. 89.

Sand Pump. A pump for ejecting sand.

The most notable instances are those of the great bridge pier caissons at St. Louis and New York. The discharge of the sand pumps at the east abutment of the New York and Brooklyn Bridge was over 346 cubic yards in 24 hours.

The general arrangement consisted of a water jet discharging upward through the center of a hollow globe: this globe was placed in the caisson at the bottom of an iron tube which extended upwards through the masonry, and was connected with a flexible tube below; the lower end of the flexible tube was kept submerged in the water below the level of the bottom of the caisson, and this water was drawn upwards by the inducing force of the jet, carrying with it a large quantity of sand; the general arrangement was not unlike that of the Giffard injector.

In sinking the Pier No. 5 of St. Charles Bridge over the Missouri River, Eads' sand pumps removed 18 cubic yards of sand per hour each. They were found to work best with a three-inch discharge-pipe and 200 lbs. per square inch water pressure. Three Cameron pumps, with 12″ × 24″ steam, 6″ × 24″ water cylinders were used to supply two of the sand pumps, and were worked up to their full capacity in so doing.

Sand Screen. A sand sifter.

San'i-tas. Russian turpentine and water are placed in huge earthenware jars, surrounded by hot water. Air is driven through the mixture in the jars continually for three hundred hours, the result being a decomposition of the turpentine, and the formation of a watery solution of the substance, to which Dr. Kingsett, the discoverer, has given the name of "Sanitas." After evaporation, the substance, as sold in tin cans, is a light brown powder, of a pleasant taste and odor, and capable in a very remarkable degree of preventing or arresting putrefactive changes. This new disinfectant has been in use for some time in England, and is highly spoken of. It is said to have a pleasant odor, is not poisonous, and does not injure clothing, furniture, etc. For household uses it would seem to be well adapted.

Sa-pon'i-fi-er. An apparatus for the manufacture of glycerine and the fatty acids, by the decomposition of fats and the isolation of their several constituents; stearic, margorinic, and oleic acids and glycerine.

Droux . . . . . * "*Scientific American Sup.*," 2562.

Sap Spout. A device for holding the bucket to the tree and conducting the sap from the tree to the bucket in sugar-making.

In the Eastern States the first flow of sugar-bearing sap which precedes the bursting of the leaf-buds, is specially called "sap." In Ohio and the West it is called "sugar water," and the later juices, which arise in the tree after the "sugar water" has ceased to run, are called the "sap."

Lawrence . . . . . * "*Scientific American*," xxxv. 325.

Sar'dine Shears. A pair of strong scissors, with pointed blades for cutting open the tin boxes containing sardines, potted meats, etc.

Sash Clamp. A clamp for squaring sash and tightening up the joints.

See Blind Clamp, Fig. 326, p. 106, *supra*.

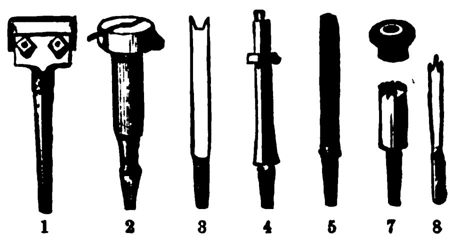
Sash Cramp. A vise for holding sash while putting together.

See Flooring; Carpenters and Joiners' Clamps, "*Mech. Dict.*" and *supra*.

Sash Lift. A handle on a sash for lifting it.

Sash Tools.

Fig. 2193.



1 2 3 4 5 7 8

Sash, Blind, and Pin Tools.

1. Blind slat chisel for stationary slats.
2. Hollow auger, for rounding slat tenons.
3. Double chisel, for sash bars.
4. Staple punch, to prick both rods and slats.
5. Pin tool, for making pins.
6. Tool, for pointing pins.
7. Burr, for rounding slat tenons.
8. Center bit, for blind boring.

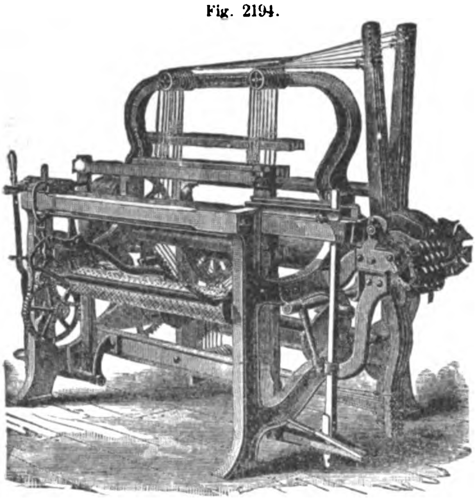
Nos. 1, 3, 4, and 5 may be used in foot-mortising machines. Nos. 2, 7, and 8 in the blind stile boring machine, and small boring shaft.

Sash Rel'ish-ing Ma-chine'. A machine for forming that part of the shoulder of a tenoned piece which projects beyond the part which enters the mortise. This is done at one operation by a cluster of circular saws, part of them set longitudinally of the stuff, with smaller ones set transversely, the front teeth of the small ones being almost in conjunction with the front teeth of the two outside larger teeth, but a little in front.

Sa-tine'. (*Fabric.*) An all-wool French goods with satin weave.

Sat'in-et Loom. A loom designed for heavy goods, such as satinets, twills, jeans, satin stripes, checked cottonades, etc. It usually has 4 boxes at

Fig. 2194.



Satinet Loom.

one end. An endless chain governs and moves the heddle levers and is readily changed to any pattern without the aid of cams. It is of the open-shed type.

The cut shows a plain lathe, single shuttle loom.

Sat'in-ing. (*Fine Art Metal-working.*) A mode of decorating silver-ware by abrading the surface with a wire brush, which is revolved while the object is pressed against it. Soapy water is dripped upon the surface under treatment, the minute scratches giving the sheen of satin.

Sat'in Weave. (*Weaving.*) A style of weaving made on a loom with 5 or more harnesses. See ARMURE.

Sau'sage Ma-chine'.

See STUFFER, Figs. 1105, 1106, p. 359, *supra.*
See CUTTER, Fig. 4587, p. 2032, "*Mech. Dict.*"
See FILLER, Fig. 4588, p. 2032, *Ibid.*
See STUFFER, Fig. 4589, p. 2032, *Ibid.*
See MINCING KNIFE, Fig. 3168, p. 1446, *Ibid.*
See MEAT CHOPPER, Figs. 3106, 3107, p. 1415, *Ibid.*
See MEAT CUTTER, Figs. 3109, 3110, pp. 1415, 1416, *Ibid.*
See MEAT CHOPPER, Figs. 1699, 1700, pp. 590, 591, *supra.*
See MEAT ROCKER, Fig. 1702, p. 591, *supra.*

Saw. (*Surgical.*) A large number of varieties of surgical saws are included in the list of saws, p. 2035, "*Mech. Dict.*" See under the following list, which embraces the more important in segregated form: —

Amputating.	Capital.
Bead.	Chain.
Bow.	Circular.
Exsecting.	Maxillæ.
Folding.	Metacarpal.
Heine's.	Post-mortem.
Hey's.	Rachitome.
Interosseous.	Rotating.
Lifting back.	Subcutaneous.

1. Circular saws were first used in Holland. — *Richards.*

The proper periphery velocity of a circular saw is 9,000' per minute, or 100 miles per hour. A saw 12" in diameter should make 8,000 revolutions per minute.

A saw-blade exhibited by Jessop & Sons at Paris, was 10' 8" diameter, 9-16" thick, and weighed 2,638 pounds.

See "*Mech. Dict.*," pp. 2033–2046.

Saw, *Simonds*	"*Iron Age*," xxii., Aug. 15, p. 5.
Saw bench, *Casson* . .	* "*Scientific American*," xxxix. 874.
Casson, Br.	* "*Engineering*," xxvi. 342.
Circular, *Wardwell* .	* "*Man. & Builder*," xii. 79.
Saw file guide, *Roth* . .	* "*Man. & Builder*," xii. 78.
Saw guard, *Garrett*, Br.	* "*Engineering*," xxviii. 446.
Lakeman, Br. . . .	* "*Engineer*," xlviii. 404.
Circular, *Dale*, Br. .	* "*Engineer*," xlix. 268; l. 229.
Saw guide, *Roth* . .	* "*Man. & Builder*," x. 225.
Saw gummer, *Densmore*	* "*Man. & Builder*," xii. 25.
Disston	* "*Engineer*," xli. 450.
Tucker	* "*Scientific American*," xli. 86.
(Emery), *Densmore* .	* "*Scientific American*," xxxv. 54.
Saw-mill, American . .	* "*Engineer*," l. 158.
Portable. "Canadian"	* "*Scientific American*," xxxv. 318.
Saw-mill dog, *Stearns Co.*	* "*Scientific Amer.*," xxxviii. 196.
Saw, perforated blade.	
Am. Saw Co. . . .	* "*Engineer*," xli. 447.
Saw set, *Jones*	* "*Iron Age*," xx., July 26, p. 5.
Saw straightening . .	* "*Scientific American*," xxxvi. 259.
Saw tooth, *Hoe* . . .	* "*Scientific American*," xxxv. 294.
Saw, insertable tooth.	
Am. Saw Co. . . .	* "*Engineer*," xli. 447.
Hoe	* "*Min. & Sc. Press*," xxxvi. 257.
Schley	* "*Scientific American*," xxxix. 406.
Saws, *Boynton*	* "*Iron Age*," xvii., June 6, p. 17.
Disston	* "*Iron Age*," xvii., June 6, p. 29.
	* "*Engineer*," xli. 447.
Scroll saw, *Bentel, Margedant & Co.* . . .	* "*Manufact. & Builder*," viii. 105.
Trump	* "*Manufact. & Builder*," viii. 112.
Beach	* "*Manufact. & Builder*," viii. 222.
Bentel	* "*Scientific American*," xxxiv. 179.
Bush	* "*Scientific American*," xxxv. 262.
Beach	* "*Engineer*," xli. 428.
"Boss"	* "*Iron Age*," xxii., Oct. 24, p. 5.
"*Dexter*"	* "*Scientific American*," xxxvi. 275.
Dexter	* "*Iron Age*," xviii., Nov. 30, p. 1.
"Eureka," *Woods* .	* "*Manufact. & Builder*," ix. 241.
Fay	* "*Manufact. & Builder*," ix. 217.
Griffin	* "*Scientific American*," xl. 150.
Lester	* "*Iron Age*," xxi., May 2, p. 25.
Lewis	* "*Scientific Amer.*," xxxvii. 390.
Plummer	* "*Iron Age*," xvii., April 13, p. 3.
	* "*Scientific American*," xxxiv. 6.
"Stafford"	* "*Scientific Amer.*," xxxviii. 217.
Stafford	* "*Iron Age*," xxi., March 21, p. 20.
Walker Bros	* "*Scientific Amer.*," xxxvii. 227.

Saw Bra'zing Forge. A forge for brazing the ends of a band or other saw, having an anvil piece with blowing furnace below.

Saw Bench. The bench on which the material rests in being worked.

Fig. 2195 shows the table of a combined cutting-off saw, rip saw, miter sawing, bevel sawing, and dado machine. The saw mandrel is placed on a carriage, and travels on ways. The saw is drawn toward the operator by the foot treadle, which allows the operator the use of both hands to handle the stuff. The mandrel is raised and lowered by means of rack and pinion to adjust the same and dado head to different thicknesses of work.

Saw Guide. An adjustable piece to direct the saw in cross cutting.

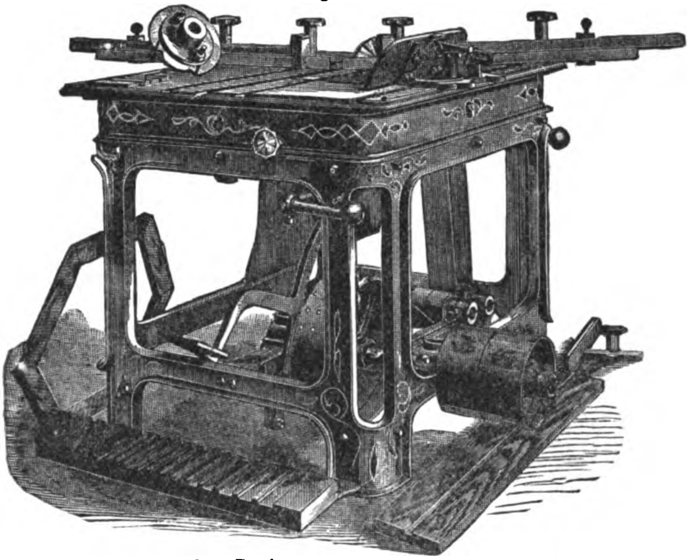
Saw'ing Ma-chine'. One with power-driven saw.

See under various heads in list of 160 kinds of saws, "*Mech. Dict.*," p. 2035.

Saw Joint'er. A device to enable gang saw operators to obtain and retain a correct, parallel, and uniform rake and breast line upon their saws.

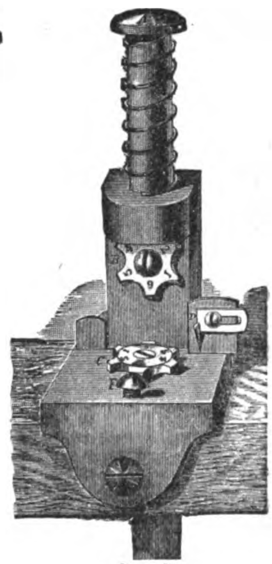
In Pond's saw jointer the saw is placed in a frame having

Fig. 2195.



Saw Bench.

Fig. 2196.



Saw Set.

tracks for the swaging blocks and file holder to travel on. The proper swage and knock-down is given each tooth by two blows on the double swaging blocks. The ways can be run up or down to preserve the breast line of the saws perfect when strained in the gate.

Experience has taught that no matter how carefully saws are strapped, and fitted by hand in the ordinary way, they will, when strained, vary on the rake line from one eighth to one half an inch in the stroke. One of the most important objects to be attained is the keeping of the saws jointed on just such lines as will give, when strained, a perfectly straight breast-line. After a saw is jointed and filed straight, put into the gate, keyed, and properly strained, it will often be found that the teeth are convex instead of being in a line as before the saw was strained. The back is slack. When the strain is forward of the center, that side will be taut, and present a convex edge, which increases or lessens in proportion to the width of the saw and the distance of the strain from the center line. The filer should give the saw a concave that will, when properly strained, become a straight line. To give a concave, so far, the eye alone has been depended upon without any scientific application of instruments. The concave should be made from end to end of the saw teeth, at every point the true arc of a circle. Unless all saws in the gang are jointed exactly alike and exactly right, the result of their action will be to retard the work of the gang, as the saws not properly jointed will wear out first and keep the good saws from performing the work they should do.

Saw Jump'er. A punch to shape the end of saw teeth. See SAW SWAGE.

Saw Set. An implement to spread the teeth of a saw laterally, to regulate the width of the kerf. See "*Mech. Dict.*," p. 2843, 2044.

In Fig. 2196 the plunger is operated by a treadle. The striking part and the anvil are star-shaped and similar in construction. The points are all of different sizes, designed to set different sized teeth.

Saw Ta'ble. A form of sawing machine adapted to trimming the edges of stereotype plates. See Fig. 5794, pp. 2079, "*Mech. Dict.*"

* "*Scientific American*" . . . . xl. 340.

Saw Tem'per-ing. The process by which the saw is given the necessary hardness and elasticity. See TEMPERING, "*Mech. Dict.*," p. 2562.

When large saws are made red hot in tempering and then suddenly cooled, they are frequently bent and buckled. This is usually rectified by a skillful stretching of the rigid spots by hammer and anvil, which liberates the structure until at length it is a flat surface, and runs true as a saw. In the new American system no hammering is resorted to. The buckled saw is compressed in a mold between two flat surfaces, the operation being performed in an oven made on purpose, which is carefully heated up to the proper temperature required to give the saw temper. The oven is allowed to cool down with equal care, and when taken out of the mold the saw is found tempered without being buckled. — *Dr. Anderson.*

Saw Tooth'ing Ma-chine'. One for increasing the depth of saw teeth. See "*Mech. Dict.*," 4616, 4617 *B*, 4636.

Saw Up-set'ter. A tool to turn over or display the teeth of a saw to widen the kerf. See SAW SWAGE.

Scab. (*Founding.*) A protuberance on a casting formed by the washing away of the mold-wall.

Scaf. (*Smithing.*) The tapered extremity or feather edge of a weld-lap.

Scaf'fold. In blast furnace practice, material which has been arched and refuses to melt down.

Scaf'fold-ing. See Elaborate illustrated article, *Laboulaye's "Dict. des Arts et Manufactures,"* vol. iv., ed. 1877, article "*Échafandage.*"

Scaffolding, Paris Exposition, 1878 . . . * "*Engineering*," xxviii. 108, 182.
Iron, *Hahn* . . . . * "*Scientific American Sup.*," 2701.
Screw (for chimneys).
Lish . . . . . . * "*Scientific American*," xli. 134.

Scales. Devices for obtaining the dimensions or weights of bodies. See "*Mech. Dict.*," pp. 2048–2051, and *supra*, pp. 316, 414, 415.

The American, French (metric), Charriere, and English gages of urethral instruments are given on pp. 5, 6, Part III., *Tiemann's "Armamentarium Chirurgicum.*"

The Fairbanks was the original compound lever weighing scale, though most American scales are of this class.

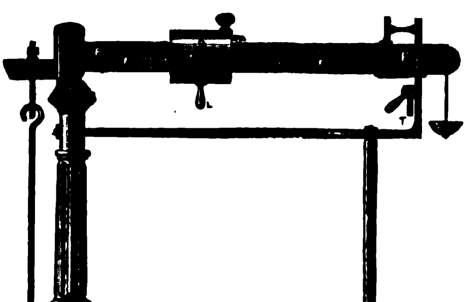
The principle of the platform scales consists in supporting a platform upon a system of four horizontal levers, which are placed in a shallow portable box or in a pit in the ground. These levers are iron bars set on edge, and each hanging upon a fixed knife edge of steel in one of the corners of the box or pit. On the original plan they all met under the center of the platform, their ends resting on the short arm of a fifth lever also of the second order, the long arm of which extended beyond the margin of the platform and was suspended by means of a connecting rod to the short arm of a lever or index beam at a convenient height above the ground. This in all the scales receives the counterpoise and the weights. The platform was fitted to a box or to a recess around the edge of the pit, resting there when not in use. Near each corner a foot projected downward terminating in a steel plate, and as the levers were raised a very little by the depression of the index beam, a knife edge fixed to each of them near the fulcrum reached this plate and together lifted the platform and its load. The weight, it is seen, was thus divided between the four levers resting upon them between their fulcrums and the power, and several times nearer to the former than to the latter. Such proportion of the load was therefore borne by the four corners, relieving the scale beam of this, as the length of the long arm of one of the levers to its whole length. The scale beam was still further relieved by the fifth lever, which was of the same order as the others, and received the weight a little within its fulcrum, which also worked upon a knife edge. In the scales of more recent construction the fifth lever is done away with, and two from the corners and at one end of the box or pit are extended entirely across, meeting each other beyond the opposite end and directly under the scale beam, with which they connect. The other two levers meet the first pair and connect, one with each of them, just midway across. A steel ring at this point hangs upon a knife edge of each of the levers of the first pair, and into this is introduced the knife edge, facing downward, of one of the other levers.

The adjustment of the bearing points is made with the utmost precision, so that the results do not vary if the load is placed successively upon different portions of the platform. Considering the small proportion of the load that actually comes upon the scale beam to be weighed, in the largest machines sometimes amounting to not more than the one hundredth or even the one-thousandth part, the results are surprisingly accurate. At a test made in the Crystal Palace, New York, 52,600 pounds was weighed successively on every portion of the platform of a railroad track scale, and the greatest variation from the main weight was three pounds.

The graduation of the beam is made very exact by machine work, and all the corresponding parts in the scale.

Chamoroy's (Paris) invention is a weighing machine, made to register the weight ascertained, by printing it on tickets during the operation of weighing. This is accomplished by arranging at suitable distances along the edge of the scale beam a series of punches, like those for stamping names or figures on wood or iron, with projecting figures: in a machine for weighing up to a thousand kilograms — about a ton — these figures represent hundreds. A movable plate is inserted in the sliding weight below the beam, and capable of being brought into contact with it by a lever. The ticket is introduced between the plate and the under edge of the beam through an aperture in the sliding weight. These figures print the hundreds; but the tens figures following by a line are set on the under side of a short bar which works in the sliding weight like the bolt of a door. The tickets

Fig. 2197.



Chameray's Registering Scale.

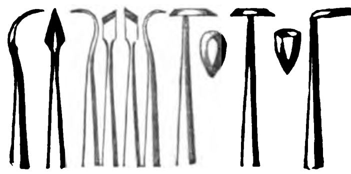
having been already printed with equi-distant spaces numbered to represent the units and divided by dots, when an article has to be weighed, the sliding weight is brought under whichever hundreds figure corresponds to the nearest approximation to the weight, and equilibrium is obtained by moving the short bar, previously mentioned, from left to right in the sliding weight. The ticket is then inserted between the movable plate and the beam, and a smart blow on the lever punches the tens and hundreds figures on the tickets, the position of the horizontal line following the tens figure with respect to the dot and line already printed, permitting of the weight being ascertained and printed correctly to a quarter of a kilogram — ½ lb.

Scale, *Marquoi* . . . * "*Scientific American Sup.*," 2095.
Scale-beam, compound division, *Weeks* . . * "*Iron Age*," xxiii., May 8, p. 24.
Scale board mach., *Huey* * "*Scientific American*," xlii. 276.
Scale equilib., *Redier*, Fr. "*Manufact. & Builder*," x. 205.
Scale factory, *Fairbanks* * "*Scientific American*," xliii. 287.
Scales, automatic, *Stoner* * "*Scientific American*," xliii. 371.
Weighing, *Riehle* . . * "*Scientific American Sup.*," 498.
Platform scale, constant equilibrium, *Redier*, Fr. * "*Scientific American*," xxxix. 233.
Fig. 976, p. 816, *supra*.

Sca'ler. A dentist's tool for removing scale or tartar from teeth.

Especially shaped and designed for removing deposits of salivary calculus from the necks and interspaces of the teeth.

Fig. 2198.



Dentist's Scalers.

Sca'ling Knife. (*Fishing.*) A knife for removing scales; sometimes has a saw edge.

Scalp'ing. (*Milling.*) Brushing the *hair* or fuzz from the ends of wheat grain to prevent its getting into the flour. One of the refinements of the new wheat processes.

Scan'di-na'vi-an Belt'ing. Cotton cloth woven solid and treated with Stockholm tar. Paper by Cobbett, London Association of Society of Foreman Engineers, reported in "*Scientific American Sup.*," 3800.

Scan'di-na'vi-an Lock. A form of lock for securing hasps to staples. It is made heavy, both branches of the bow withdrawing from the lock. See JAIL LOCK, Fig. 1481, p. 511, *supra*.

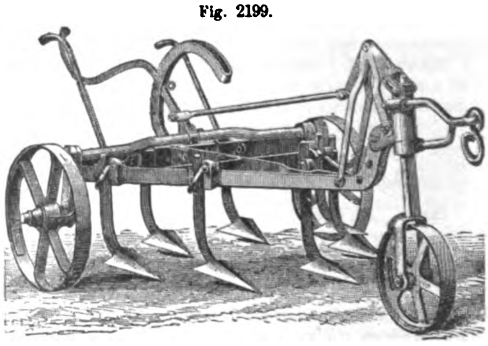
Scar. (*Founding.*) A weak or faulty part in a casting, due to an imperfection of the metal.

Scarf'ing Frame. A holder in which a band-saw is placed while the scarfed ends are brazed together. See BAND-SAW HOLDER, p. 72, and Fig. 199, p. 73, *supra*.

Scar'i-fi-er. A cultivator having long, sharp teeth, with wheels to regulate the depth of cut.

Fig. 2199 is a French horse-power cultivator of the largest class; it is called a *Scarificateur extirpateur*, and is an efficient implement when sufficient power is applied. Seven shares are fixed in the triangular iron frame, the front angle of which has a goose-neck in which the standard of the caster wheel is placed. A single movement of the lever raises or

Fig. 2199.

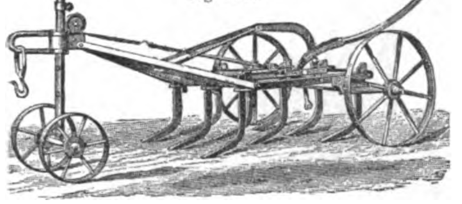


French Scarifier. (*Breloux, Nevers, France.*)

depresses the frame at all points equally, so as to keep it in parallelism with the soil. It resembles some of the cultivators in the series of steam-plow implements.

Fig. 2200 is much like the preceding, but having four

Fig. 2200.

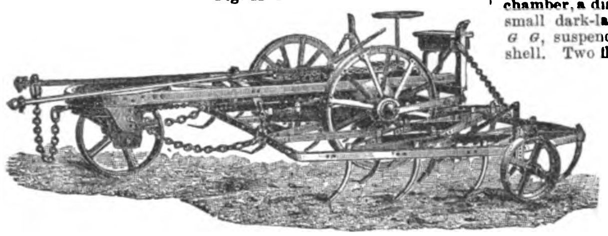


Four-Wheeled Scarifier.

wheels instead of three, and teeth more for stirring than cutting.

Fig. 2201 shows a turning harrow, between a steam cultivator and steam harrow. It is fitted at will for either of two kinds of shares, a broad one for cutting and a square-pointed one for simply stirring the ground. The instrument is in three pieces to accommodate itself to uneven surfaces, and will take in a breadth of 12′ to 15′. The steering frame is adapted to take different harrows, from the lightest seed-harrow up to cultivating tools. On the short end of the turning lever is a chain communicating with a quadrant on the crank axle, and as the lever is pulled around the chain, acting on the quadrant, turns the axle, lifts the frame, and raises the tines out of the ground.

Fig. 2201.



French Cutting and Stirring Scarifier.

Sci-en-tif′ic Ap′pa-ra′tus.

Scientific apparatus, London exhibition of .	"*Engineering*," xxi., various art.
Loan collect. Engl. .	"*Scientific American Sup.*," 505.
London exhibition of	"*Engineering*," xxii. 4 and following.
Exhibition of . . .	"*Engineer*," xli. 341, 352, 371, 376, 389, 425, 481-486.
Scien[illegible]logs	* "*Man. & Builder*," viii. 36, 60.

S[illegible]ors. (*Surgical.*) The following list of shea[illegible]nd scissors used in surgery embraces the more important: —

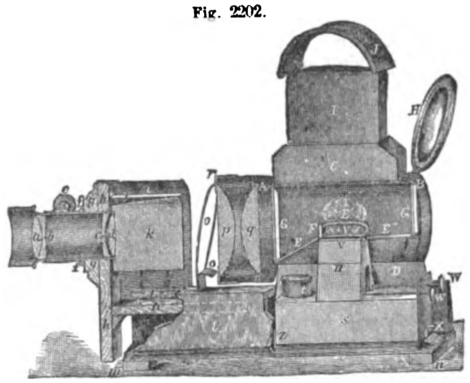
Amputating cervix.	Perforating.
Angular.	Pile.
Artery.	Phymosis.
Canulated.	Plaster of Paris.
Ceratome.	Probe-pointed.
Conjunctiva.	Pterygium.
Curved.	Staphylorraphy.
Dissecting.	Strabismus.
Dressing.	Tonsil.
Ear.	Tonsilotome.
Enterotome.	Tooth-edged.
Harelip.	Trachea.
Hemorrhoidal	Uterine.
Hysterotome.	Uvula.
Iris.	Wire-cutting.

See many illustrations in Fig. 4671, p. 2064, "*Mech. Dict.*" Some others are shown in present volume under their alphabetical heads. See also: —

Bankers' scissors.	Paper-hangers' shears
Barbers' scissors.	Pocket scissors.
Button-hole cutters	Pruning shears.
Ladies' scissors.	Sardine shears.
Nail scissors.	Tailors' shears.
Paper scissors.	Trimmers, straight and bent.

Scissors, for glass.	
Martini . . .	"*Technologiste*," xxxviii. 217.
Bruder-Johnson .	* "*Iron Age*," xvii., Jan. 18, p. 9.
Young	* "*Iron Age*," xvii., Feb. 8, p. 11.
Folding	"*Scientific American*," xxxv. 159.
Scissors gage, *Wiggins* .	* "*Scientific American*," xxxv. 66.

Fig. 2202.



Marcy's Oil-light Sciopticon.

Sci-op′ti-con. A form of magic-lantern for exhibiting photographic objects.

Fig. 2202 shows Marcy's Oil light Sciopticon. The flame-chamber, a distinctive feature of the oil-light sciopticon, is a small dark-lantern in itself, with a front and back-glass, *G G*, suspended by cross-strips in a ventilated protecting shell. Two flames, starting wide apart at *v v*, are deflected as close toward each other as they can be without interfering, over a rising current of air, which thoroughly oxygenates the inner surfaces. The chimney-cap is telescoping, and can be raised or lowered. The reflector *H* is outside the flame-chamber, and answers the purpose of door and reflector. Its burnished surface is kept from tarnishing by a protecting film. The condenser *p q* is suspended free from contact in a chamber separate from the flame-chamber. Its front band presents a good bearing for rests and slides, and the lenses are removable. The extension front is readily removable to give access to the interior of the instrument, and can be drawn forward to suit different lenses.

Schist Oil. Article "*Huile de Schiste,*" Laboulaye's "*Dictionnaire des Arts et Manufactures,*" tome iv., ed. 1877.

Scoop. 1. (*Surgical.*) A ladle or spoon shaped instrument used in removing objects from cavities. Among them are those having the following applications: —

Bone.	Laryngeal.	Sessile tumor.
Cataract.	Lithotomy.	Urethral.
Lens.	Rectal.	Uterine, etc.

Thomas's serrated scoop for the detachment of sessile uterine fibroids has a saw-shaped edge to the scoop.

See also CURETTE.

2. A form of wheel used in lifting water. See Fig. 4677, p. 2055, "*Mech. Dict.*"

3. A spoon-shaped capacious shovel.

4. A bowl-shaped pan on a weighing-scale.

Weighing scoop . . .	* "*Scientific American*," xxxviii. 23.
Scoop, smooth back.	
Hussey, Burns & Co.	* "*Iron Age*," xix., April 5, p. 11.

Scoop Net. (*Fishing.*) A baling net for emptying the fish collected in a pound.

Scor′ing Ma-chine′. The corner cutting and scoring machine is one used in making small boxes of card-board, to cut off the superfluous material from the blank and to make a score on the future angles of the box in order to make the stuff bend readily and accurately at such places.

See PAPER-BOX SCORING AND CUTTING MACHINE.

Score. (*Nautical.*) The groove on the body of a tackle-block to hold the strap.

Scour'er. A form of grain cleaner in which the berry is subjected to a rubbing action to remove all extraneous matters: smut, dust, mildew. See GRAIN CLEANER, SMUTTER, etc., and references *passim*.

Scour'ing. 1. (*Grain.*) A process in which grain is rubbed and brushed to remove smut, dust, mildew, etc.

2. (*Leather.*)

Scouring on the flesh. — On being taken out of the water the skins are spread out and set on the scouring table by passing a steel slicker over the flesh side, which brings the grain in close contact with the table, and, being wet, it adheres to it. A bountiful supply of water is applied and rubbed briskly over the flesh side with a stiff brush, whereby the pulpy portions of the surface are scrubbed off, and the skin presents a soft, whitened appearance and the pores are opened.

Scouring on the grain. — The skin is set on a scouring table by a slicker, which stretches it and at the same time loosens the bloom. The grain side is kept uppermost, and is smartly brushed with a stiff hair brush, using at the same time plenty of water, when the slicker is again used to remove the water and loosened bloom. A stock-stone is often used instead of the slicker to loosen the bloom.

3. (*Fabric.*) A process for renewing the surface of soiled stuffs, removing stains, etc. The dégraissage of the French. *Laboulaye's "Dictionnaire,"* i., "*Degraisseur.*"

Scour'ing Ta'ble. (*Leather.*) A large firmly built table, with a mahogany, bird's-eye maple, slate, or marble top. It is about 12′ long and 4′ wide, so constructed that the water used in scouring may pass off readily upon the side opposite to that on which the workman is engaged.

Scow, Cheap. A small flat boat.

Scow, cheap . . . * "*Scientific American Sup.,*" 897, 410.

Scrap Cut'ting Ma-chine'. A machine for cutting long metal scrap for bundling and reworking. See BAR CUTTER.

Scrap shears.
Parkgate Iron Works, Br. . * "*Engineering,*" xxix. 284.

Scra'per. (*Iron Working.*) 1. A tool used in getting a true face on a metallic surface after leaving the planer.

2. An arrangement for leveling or moving dirt, removing weeds, etc.

A leveling attachment for dirt cars. Two spreading wings attached to the rear car of a construction train run outside the rails near the ties, to level the dirt that has been dumped from the preceding cars.

The Johnson wheeled earth scraper, Fig. 2203, is suspended from the axle by a hanger pivoted at the lower end in the center of the side of the scraper box. The axle being free at the top permits the wheels to roll forward when raising the back end to fill or dump, although the formation of the scraper will not admit of a horizontal position while filling.

Earth car, Leveling attachment for.
Andrews . . . . . * "*Scientific American,*" xliii. 271.
Scraper, Earth . . . . * "*Scientific American Sup.,*" 225.

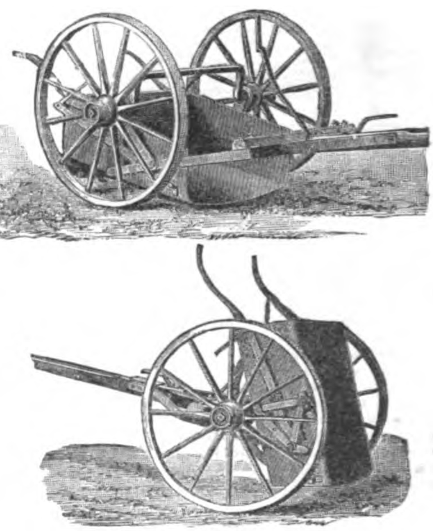
Pettier's scraper for cleaning in gardens and vineyards has a broad hoe-shaped blade, followed by a row of iron teeth. The blade cuts the weeds and grass off at the surface of the ground while the teeth gather up the grass and weeds, and loosen the soil.

For different scrapers, see pp. 2057-2059, "*Mech. Dict.*"
Wheeled, Fig. 4694, p. 2058, "*Mech. Dict.*"
Revolving, Fig. 4695, p. 2058, *Ibid.*
Oblique board, Fig. 4693 *B*, p. 2058; Fig. 4365, p. 1954, *Ibid.*
Wagon mounted, Fig. 4696, p. 2059, *Ibid.*
Scraper, earth. *Doty* . * "*Engineer,*" xlii. 199.
Revolving, *Revolving Scraper Co.* . . . * "*Iron Age,*" xvii., Feb. 17, p. 19.

(*Wood Working.*) Fig. 2204 shows Whitney's machine for giving a fine surface to hard woods, particularly where the grain is irregular; a planing machine, in which the wood is carried by rolls suitably placed against a stationary cutter.

This cutter is a steel blade of sufficient length to extend across the machine, secured in a block of such strength as to be safe against springing. This blade is exceedingly sharp,

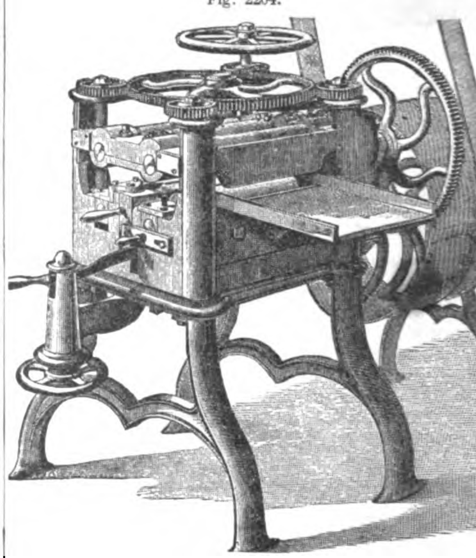
Fig. 2203



Earth Scraper.

and has the feather-edge which is generally considered essential in a scraping-tool for wood. The blade is very carefully set to take the thinnest possible shaving from the surface of the wood, which is given an ordinary good finish on the planing machine before it is sent to the scraper. A little machine accompanies the scraper, specially designed to sharpen the

Fig. 2204.



Wood Scraper.

blade. It consists of a pair of emery-wheels, so set that one can bevel the edge of the cutter while the other squares up the face. The blade is clamped, during the operation, between a pair of jaws, which hold it firmly and precisely in position. As the sharpened blade passes from under these wheels, a stationary steel bar touches the edge, and, sliding along it, turns it, producing the feather-edge.

Scrap'ping. A device for carrying away the scraps of paste, the residuum of the sheet after stamping out crackers, biscuits, or cakes in the machine. See CRACKER-CUTTING MACHINE; PANNING MACHINE.

Scratch'er. (*Plasterers.*) The scratcher is made of pointed slats, set 1" apart, and kept in position by cross pieces; one slat is left longer than the others, and answers the purpose of a handle.

Screen. A separator or partition.

A screen for working ores by the wet process is made of Russian sheet-iron, the smooth planished iron being punctured with fine holes.

Screens for working dry ores are made of wire, and vary in fineness from 900 to 10,000 meshes to the square inch.

A protecting shield around radiators.

A sifting arrangement for sand, etc.

A blind to intercept heat or light.

A riddle or sieve. See GRAIN CLEANER, etc.

A jigger, etc., for ore.

See "*Mech. Dict.*," p. 2059.

Screw. See under the following heads: —

Cap screw.	Oval point set screw.
Coach screw.	Round head cap screw.
Countersunk head screw.	Screw bolt.
Hanger screw.	Screw eye.
Hexagon-head cap screw.	Screw knob.
Knob screw.	Set screw.
Lag screw.	Skein screw.
Machine screw.	Wood screw.

Screw-head key . . . * "*Eng. & Min. Jour.*," xxvi. 187.
Screw-plate . . . . * "*Iron Age*," xxii., Dec. 5, p. 9.
Launch engine . . . Figs. 1549-1555, pp. 531, 532, *supra*.
Screw cylinder engine . *Infra.*
Six cylinder engine . . *Infra.*
Screw propeller, feathering, *Moyse*, Br. . . . * "*Engineer*," xlv. 59.
* "*Scientific American Sup.*," 2299.
Screw steerer . . . . * "*Scientific American Sup.*," 2162.

See article "*Helice*," *Laboulaye's* "*Dictionnaire des Arts et Manufact.*," tome iv., ed. 1877. Number of arms; diameter; area: rate and recoil, etc. Sollier's and Mangin's systems.

Screw-thread forging machine . . . . . * "*Scientific Amer.*," xxxvii. 114.
Screw propeller.
Deane, Br. . . . . * "*Engineering*," xxviii. 40.
De Bay . . . . . * "*Scientific American*," xliii. 198.
De Bay, yacht "Iolar," Br. . . . . * "*Engineer*," xlviii. 352.
Eyre . . . . . . * "*Engineering*," xxiii. 236.
Eyre. Engl. . . . . * "*Scientific American Sup.*," 1169.
Griffiths . . . . . "*Scientific American Sup.*," 2878.
Ressel (1812), Sweden * "*Engineering*," xxvii. 13.
S. S. "City of San Francisco," *Roach* . . * "*Engineering*," xxiii. 268.
Thorneycroft . . . * "*Scientific American Sup.*," 1220.
Thorneycroft, Br. . . * "*Engineering*," xxi. 88.
Assistant.
Mackenzie, Br. . . * "*Engineer*," xlviii. 198.
Dynamometer.
Froude, Br. . . . * "*Engineer*," xliv. 77.
Feathering.
Kirk & Hunt, Br. . * "*Engineering*," xxix. 225.
Moysey, Br. . . . . * "*Engineer*," xlv. 59.
Raising, etc., *Sadlier* . * "*Scientific Amer.*," xxxviii. 120.
Testing apparatus . . * "*Engineer*," xlvii. 389.
Testing apparatus, Br. * "*Engineer*," xlvii. 124.
Screw propellers.
Howden . . . . . * "*Scientific American Sup.*," 1599.
Screw cutting machanism.
Engl. . . . . . . * "*Scientific American Sup.*," 2463.
Screw cutting tools, kit of, *Wiley & Russell* . * "*Scientific American*," xxxvi. 54.
Screw cutter and nut tapper, *Schlenker* . . * "*Iron Age*," xxi., May 2, p. 26.
Screw collier "Fenton," *Austin & Hunter*, Br. * "*Engineering*," xxviii. 490.
Screw cutting lathe . . * "*Scientific American*," xxxvi. 118.
Brown & Sharpe . . * "*Man. & Builder*," xi. 199.
Ferris & Miles . . . * "*Engineering*," xxi. 372.
* "*Railroad Gazette*," xxi. 71.
Goodnow . . . . . * "*Scientific American*," xxxix. 53.
Johnson . . . . . * "*Iron Age*," xix., March 8, p. 5.
Weise . . . . . . * "*Scientific American*," xxxv. 291.
Screw cutting foot lathe.
Astbury, Br. . . . . * "*Engineering*," xxx. 321.
Screw driver, *Abrams* . * "*Scientific American*," xli. 358.

Screw engine (for propellers) *Cramp* . . . . * "*Engineering*," xxi. 480.
Screw hoisting tackle.
Box & Co. . . . . . * "*Iron Age*," xxiii., Feb. 13, p. 11.
Screwing machine.
Pratt & Whitney . . * "*Engineer*," xlii. 24.
Barrow, Br. . . . . * "*Engineering*," xxx. 127.
With releasing motion.
Brown, Br. . . . . * "*Engineer*," xlii. 349.
Screwing and tapping machine, *Pratt & Whitney* * "*Engineering*," xxi. 248.
Bowker . . . . . * "*Scientific American Sup.*," 165.
Screw-jack, 6-ton.
Maude, Br. . . . . * "*Engineer*," xlvii. 117.
Telescopic, *Ball* . . * "*Engineer*," xlix. 286.
Screw machine.
Browne & Sharpe . . * *Thurston's* "*Vienna Rept.*," ii. 232.
Pratt & Whitney . . * *Thurston's* "*Vienna Rept.*," ii. 225.
Self-slotting, *Hubbel* . * "*Iron Age*," xviii., Nov. 30, p. 1.
Screw shaft flexible coupling, *Snowden*, Br. . * "*Engineering*," xxix. 474.
Screw shafts, flexible coupling for . . . . * "*Scientific American Sup.*," 3898.
Screw steamer of 1804.
Stevens . . . . . * "*Manufact. & Builder*," ix. 190.
Screw thread forging machine, *Bouchacourt & Delille*, Fr. . . . . * "*Engineer*," xliii. 417.
Screw ventilator, *Pelzer* * "*Scientific American Sup.*," 4071.

Screw Burn'er. (*Lamps.*) *a.* A burner in which the wick is lifted and depressed by a screw. Found in Argand lamps.

b. A burner which fastens by screw thread to the socket of the lamp-top.

Screw Cal'i-pers. In which the adjustment of the points is made by screw. See several forms in Fig. 1029, p. 429, "*Mech. Dict.*"

Screw Cut'ting Ma-chine'. A screw cutting machine takes a rod of iron, steel, or brass, and by an automatic series of operations drops screws at the other end of the machine. One tool cuts the point of the rod down to the dimensions of the screw, another cuts it off, having the head the full size of the rod, another takes it from the last and passes it on to have the thread cut, a cutter passes by and leaves it slotted, another with four iron fingers takes it and transfers it to a fifth cutter, where the head is finished, when still another tool comes to push it into the pan placed to receive it. No intervention is needed until another rod is wanted. See SCREW, *supra*.

Fig. 2206 represents a machine for screwing and cutting off steam and gas pipe. The belting and gearing are arranged for obtaining suitable power and speed for the varying sizes of pipes. The die and head to which it is attached are so constructed that pipe may be alternately screwed and cut off without removing the die from the machine.

See various forms on pp. 2065-2067, "*Mech. Dict.*"

A form of lathe as in Figs. 4725, 4734, pages above cited.

See also BOLT-CUTTER, Figs. 367-371, pp. 117, *supra*; Figs. 770, 771, 777, 778, pp. 324-326, "*Mech. Dict.*"

TURRET LATHE, Fig. 6824, p. 2665, "*Mech. Dict.*"

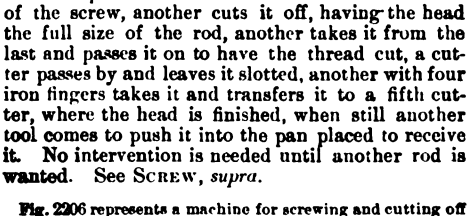
PIPE THREADER, Fig. 3744, p. 1712, "*Mech. Dict.*"

SCREW, *supra*.

Screw Ma-chine'. In sheet-metal working, a machine for threading zinc or sheet-metal screws for can-tops, etc.

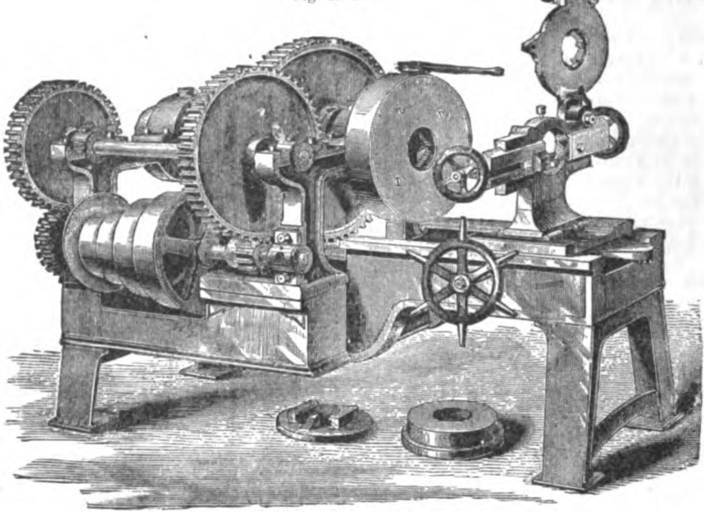
Screw Dog. A clamp to hold the stuff firmly in the carriage, adjustable by a screw.

Fig. 2205.



Extra Screw Dog for Holding Dimension Stuff.

Fig. 2206.



Screw Cutting Machine.

Fig. 2206 shows a feeding or tail screw hung in an iron box, let into the back end of the carriage, so as to come entirely below its surface; on this screw is a nut with a traverse dog for holding the stuff, and operated by a hand-wheel on the outer end of the screw. The front dog for holding the stuff consists of a plate having teeth on one side and running across the entire width of the carriage, and which is held in its place by teeth on an iron plate let into the sides of the carriage, requiring no bolts or keys to hold it firm.

Screw El′e-va′tor. 1. (*Dental.*) A staff with gimlet screw on the end to screw into a root as a means of withdrawal. Fig. 4730, p. 2066, "*Mech. Dict.*"

2. (*Surgical.*) A hard rubber conical screw to force open the jaws of maniacs or lock-jawed.

3. A form of passenger lift in which a screw is used to elevate the cage.

Screw En′gine. Engines of this type, for vessels up to 300 tons, have inverted steam cylinders carried on strong hollow standards, which also form the guides for the cross-heads. The slide valves are between the cylinders, and the valve-box cover is on the side, giving easy access to the valves for examination. The engines have case-hardened link-motion reversing gear, and separate expansion valve.

The condenser is fixed on one side; the air-pump is driven by side levers from the cross-head of the engine. The standards which carry the engines are fixed to a strong cast-iron base-plate; the bearings for the crank-shaft, including the thrust bearing, are also secured to this plate. The screw shaft is coupled direct to the crank-shaft, and passes through a stern tube, as shown. It is usually fitted with a three-bladed screw propeller, but any other form may be adopted, and the propeller is made of malleable cast-iron, gun-metal, or cast-steel, as may be desired, the price varying according to the material employed. The boiler is of the ordinary circular form, with an internal flue and return tubes, the uptake leading to the chimney being in front of the boiler and directly above the fire-door. The boiler is of the best material and workmanship throughout, and is furnished with all the steam mountings and furnace fittings necessary for its safe, efficient, and economical working. A donkey-pump feeds the boiler.

M. Cavé's (Fr.), *Fig. 3417, vol. iv., Laboulaye's "*Dict. des Arts et Manuf.*," ed. 1877, article "*Bateau à Vapeur.*"

Screw Eye. A loop with threaded shank, to be screwed into an object.

Screw Fin′ish-ing Ma-chine′.

Fig. 2207 is specially adapted for small hand-tooling, finishing the heads of screws, pins, and a variety of similar work. A half-inch hole extends through the spindle. Self-adjusting shell chucks are used in the spindle. These are opened by the knee of the operator without stopping the machine, thus saving the time of stopping and starting every time the work is put into the machine or removed. The boxes are self-oiling, running from two to three months without the necessity of oiling them. The machine is arranged for a high rate of speed. Tight and loose pulleys are upon the spindle. Either one or two counter-shafts accompany the machine, as may be desired. They are provided with adjustable hangers, iron cones, and pulleys. First countershaft should run 450 turns per minute. Tight and loose pulleys 6″ diameter, 2¼″ face. Weight of machine with both countershafts, 425 lbs.

Screw for Boot Soles. Article "*Chaussures à Vis,*" * Laboulaye's "*Dict. des Arts et Manufactures,*" vol. iv., ed. 1877. See SOLE-SCREWING MACHINE.

Screw Gage. 1. A device for measuring the pitch of the threads of the screw.

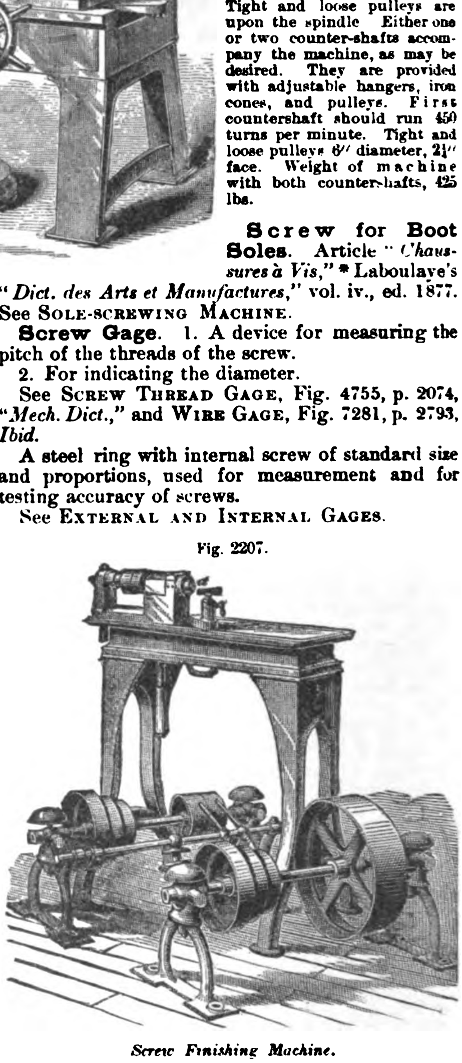
2. For indicating the diameter.

See SCREW THREAD GAGE, Fig. 4755, p. 2074, "*Mech. Dict.,*" and WIRE GAGE, Fig. 7281, p. 2793, *Ibid.*

A steel ring with internal screw of standard size and proportions, used for measurement and for testing accuracy of screws.

See EXTERNAL AND INTERNAL GAGES.

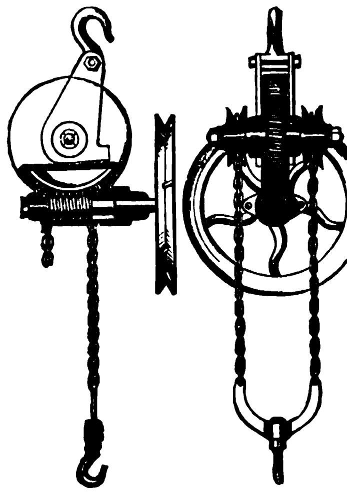
Fig. 2207.



Screw Finishing Machine.

Screw Hoist. In Fig. 2208 the axle of the ordinary large winding wheel has screw threads cut thereon which mesh with the gear on a smaller wheel set above the axle and transversely to the large wheel. On the opposite ends of the axis of the latter wheel are pulleys, over which chains pass which are attached to the swivel hooks below. It will sustain at any point, but will lower rapidly when started.

Fig. 2208.



Screw Hoist.

Screw Hook and Eye Hinge. A hook and eye gate hinge, each part of which has a screw shank.

Screw Hook and Strap Hinge. A hook and eye hinge of which the hook part has a screw shank and the eye part a strap to be secured to the gate or door.

Screw'ing Stock. A stock or handle which holds the threaded nut for making a thread on a bolt or bar. A screw plate.

Fig. 4739. *f*, page 2069, "*Mech. Dict.*"
Fig. 4754, *a*, p. 2074, *Ibid.*

Screw Knob. A curtain knob with screw shank.

Screw Line Box. One the cover of which is depressed by a screw. A *spring* line box is shown in Fig. 1615, p. 552, *supra.*

Screw Ma'king Tools. Taps, dies, stocks, etc. Figs. 4739, 4754, pp. 2069, 2074, "*Mech. Dict.*"

Screw Nick'ing Ma-chine'. One for cutting the nicks in screw-heads. See Screw Slotting Machine.

Screw Pile. (*Hydraulic Engineering.*) The procedure in the setting of the screw-piles for the United States pier near Lewes, Del. (1877, 1878), is carefully shown in the "*Report of Chief of Engineers U. S. Army,*" 1879, * i. 448.

Mitchell, * *Laboulaye's* "*Dictionnaire*," iv., ed. 1877; "*Pilotis.*"

Screw Pol'ish-ing Ma-chine'. See Screw Finishing Machine.

Screw Press. A machine in which the pressure is given by means of a screw. The applications are numerous and the examples are given under specific heads. See list under Press, *supra*, and p. 1784, "*Mech. Dict.*"

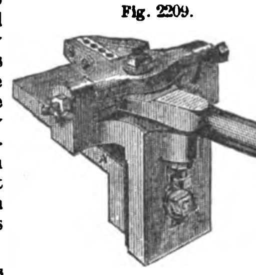
Some of the prominent are under
Cheese Press, Fig. 609, p. 194, *supra.*
Cider Press, Figs. 616–618, p. 196, *supra.*
Olive Press, Figs. 1839–1841, p. 642, *supra.*
Portable Press.
Stearine Press.

Screw Sha'ving Ma-chine'. A machine for turning off wood-screw blanks.

It is furnished with ten spring collets, a cross-rest with two shaving tools, oil-tank, dripper, and countershaft. The collets are opened and closed in the spindle by a hand-lever, and hold screws ⅛″ to ⅝″ diameter, increasing by sixteenths; ⅝″ to 1″ diameter by eighths. The shaving tools are circular, and may be sharpened by grinding without changing their form.

Screw Slot'ting Ma-chine'. The device shown in Fig. 2209 can be attached to an ordinary hand lathe, and is believed to be more efficient for the purpose than any machine heretofore made. An active boy can slot from ten to fifteen thousand screws per day.

Fig. 2209.



Screw Slotting Machine.

A single bolt fastens the platform *A* of this apparatus to the bed of a hand lathe, the long lever projecting in front at a right angle with the bed. An arbor carrying a circular cutter is held in the center of the lathe. The long lever is moved horizontally to open the jaws for inserting and removing the screws, and downward to bring the screws to be slotted against the saw. The stop screw *B* governs its downward motion, and thus regulates the depth of slot in the screw head. The working part of the apparatus can be raised or lowered on the platform front by means of the bolt *C*.

In the Pratt & Whitney machine, the head-stock has a cone of 3 grades for a 2″ belt. The stock holding the vise-jaws and dies may be adjusted toward or from the spindle and transversely across the table. The spindle carries a rotary cutter, against which the head of the screw is brought by a vertical movement of the vise, produced by a hand-lever, rack, and pinion. The same motion of the lever that closes the vise, also raises it with the screw to be slotted, and a weight under the table instantly opens the vise and releases the screw as soon as the pressure on the hand-lever is removed. The machine slots screws of 9-16″ and less diameter. Weight of machine, with countershaft, 500 pounds.

Screw So'ling Ma-chine'. A machine for uniting the uppers and soles of boots and shoes by means of a brass screw made on the machine, operating automatically, whereby it grasps the wire, carries it forward, cuts a thread upon it, screws it into the sole of the shoe and cuts it off in suitable lengths — all at the same time. — *Tyson.*

Screw Steer'er. A device to assist the helmsman in holding the rudder at every point of its movement, to prevent the rudder kicking or running down by surges.

See Steering Apparatus, Figs. 5757–5760, p. 2372, "*Mech. Dict.*," and Fig. 4753, p. 2073, *Ibid.*

Scri'ber. A marker.

Scribing tools, *Rose* * "*Engineering*," xxi. 119, 139, 330, 521.

Scrod'dled Ware. (*Ceramics.*) Ceramic ware, made by taking scraps and pieces of differently colored clays, such as are left over in making vases and plaques, and laying them together, joined but not intermixed, so as to produce a marbled or mottled effect.

Tortoise-shell ware had a similar origin. See also Pâte Changeante.

Scroll Chuck. A lathe chuck in which the dogs are moved in concert by a scroll hidden in the body of the chuck; as in Fig. 4767, p. 2077, "*Mech. Dict.*" Several of the chucks shown in Figs. 874–876, pp. 273–275, and Figs. 1540–1544, p. 529, *supra*, are scroll chucks.

Scroll Lathe. One adapted to turn spiral and scroll work, such as balusters, table and piano legs, etc. See Fig. 555, p. 174, *supra.*

Scro'tal Clamp. (*Surgical.*) A clamp for castrating or for amputation of redundant scrotum for the relief of varicocele Scrotal forceps.

Scro'tal Com-pres'sor. (*Surgical.*) For mechanical pressure on the morbidly distended scrotum in orchitis. A hard rubber globular bag with lacing holes.

Scro'tal In'stru-ments. (*Surgical.*) Instrument for hydrocele, varicocele, etc. The list includes: —

Canula.	Scrotal clamp.
Depilating forceps.	Suspensory bandage.
Injector.	Scrotal compressor.
Varicocele clamp.	Trocar.

Scrub'ber. A washing and brushing, cleansing apparatus.

Scrubber gas, on. *Hunt*, Br. . . . . "*Engineering*," xxii. 48.
Scrubbing machine, domestic, *Stockley* . . * "*Min. & Sc. Press*," xxxvi. 249.

Scuf'fle Hoe. One having a push motion instead of the downward and pull motion.

Scuffle hoe, *Munson* . . * "*Scientific American*," xl. 389.

Sculp'ture. Mechanical aids in reducing the labor of the sculptor and for copying. See article "*Sculpture,*" Laboulaye's "*Dictionnaire des Arts et Manufactures,*" vol. iii., ed. 1877.

Article "*Tours Composés,*" Laboulaye's "*Dict. des Arts et Manufactures,*" iv., ed. 1877, Fig. 42.

Scutch'ing Ma-chine'. One for separating the individual fibers of cotton or flax, which have gone through the preliminary opening process.

Scutching machine, *LeFranc*, "*Iron Age*," xx., July 19, p. 20.

Scut'tle. 1. A small light aperture, closed by a hatch or shutter.

2. A coal bucket

See SIDE LIGHT, "*Mech. Dict.*," p. 2174, *et infra.*

Sea Bat'te-ry. (*Electricity.*) One in which the plates are immersed in the sea, so as to be acted upon by the salt water. Such are used in making luminous signals on buoys, etc.

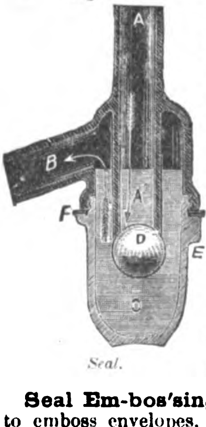
Sea Cock. One opening through the hull into the sea.

Spence's improved sea cocks . * "*Engineer*," xli. 287.

Seal. An automatic valve closing a pipe; or a U-shaped bend in which water collects and prevents passage of air. See SEWER TRAP.

The common siphon trap as used in most sinks and water-closets is subject to two objections: First, the sewer gases in the ascending branch of the trap are in constant contact with the water, and permeate it without hindrance, by which it becomes foul and gives off offensive odors in the other ascending branch of the trap; second, when from some cause or other pressure takes place in the descending branch connected with the sewer, the sewer gas will bubble up through.

Fig. 2210.



Seal.

The inlet pipe connecting with the washstand, sink, or other fixture extends down about half way into the center of an enlarged U-shaped chamber two thirds full of water in which floats a rubber ball fitting tightly up against the end of the inlet pipe, forming a perfect seal. The outlet pipe is in the top of the U-shaped chamber, above the end of the inlet pipe.

See Fig. 5766, p 2374, and Fig. 6618, p. 2616, "*Mech. Dict.*"

Seal Em-bos'sing Press. A press intended to emboss envelopes, or name or initials on note paper, or the stationer's card on any paper they print or furnish. It is worked by a cam and gearing; is very powerful and speedy, and is readily adjusted to any pressure wanted.

Seal Hook. An iron hook which is inserted into the hasp of a freight-car door and to which a seal wire and metal seal are attached.

Seal Lock. A lock in which a seal made of glass, paper, or other material is inserted in the lock in such a manner as to cover the bolt or the key-hole. The lock cannot be opened without breaking the seal.

Seal Press. A pair of levers arranged like a pair of pincers and with two dies with which lead car-seals are compressed on the wire to which they are attached. The two dies leave an impression on the lead so that if the seals are removed or defaced it can be known. — *Forney.*

Seal'skin. (*Fabric.*) The imitation sealskin is made under a process invented by Crosland, of Huddersfield, England, in 1850, by which the short hairs of the cow and calf could be used in the manufacture. The main feature of the process consists in boiling the fabrics for a long time in water, which develops the luster of the fiber.

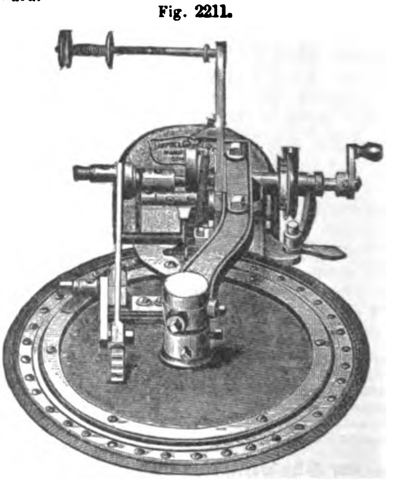
Seal Wire. Several strands of fine wire which are twisted together like a rope, and by which leaden seals are attached to car doors.

Seam'ing. (*Fishing.*) The marginal line which surrounds a seine, and to which the meshes are seized. A *meter* is an outer strengthening line, seized at intervals of a yard. To the meter, on the upper edge, the floats are attached, and to the meter below, the weights.

Seam'ing Ma-chine'. The Royer & Lincoln seamer for use in print works, bleacheries, dye works, and cotton mills trims woven goods neatly and evenly; and joins the margin of cloth outside the seam so that it will pass through the shearing machine without raising the blades.

In this machine the grooved points, on which are placed the loops of the ends of the knit goods that are to be seamed together, are arranged radially and set in a brass ring, which is 16″ in diameter, and is secured in a circular bed that is mounted to turn on an upright axis, and has on its bottom, or lower part, a concentric circle of gear teeth which gear into a pinion fast on a shaft with a ratchet wheel having teeth to suit the gage of the circle of grooved points. This ratchet is turned one step at each revolution of a driving shaft by means of a pawl connected with that shaft, and thereby the circle of points is turned a step equal to the distance from one point to the next so as to bring the next point under the needle. A dog drops into the teeth of the ratchet and prevents the latter and the circle of points from turning backward.

Fig. 2211.



Seaming and Turning-off Machine.

The needle is held by an arm which is mounted on a fulcrum and gets its to and fro motion by a cam on the driving shaft. The looper is held by a separate arm which receives its motion by a side cam connected to the needle cam, so that the points are fed forward one step, as above described, and a stitch is made by the needle and looper at each revolution of the driving shaft.

The points are firmly held in their places by caps or segments with three screws each. The gage can be changed by taking out the brass ring that holds the points and putting in another with more or less points to make the gage required. The ratchet must also be changed for another having the proper number of teeth to turn the circle of points with the necessary step by step movement corresponding to the change of gage.

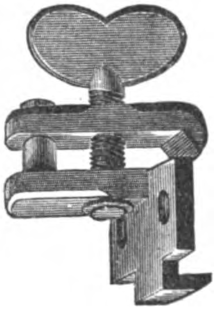
The main driving shaft should revolve 115 to 120 times per minute in order to give a good result.

Search'er. (*Surgical.*) A flexible instrument or sound introduced through the urethra to explore for a stone by contact.

Andrew's, Little's, Gouley's, Bilroth's, Thompson's, Otis's, etc.

Seat Fas'ten-er. Fig. 2212 shows a clamp for holding a wagon seat firmly in position, and for keeping the body from spreading.

Fig. 2212.



Seat Fastener.

Seat Lock. A lock for holding the back of a seat so that its position cannot be reversed. Such locks are attached either to the seat-end, seat-back arm, or the seat-back stop.

Se-bas'tine. A Swedish explosive made of nitroglycerine, wood-charcoal, and certain explosive salts. Ignited by fire it burns readily but does not explode. If confined in detonating capsules it explodes with great force. Patented in Sweden in 1872.

Sec'on-da-ry Bat'te-ry. (*Electricity.*) Invented by Plante. A battery having two plates of large surface immersed in an acid solution and charged from a primary battery, the polarization resulting from the primary current serving upon the breaking of the primary circuit and the closing of the secondary circuit to give a reverse current of great electro-motive force, which may be used for lighting, heating, or other effects.

Planté's secondary batteries may be considered as voltameters made of two sheets of lead rolled up in a spiral, so as to give large surface and small distance of plates. They are charged with dilute acid, which is decomposed by a current passed into the plates, producing peroxide of lead on one plate and a film of hydrogen on the other. In this state the cell itself will furnish a current for a short time. By connections which unite the cells of the secondary for quantity during charging, two Bunsen cells arranged for intensity will produce the desired effect. By connection of the secondary in series for discharge, a very powerful current — equal to that of many Bunsens in series — may be obtained.

Fig. 2213 shows a secondary element as now constructed. In a tall vessel of glass, gutta-percha, or ebonite, are placed two sheets of lead, rolled spirally, and parallel one to the other, and kept from touching by two cords of india-rubber rolled up with them; these two sheets of lead are immersed in a solution of one part of sulphuric acid to nine parts of water. The vessel is closed by a sealed cover pierced with a small hole, through which the liquid can be poured in or extracted, and which also allows the escape of any gas which may be generated during the charging of the battery. The apparatus is surmounted by a disk of ebonite, upon which are fixed two contact pieces in connection with the two electrodes; two clips are also provided for the purpose of holding metallic wires to be made red hot or melted by the secondary current.

Two Bunsen cells, or, in their stead, three Daniell cells, are required to charge this secondary element. During the operation of charging, one of the electrodes oxidizes, a brown coating of peroxide of lead soon shows itself, and the metallic appearance disappears entirely; the other electrode also changes in appearance, — its surface becomes covered with a powdery gray coating.

When the charge has attained its maximum — that is to say, when oxygen commences to be given off by the brown electrode, it is well to disconnect the secondary element from the charging battery, for any further expenditure of the polarizing current is entirely wasted.

The secondary element once charged in this manner and left to itself will retain a portion of its charge for several days; and even at the end of a week it is still far from being exhausted.

The secondary element, when fully charged, has an electro-motive force equal to one and a half times that of a Bunsen; it will redden a platinum wire of a greater or lesser diameter according to its size, or rather according to the size of the electrodes; for it is of course understood that the quantity of electricity which the apparatus can furnish is in proportion to the extent of the surface subjected to the action of the polarizing current and covered with an active electro-chemical deposit.

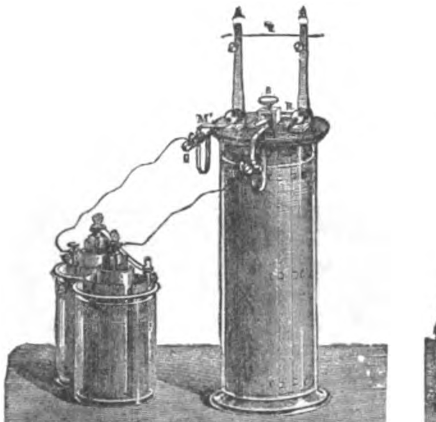
The spiral form of the electrodes gives an element having a large surface and a small resistance within a small space, so that one of Planté's secondary elements is equal to an active or ordinary element of a very unusual size; the small pattern has an active surface of 124 square inches, the large pattern of a surface of 620 square inches.

The current furnished by the secondary element will effect chemical decomposition, act upon an electro-magnet, etc.

A secondary element is all the better for having been charged and discharged a great number of times; at first, when it is almost new, there is an advantage in polarizing the electrodes, sometimes in one direction and sometimes in the other, reversing several times the direction of the charge; but when the element is formed the greatest care must, on the contrary, be taken to charge it always in the same direction.

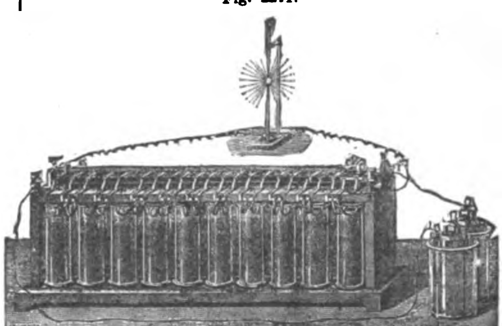
These secondary elements can be joined together, either for intensity or for quantity, and they form batteries capable of producing all the effects of batteries of the ordinary

Fig. 2213.



Secondary Element.

Fig. 2214.



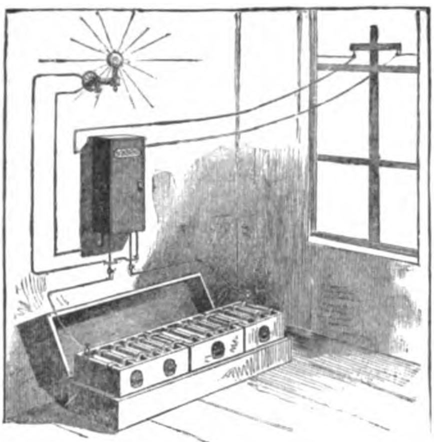
Planté's Secondary Battery.

form, and of the most powerful kind. Fig. 2214 represents a secondary battery as arranged by M. Planté.

Faure, observing that the lead plate of a good battery became coated with oxide of lead, applied oxide of lead to his plates and found that he could make a battery without charging and recharging for months.

Brush claims the invention of a process of effectively preparing his lead plates without any oxide of lead at all. His method is a secret and he claims there is no coating of minium on the plates, the battery can be charged more quickly and discharged more safely, and the process of manufacture is no more prolonged or costly than in the case of Faure's apparatus. The batteries shown in Fig. 2215 are contained

Fig. 2215.



Brush's Secondary Battery.

in a box 8′ long, 15″ wide, and 16″ high. Charged from an arc light circuit wire, they will feed 27 Swan lamps of 16-candle power, and run a small motor of one-horse power. A series of 20 cells, each cell consisting of two lead plates, about 16″ square in size, is sufficient to supply from 40 to 60 Swan lamps of 16-candle power, or as many lights as a good sized house would require. In connection with Swan lamps, one horse power, if used to run a dynamo connected with a battery, will store up sufficient electricity to run from 9 to 10 lamps. This current can be taken from an arc circuit without interrupting the burning of arc lights; the batteries are placed in the cellars of each house where the light is furnished. Mr. Brush says that the batteries are indestructible, and improve with age, the only attention necessary being the addition of water every few months to take the place of that which has evaporated.

In 1801 Gautherot, a French physician, discovered that platinum or silver wires immersed in a saline solution, after having been used for decomposing the salt, gave a current of their own of short duration upon being disconnected from the battery.

In 1803 Ritter made the first secondary battery by superposing a series of gold disks separated by pieces of cloth dampened with a saline solution. He also employed platinum, copper, brass, iron, bismuth, and silver, and remarked that still better results were obtained with carburet of iron and peroxide of manganese. He obtained no effect with lead on account of the solution which he made use of. He used common salt and sal ammoniac.

In 1859 Planté published accounts of experiments made by him upon most of the metals, and many different solutions for the purpose of determining the best construction of elements for secondary batteries.

In 1860 Planté constructed a secondary battery of two plates of lead separated by cloth and rolled up into a spiral and immersed in a dilute solution of sulphuric acid. He afterwards substituted for the cloth two thin strips of rubber.

In 1861, Kirchhof, U. S. Patent, No. 31,545, February 26. Two roughened, perforated, or recticulated platinum electrodes in a solution of nitrate and acetate of lead, nitrate of potash, acetic and nitric acids and nitrate or acetate of iron or zinc, all suggested. Upon charging, one plate became covered with peroxide of lead, and the other with crystallized lead. He also described a switch whereby the cells could be charged, one after the other, while the others were discharging. Also a commutator for the dynamo whereby the charging circuit was always left open when the machine was not running.

In 1866, Percival, U. S. Patent, No. 53,668, April 3. A box with two compartments separated by a porous partition, and filled with powdered carbon, granular lead, or other conducting powder moistened with acidulated water. Copper or lead plates immersed in the powder served as conductors.

In 1867, Leclanché, U. S. Patent, No. 64,113, April 23. Two graphite plates in powdered charcoal saturated with potash water, porous partition.

In 1869, Percival proposed to make the positive electrode of some more active metal, such as zinc, and then to use a neutral solution of the positive metal as with zinc, zinc sulphate, with copper, copper sulphate, etc. Upon charging, peroxide of lead formed on the lead plate and finely divided zinc on the zinc plate, sulphuric acid being set free. Amalgamated the zinc.

In 1869, Varley, English Patent, No. 2,525, makes use of plates of paladium or arsenic on account of their capacity for storing hydrogen. These are used in connection with carbon plates rendered porous for the absorption of oxygen by dissolving out the silica from gas retort carbon by hydrofluoric acid.

In 1876, Jablochkoff, French Patent, No. 112,024, March 23 and October 2, in an electric lighting system places a secondary battery in a shunt around each light.

In 1878, Fox, English Patent, No. 3,988, suggests the use of plates of copper in a solution of bicarbonate of soda. The secondary batteries are connected in a lighting system between the main wires and the ground, thereby serving to store up any surplus energy thrown upon the line.

In 1879, Thomson & Houston, U. S. Patent, No. 220,948, October 28, and English Patent No. 4,400. A series of disks of copper or other suitable metal are arranged one above another, and separated by rings of earthenware, rubber, wood, or other non-conductor. Diaphragms of felt are interposed, and the whole is secured by bolts and end-plates. The solution may be zinc, sulphate, or other similar salt, and must entirely fill the spaces between the plates. When subject to motion the spaces between the plates are filled with sand, pumice-stone, sawdust, or the like. During charging, zinc is deposited on the under side of the plates while the upper sides dissolve to form copper sulphate. In the English patent negative plates of mercury, silver, or lead are proposed, which may be roughened, serrated, or coiled, or may be formed by a tray filled with fragments of the metal. The upper plate may be perforated and varnished underneath. Pieces of hard carbon may be placed upon the upper plate to receive zinc deposit, or spurs or projections may be formed on its upper surface for same purpose.

In 1880, Faure, French Patent, No. 139,258, October 20, applies a superficial coating of lead oxide, spongy lead, or similar active conducting material to the surface of the electrodes, and holds it in place by porous partition.

In 1881, Faure, cert. of add to French patent, February 9, proposes red lead or minium for a coating.

In 1881, Swan, English Patent No. 2,272, May 24. Lead plates, honey-combed, ribbed or cellular, for increasing surface and forming better support for the porous deposit.

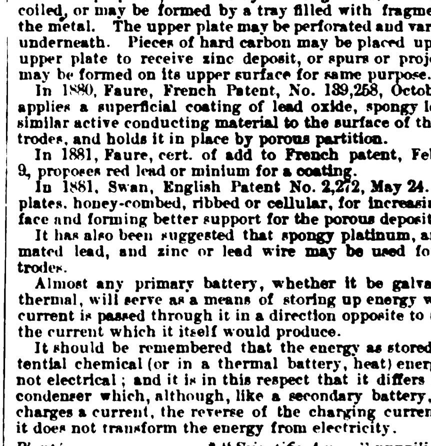
It has also been suggested that spongy platinum, amalgamated lead, and zinc or lead wire may be used for electrodes.

Almost any primary battery, whether it be galvanic or thermal, will serve as a means of storing up energy when a current is passed through it in a direction opposite to that of the current which it itself would produce.

It should be remembered that the energy as stored is potential chemical (or in a thermal battery, heat) energy and not electrical; and it is in this respect that it differs from a condenser which, although, like a secondary battery, it discharges a current, the reverse of the charging current, still it does not transform the energy from electricity.

Planté	* "*Scientific Amer.*," xxxviii. 313.
	"*New York Times*," May 13, 1882.
	* "*Scientific Amer. Sup.*," 65, 2527.
Telegraphic Journal . .	* "*Scientific Amer.*," xxxviii. 313.
Niaudet, Am. transl. .	* 243.
Disser. on secondary Batteries	"*English Mechanic*," xxvii. 476.

Fig. 2216.



Section Cutter.

Sec'on-da-ry Coil. (*Electricity.*) A coil of wire usually wound upon, but entirely separated from the primary coil by insulation.

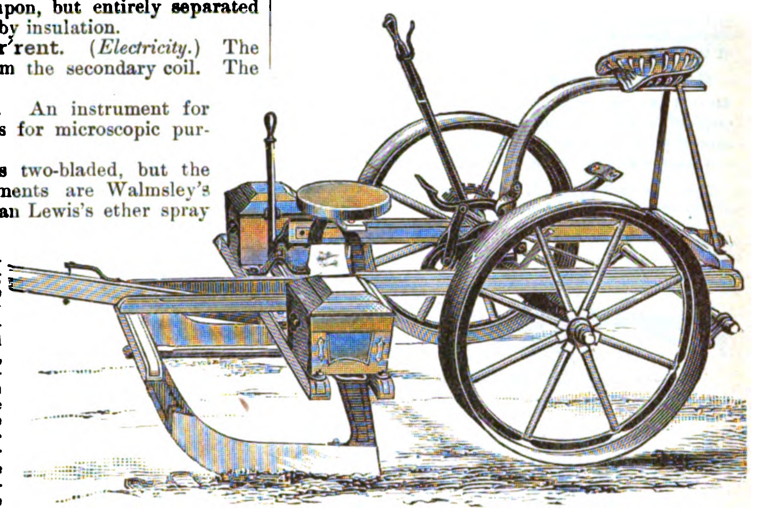
Sec'on-da-ry Cur'rent. (*Electricity.*) The current emanating from the secondary coil. The *induced* current.

Sec'tion Cut'ter. An instrument for making very thin slices for microscopic purposes.

Valentine's knife is two-bladed, but the most delicate instruments are Walmsley's adaptation of Dr. Bevan Lewis's ether spray microtome.

In Fig. 2216, some thickened gum water being placed upon the top of the tube, a piece of tissue, say a portion of the spinal column from a freshly killed animal, may be placed in it, and the nozzle of the freezing atomizer having been introduced into the tube beneath, the tissue will be solidly frozen in from one to three minutes. Ether may be used, but rhigoline is much better. A considerable portion of it will be condensed in the chamber, and can be drawn off by the tube shown in the illustration, for further use. The knife should be kept cold, by placing on a block of ice before using.

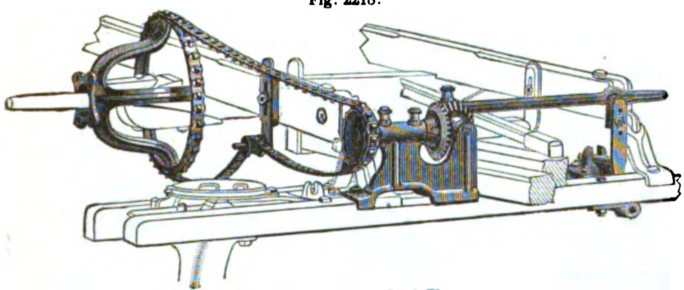
Fig. 2217.



Seed Planter.

Seed Drill. A machine for sowing various seeds in drills or rows. See Grain Drill.

Fig. 2218.



Drilling Attachment to Seed Planter.

Beet-seed drill	Figs. 268-270, p. 92, *supra.*
Broad-cast seeder	Figs. 430-432, p. 136, *supra.*
Corn drill	Fig. 691, p. 222, *supra.*
Corn planter	Fig. 697, p. 223, *supra.*
Hand planter	Fig. 2382, p. 1037, "*Mech. Dict.*"
Seeding machines	Figs. 4808-4814, pp. 2088, 2089, "*Mech. Dict.*"
Wheat Drill	Figs. 7163-7168, pp. 2761-2763, "*Mech. Dict.*"

Knight's Report, "*Paris Exposition Reports,*" 1878, v., pp. 102-119.

Seed Drill (beet) French, McMurtrie's Plate I., Report, "*Department* of *Agriculture Special Report,*" No. 28.

Fig. 2219.

Fertilizer Sowing Attachment.

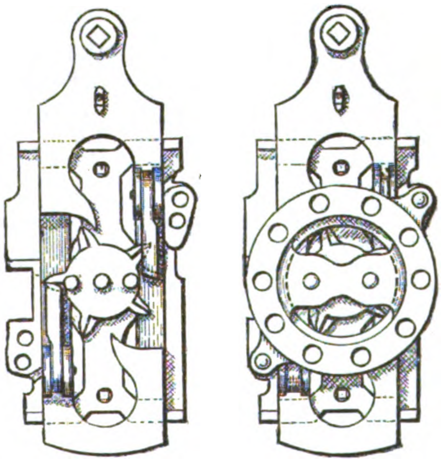
Seed Mi'cro-scope. A small hand magnifier for examining seeds, or living objects, which are inclosed in a case with glass sides.

Seed Plant'er. An implement for planting in hills in contradistinction to *drilling* or *broadcasting.*

In the Farmer's Friend Planter, of Dayton, Ohio, shown in Fig. 2217, the foot treadle and hand lever are pivoted and work together to raise or lower the runners, which are coupled to the frame with a treadle. Pressing with the feet on the rear of this raises the runners, while power applied to the other by means of an independent foot piece forces them into the ground. A hand lever, held by a spring catch, is pivoted to the treadle. The runners adjust themselves to uneven surfaces, and plant two rows at different levels, each the same depth. The entire weight of the machine can be locked on the runners. Gage plates regulate the depth. Fig. 2118 shows a drilling attachment for use in drilling corn. Fig. 2219, an attachment for sowing fertilizers.

Fig. 2220 represents the dropping device, Fig. 2221 *a*, the same with the seed plate removed. The device consists of a slide resting on a bed plate, and pawls pivoted to the sides of the

Fig. 2220. Fig. 2220 *a*.



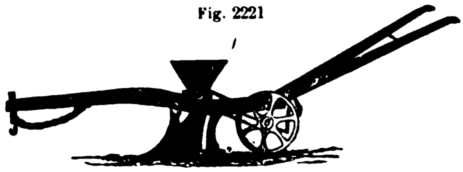
Dropping Device for Seed Planter.

slide for driving the star-shaped casting which carries the seed plate. When the slide is moved, the pawls come in contact, alternately, with the points of the star, moving it round, carying the seed plate with it, dropping seed at each motion of the slide.

Seed'ing Plow. A single row implement known as a seeding barrow. It is made either with cups or brush. Some of these are intended to follow after a plow or in a furrow laid out, while others have a share which opens the furrow.

The Plow Drill, Fig. 2221, shows an old form of drill of Hindustan, probably the one noticed in use in the watered

Fig. 2221



Seeding Plow.

rice fields of the East, by Aristobulus, one of Alexander's generals. These old drill plows are still in use in southern Asia, and were exhibited at the Centennial and the Paris Expositions from India, Java, and China.

Seg'gar. (*Ceramics.*) A vessel of infusible fire-clay to hold ware while being baked or burned in the kiln.

Seg'ment Saw. An annular saw which is made of segmental plates; as distinguished from a solid plate-saw. A vibrating saw with a curved blade, that formed a segment of a cylinder, was some years since patented in England, but does not seem to have come into use; its purpose was the same as that of the tubular saw.

Seine. (*Fishing.*) This in its simplest form is a flat web of netting, with corks or floats at the upper edge and weights at the lower edge, used to inclose an area of water, and by bringing the ends together, either to a boat or on the shore, to secure the fish that may happen to be in the inclosure.

The seine varies in length from a small minnow seine to a shad seine a mile long, hauled in by a windlass worked by horses, oxen, or by steam engine.

A form of net used in sweeping areas of water. Divided into *haul*-seines and *purse*-seines.

A large haul-seine on the Atlantic sounds and bays is 1,000 fathoms in length, but one at Stony Point, on the Potomac, is 8,400 yards. The seine depends from a cork-line, and the lower edge is weighted with leads which sweep the bottom. A line known as the *toggle*-line is sometimes used, so called from its being secured to the seine at regular distances by toggles. At the ends of the seine are the land-lines, which go to shore and pass round the shears-blocks to the windlasses. At the mid-length of the seine is the *bag* of the net, which comes last ashore. The *wings* are the ends.

Seine Wind'lass. (*Fishing.*) A winch to haul in a seine line.

Seis'mo-graph. An instrument for recording shocks or perturbations.

1. The *seismometer* of Prof. Palmieri, p. 2091, "*Mech. Dict.*," was for detecting earthquake shocks and recording their duration.

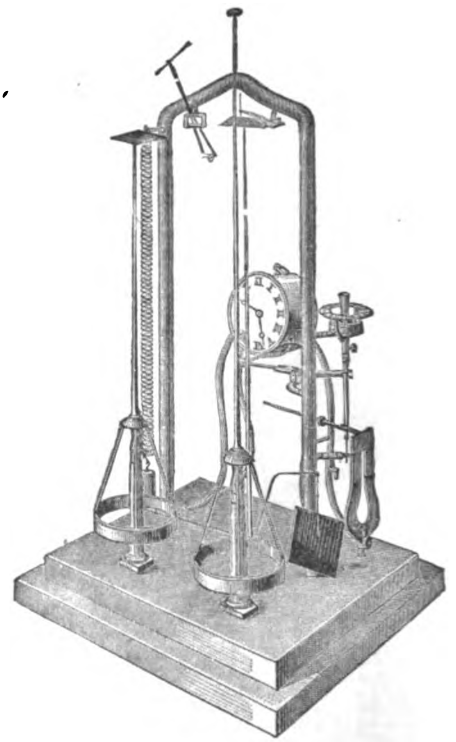
M. Hattori, of the University of Tokio, gives a description of an *earthquake indicator* invented by Choko, about A. D. 132. "It consisted of a copper vessel, the diameter of which was eight shaker or feet, and whose convex cover was ornamented with characters, mountain turtles, birds, and beasts. In this vessel there was one main piston in the middle with its eight branches, wires, and springs. On the outside of this vessel were eight dragon heads, each of them having a copper ball in its full opened mouth. Under each of the dragon heads there was a frog looking upward with its mouth fully opened. The wire works and springs were very skillfully arranged in the vessel, but the cover was closely fitted, and they could not be seen. Whenever the earth shook one of the dragons dropped the ball, the frog underneath received it in its mouth, and produced a sound. By this means the direction of the shocks was ascertained. Once one of the dragons dropped its ball, but no person near it perceived any shock, and all the learned men of the capital doubted the trustworthiness of the machine; but after a few days a mail arrived from Rossi and reported the occurrence of an earthquake there."

Sig. Ignazio Galli's apparatus for registering earthly perturbations at the Meteorological Observatory of Velletri, Italy, consists of six separate devices for observing and recording automatically: —

1. The horizontal amplitude of earth tremors.
2. The vertical amplitude.
3. The direction of the earthquake movement
4. The time of the shock.
5. The intensity of the attending magnetic disturbance.

At one corner of the marble base is a short standard of metal, on the top of which rests an agate cup, balanced by a

Fig. 2222



Seismograph.

ring below, and carrying above a long, slender vertical rod, the whole forming a sensitive pendulum. At the top of the rod is a small silver mirror, carrying a fine needle, the movements of which are observed through a small telescope. Any movement of the base is so magnified at the upper end of the rod that the minutest tremors of the earth are thus made visible.

The adjacent device is substantially the same, except that the vertical rod is shorter and carries at top a sheet of paper covered with lampblack. Resting on this blackened paper is the fine needle of a nicely balanced lever attached to the brass support which arches over the middle of the base. As the earth tremor causes the paper to move the relative extent and character of the movement are marked by the needle on its blackened surface. Behind this part of the apparatus is a weight suspended by a sensitive spiral spring. At the bottom of the weight is a lever, to the other end of which a needle is suspended by a hair, the point of the needle resting on a sheet of blackened paper slightly inclined. This is for measuring the vertical height of the earth movement.

The direction of the movement is marked by the needle of the lever attached near the upper right-hand corner of the frame, on the sheet of blackened paper on the top of the rod which rises from the middle of the base.

To ascertain the quarter whence the movement proceeds and the time of the shock, a truncated metal cone is inverted and balanced on a horizontal metallic disk surrounded by a ring marked with the cardinal points. The instant the apparatus is moved the cone tips against that side of the ring whence the motion proceeds, and in falling acts upon a lever which stops the clock, thus indicating at once the direction of the source of the shock and the time of its occurrence. The intensity of the accompanying magnetic disturbance is measured by the magnet and its attachments. This seismograph is inclosed in a glass case, is small, extremely sensitive, and records the slightest tremors of the earth with great precision.

The Bregnet seismograph, exhibited at the Paris Exposition, 1878, is an instrument for measuring and electrically registering the deviations of a long pendulum under the influence of terrestrial movements or solar-lunar attractions.

It consists of a heavy pendulum suspended by a wire from a support above and carrying a pointer below which traverses in close proximity to a horizontal sheet of white paper, traveling over a flat metallic plate, by the rotation of a pair of rollers in gear with the train of a clock. The pendulum and metallic plate are insulated from one another, and are respectively connected to the two terminals of a small induction coil, which is, by the movement of the clock, periodically placed in circuit for a few seconds with a battery.

When this takes place sparks pass through the paper, between the pointer of the pendulum and the metallic plate, causing a series of perforations on the paper band, forming a record.

"*Telegraphic Journal*" . . . vi 499.

2. The name is also applied to an instrument, invented by Carlisle (England), for recording the shocks received by or the oscillations produced in a vehicle, a railway carriage for instance, when in motion.

Its action depends upon the inertia of a suspended weight attached by an elastic medium to a point of support. If such a point be shifted suddenly in any direction, the suspended body, from its inertia, retains for a moment its original position, and only gradually recovers its relative position to the point of support, and that with an amount of force varying according to the distance through which, and the velocity with which, the point of suspension has been disturbed.

By a mechanical arrangement this force is made to move a pencil at right angles to a straight line which the pencil when at rest is describing upon a strip of paper traveled at a determinate rate by clock work. By this means the time as well as extent of the oscillation is recorded.

A is the base plate and *B* the standard, to the latter of which the weight *C D* is attached by gimbal-joint, allowing it to swing freely. The outer ring *E* of the gimbal is pivoted to the frame at *F F* and the inner ring to the outer, as usual. The weight *C* has a light barrel *D* both turned true to an axis, and the swinging end is supported at the point *G* by springs *H H* suspended from an arm *I* secured at *K* to the frame *B*. At the end of the weight *C* is a hollow axial projecting stud *L* which serves to limit the oscillation of the weight by contact with the ring *M*. When it is desired to lock the weight so as to put the instrument out of action, the lever *P* on shaft *O* is moved, throwing the pin *N* into the hollow of the stud *L* and holding the weight rigidly. The play of the stud *L* in the ring *M* is about 1.25″ in every direction from the axis.

The inner ring of the gimbal is turned out at the rear so as to form a flat annular surface against which a disk is pressed by the spring *V*, and this disk is supported by an arm projecting from the upright rod *a*, a portion of which shows in the figure. Near its upper end the rod *a* has another horizontal arm *b* which connects at point *r* with a rod *c* to move the arm *d* which carries the pencil *e*.

Any movement of the weight swinging on its gimbal-joint produces a thrust motion upon the disk which is pressed against the rear of the gimbal ring, and this motion is transmitted to the pencil by the means just described. The pencil-arm *d* is mounted on the axis *f*, which is surrounded and moved by a spiral spring which brings the pencil back to the base line on the paper after each lateral movement, and an adjustment at *r* in the slotted end of the lever *b* permits the arm *d* to be so adjusted as to show, either all the oscillations indicated by the weight, or only such of them as exceed a certain limit. An index finger *q* and a graduated arc, *s*, afford means for regulating this adjustment with accuracy.

The strip of paper *i* is moved by rollers and clockwork. One of these rollers *l* makes a revolution once in 5 minutes marking minutes on the paper by 1 prick and 5 minutes by 2 pricks. The paper delivered by one roller is taken up by roller *m*.

To observe oscillations, both vertical and horizontal, the instrument is placed on the floor of the car, its axis parallel with the direction of movement. To obtain only vertical oscillations the axis of the weight is across the car and blocks are placed to restrain lateral movement.

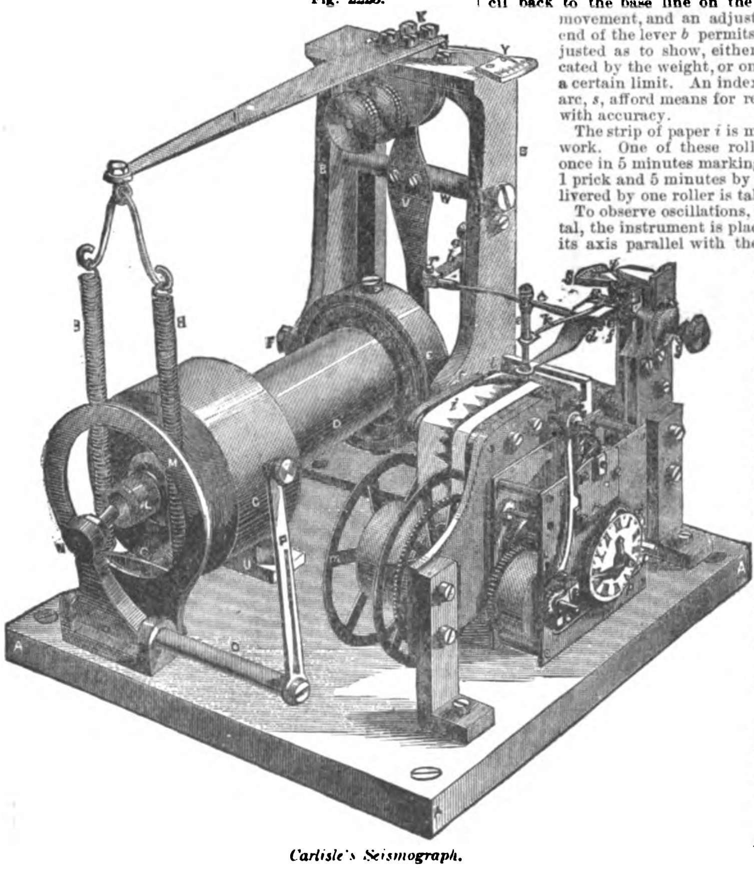
The time of starting being noted on the paper, and the clock-work being started coincidently with the engine, the strip is a record of the trip. The instrument is used to test the condition of a track, the personal equation, so to speak, of the machine being known; or that of the track being known or assumed, to test the relative steadiness of different engines or cars passing over a specific portion of the road.

Reference may be made to:—

* "*Engineering*," xxii. 160; xxvi. 426.
* "*Scientific American Supplement*," 646.
* "*Railroad Gazette*," viii. 411.
U. S. Patent, 222,292, T. L. Luders, Shock or Jar recorder, Dec. 2, 1879

A very striking instrument for testing the road bed of railways, the trac-

Fig. 2223.



Carlisle's Seismograph.

tive force required on curves and grades, and other similar data is the dynagraph car of Mr. P. H. Dudley.

The indications of the instrument are by no means confined to those given by the Carlisle instrument where the vertical and lateral oscillations of the car under inequalities in the road are interpreted as shocks or perturbations; but it affords numerous additional data for calculations, all of which are drawn graphically on paper by pens which are intermediately connected to the draw-bar of the car or worked by electricity.

The draw-bar is connected with a piston which works in a cylinder filled with oil, the pressure is transmitted through a pipe to another cylinder over a table in the car, and a piston is connected with a pen, which marks on a roll of paper the resistance of the train. Other pens indicate the space passed over each second, each 10 seconds, and each minute, each revolution of the driving wheels, each mile passed, the alignment of the road, the quantity of water consumed by the engine, the quantity of coal used, the resistance of the wind, etc. See DYNAGRAPH.

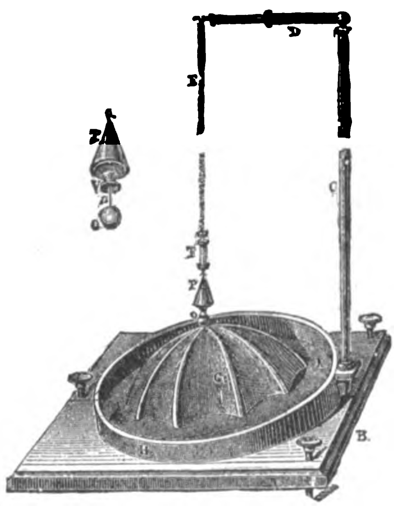
Seismograph, *Carlisle* . * "*Railroad Gazette*," viii. 411.
* "*Engineering*," xxii. 160.
Eastern Ry. of France * "*Engineering*," xxvi. 427.

Seis-mom'e-ter. An instrument for measuring cosmic perturbations or **shocks**. See SEISMOGRAPH.

The application of the microphone as a seismometer is referred to in "*Engineering*," xxix. 498.

Fig. 2224 shows the earthquake indicator of Count Malvaria, of Bologna, Italy. The table is adjusted level by the set screws, which serve as feet. Upon it is a circular inclined plane, *K*, surrounded by a rim, *H*, and carrying in its center a reversed hemispherical cup, *G*, the surface of which is divided into eight channels which are placed so as to correspond with the eight principal points of the compass. The

Fig. 2224.



Malvaria's Seismometer.

summit of the cup is provided with a metallic point which enters a shallow indentation in a ball, *O*. The ball is maintained in place by the concave lower portion, *V*, of a weight, *P*, resting upon it. The weight is sustained by the chain *E*, which is supported by the standard *D C*, and adjusted by the screw *F*.

To set the apparatus, it is arranged as depicted in the engraving, the weight pressing upon the ball just sufficiently to hold it on the apex of *G*. The instant, however, a trembling of the earth occurs, the ball rolls from under the weight, down a channel in *G*, and thence to the inclined plane *K*, through an aperture, *L*, in which it falls, striking spring mechanism, and so firing a gun, or else acting upon a clock so that the latter is caused to stop, thus registering the exact moment of the shock.

In order to determine the direction of the vibrations, a fine hole is made, from bottom up, in the weight *P*. In this a needle, *a*, is placed so that its end rests upon the ball, although its body is then pushed up into the weight aperture. When the ball falls, the needle drops also, but is held by its enlarged head, so that it cannot escape from the weight. It rests, however, in the groove on the cup *G*, down which the ball has rolled; and as this groove must be opposite in direction to that pointing to the course of the impulse of the soil, the true bearing of the vibration is at once determined.

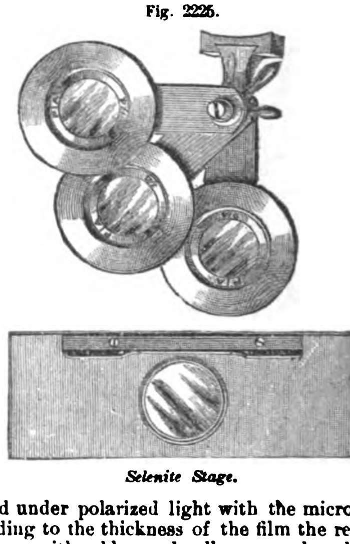
The instrument is said to possess great accuracy, and, doubtless, will serve important ends in localities subject to earthquakes.

Seis'mo-phone. An instrument for distinguishing and locating subterranean sounds, such as that of flowing water, subterranean explosions, etc.

In India, a business is carried on by men called spring-seekers, who generally succeed in designating the subterranean place where water may be obtained; they lie down on the ground and found their judgment on their hearing, which becomes extremely acute by practice. A few years ago, on the occasion of an earthquake at Bagneres-de-Bigorre, in the Pyrenees, Mr. Maxwell Lyte had the idea of placing on the ground an instrument resembling a gigantic stethoscope, and was able to hear the crackings of the terrestrial crust. To M. De Rossi was reserved the honor of raising those empirical attempts to the height of a science. by applying the microphone to the exploration of the soil in its hidden depths. The learned founder of the "Bullettino del Vulcanismo Italiano" commenced his researches in his Observatory of Rocca di Papa, near Rome, and was very soon able to distinguish three different sounds which he could connect with the various movements of his seismatic pendulums. He was able afterward to confirm his results in observing the microphone at Vesuvius, and the solfatara at Pozzuoli, where the movements of the earth's crust are very frequent. Without going any further into the details of that memoir, we must mention the fact that very strong subterranean explosions were heard through the microphone immediately preceding a shock of earthquake. Although M. De Rossi is too prudent to assert the fact, he gives us a glimpse of the possibility of thus predicting approaching cataclysms. However that may be, the *savant* has conferred on science a new means of study which ought to be employed at all meteorological observatories. By establishing facts which have hitherto escaped us, we may perhaps succeed in explaining the causes, still so mysterious, of earthquakes.

Sel'e-nite Stage. (*Optics.*) A film of selenite mounted between two pieces of glass fitted into a brass stage and laid under an object when

Fig. 2225.



Selenite Stage.

viewed under polarized light with the microscope; according to the thickness of the film the resulting colors are either blue and yellow, or red and green, or any intermediate tints with their complementaries.

Se-le'ni-um Eye. A name given by Dr. C. W. Siemens to a small apparatus, in imitation of the natural eye, in which a disk formed by a drop of fluid selenium compressed between mica plates, and with proper electric connections, is made, by the electro-sensitiveness of the selenium to light, to operate two eyelids when exposed to a flash of light, imitating spontaneous blinking of the natural eyelids.

Paper by Siemens, *Royal Institution of Great Britain*, meeting in February, 1876. Report in "*Engineering*," xxi. 161.

Self-act'ing Boil'er Feed'er. An automatic device in connection with the boiler and the feed-water tank, that as the water is reduced below a given level, a valve at the exit of the feed-pipe that has been kept shut by the pressure of the water, opens, and the steam finds passage through the pipe into the feed-water, which has a lower temperature. It will then, although partly condensing, press upon it with the steam pressure as in the boiler, and the water is forced through the feed-pipe into the boiler till the equilibrium is again regained.

Self-act'ing Lathe. A British name for an automatic lathe, having shaper-plates to govern the cut of the tool.

Shaw & Co. . . . . * "*Engineering*," xxi. 406.

Self Bind'ers. Reaping machines which automatically bind the grain as cut. See BINDERS and REAPERS, *supra*.

To show to what immense proportions the manufacture of binders, reapers, and mowers has grown in the United States, we give below the dimensions of the establishments of one of the great firms, the Champion Machine Shops of Springfield, Ohio, the outgrowth, we might say, of the industry of William N. Whitely, whose sole stock of capital, a few years since, was his untiring energy and wonderful fertility of invention.

The six establishments, located in the city of Springfield, Ohio, and devoted exclusively to the production of the Champion Harvesters, constitute one of the largest manufacturing interests in the world. The various factories comprised the following grand total of floor space on January, 1883: —

	SQUARE FEET.
Champion Machine Co.	317,450
Whitely, Fassler & Kelly	1,000,500
Warder, Bushnell & Glessner	485,170
Champion Malleable Iron Co.	140,985
Champion Bar and Knife Co.	160,500
Total	2,104,605

Thus the combined Champion interest occupies a grand aggregate of floor space in the manufacture of Champion Harvesting Machines of 2,104,605 square feet, equal to a room 42,092′ long by 50′ wide, or a building 50′ wide by about 8 miles long, constituting the largest industrial shops in the world. Aside from the figures given, the Champion interest have 50 acres of ground used for lumber yards, railway sidings, and sheds.

The following exhibit of the different kinds of material annually consumed by this interest, based upon the consumption of 1882, cannot but impress the reader with the magnitude of the business done by the manufacturers of the Champion Machines: —

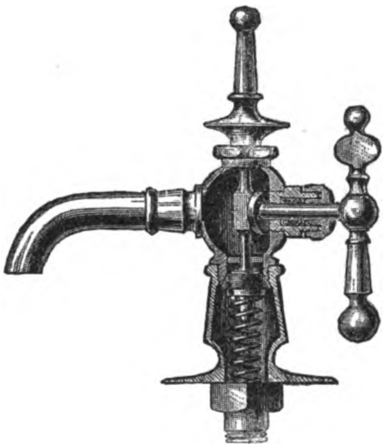
Pig iron	22,000 tons.
Steel	3,100 tons.
Wrought iron	8,200 tons.
Malleable iron	6,550 tons.
Lumber	9,000,000 feet.
Painting materials	221 tons.
Coke	8,850 tons.
Coal	32,600 tons.
Molding sand	6,810 tons.
Grind stones	1,150 tons.
Rivets	212 tons.
Screws	31,400 gross.
Brass spring wire	33,000 lbs.
Paper (apportioned as follows:)	200 tons.
Illustrated Champion	95 tons.
Books and pamphlets	75 tons.
Circulars and blanks	20 tons.
Stationery	10 tons.

The force of employees in 1883 numbers about 3,000, exclusive of the large corps of agents employed in selling the machines. The monthly pay rolls of the combined institutions will average $148,000, or an annual sum paid out for mechanical labor amounting to nearly a million and a half dollars.

Self Clos'ing Fau'cet. One having a valve held to its place by a spring to guard against waste of water through liability of being left open.

The Fuller-Meyer faucet shown in Fig. 2226 is self closing and cannot be forced open by any sudden pressure of water,

Fig. 2226.



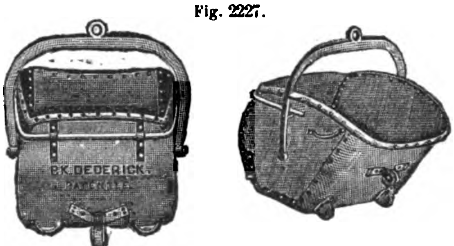
Self Closing Faucet.

such as may be experienced where the Holley and similar systems of waterworks exist. Should the spring become weak or broken it may be kept closed with the handle.

Self Dump'ing Coal Tub. Tubs arranged to dump automatically at a desired point.

Fig. 2227 shows the handles pivoted in such manner that the tubs as long as running on their wheels maintain an up-

Fig. 2227.



Self Dumping Coal Tub.

right position, but when the end of the track is reached the weight turns them on the tubs' axes and dumps them.

Self Lock'ing Hook. One which automatically closes the opening over against the point of the hook. See MOUSING HOOK.

Self-lock hook, *Haines*, * "*Scientific American*," xlii. 339.

Self Mous'ing Hook. A hook having an arm depending from its top part, to enter a hole in the upturned end of the hook and prevent the end spreading under heavy strains.

Self Oil'ing Bear'ing. One in which the oil is placed in a receptacle and fed automatically to the point desired in quantity desired.

In Lane and Bodley's oiler, an oil cell is formed below the matrix of the shaft, in the casting from the bearing. Communicating with this oil cell are drilled a number of small holes, about 1-16 of an inch diameter. At the ends of the bearing proper there are the usual dripping cells communicating with the oil cell mentioned for the return of the oil after it has passed through the bearing. The oil, when the shaft is running at high speed, is drawn rapidly up through these small holes, and circulates through the bearing at a rate much more rapid than can be attained with fibrous feeding wicks. Its adaptation for the bearing of line shafting has been very fully demonstrated.

Sel'vage. (*Mining.*) A thin vein of earthy matter between the vein and walls.

Sem'a-trope. An adaptation of the heliotrope. An instrument designed for army signaling purposes. The object is obtained by reflecting the rays of the sun in any given direction.

Sem'i-fixed. Said of a steam engine bolted to an iron foundation piece on which it may be moved intact. Wheels would constitute it *portable*. *Semi-portable* is used by some makers in the same sense as *semi-fixed*.

Sem'i-mul'ti-flue Boil'er. A steam boiler whose outer shell and internal flue are cylindrical and the ends flat; the front part of the flue is arranged with a fire-grate like the Cornish or Lancashire boilers, but, unlike these, a flue-plate is fixed in the flue a short distance behind the furnace, and a number of wrought-iron or brass flues pass from this to the back of the boiler.

Sem'i-mul-ti-tu'bu-lar Boil'er. A term applied to those boilers in which a portion of the cylindrical shell is occupied by flues. It is a pity that the proper distinction between *flues* and *tubes* is not maintained in the nomenclature; *flues* are for flame, *tubes* for water. See SEMI-MULTIFLUE BOILER.

Sem'i-port'a-ble Steam En'gine. One movable on its foundation-plate; as distinct from the *portable*, which is on wheels.

Semi-portable engine.	
Garrett, Br.	* "*Engineer*," xliv. 426.
Deakin, Parker & Co., Br.	* "*Engineer*," xlvii. 248.
" Eclipse "	* "*Scientific Amer.*," xxxviii. 214.
Garrett, Br.	* "*Engineering*," xxvi. 470.
Semi-portable Steam engine, *Baxter*	* "*Engineering*," xxiv. 49.
Roberts	* "*Scientific Amer.*," xxxviii. 342.

Sem'i-ro'ta-ry En'gine. An engine between a reciprocating and rotary one. The piston has a forward, then an up-and-down and backward movement. It is a very compact engine, with few wearing parts, and is governed expansively.

	* "*Scientific American*," xxxiv. 228.
Higginson, Br.	* "*Engineer*," xli. 115.

Sem'i-tu'bu-lar Boil'er. A name applied to a system of boilers in which the water, first heated in a cylindrical shell boiler, passes thence to a second boiler provided with flues; the intention being that the water shall deposit its sulphates and carbonates in the first boiler, which is more readily cleaned. See instance in "*Engineer*," * xlv. 392.

Sem-o-li'na. A grade of middlings or cracked wheat. To indicate how difficult it is to define the grade, it may be said that Haggenmacher's *semolina purifier*, a famous machine in Austro-Hungary, at one operation divides the meal into four grades of first-class semolina, four of second-class semolina, and two sizes of offal. See cut in "*American Miller*," vi. 35.

Semolina separator	* "*Scientific American*," xxxv. 405.
	* "*Scientific American Sup.*," 327.

Sen'si-tom'e-ter. The invention of M. Warnerke. A species of actinometer for measuring the relative sensitiveness of films.

It consists essentially of different thicknesses of gelatine impregnated with lampblack, and used for photographic purposes. The *actinometer* proper is for measuring the relative actinic powers of light. See ACTINOMETER, "*Mech. Dict.*," p. 11, *et supra*, p. 4. The *Photometer* is for measuring the relative luminous powers of lights. See PHOTOMETER, "*Mech. Dict.*," pp. 1687, 1688, *et infra*.

The gelatine films of various thicknesses, as above described, are placed in little squares on a glass plate. On each square is printed a number corresponding with the thickness of the gelatine, and consequently when two sensitive films are successively exposed behind the plate for a given time that one which upon development shows the highest readable number is the more sensitive.

Sep'a-ra-ting Disk. (*Dentistry.*) A disk of emery journaled in the yoke of a handle and connected by a coil wire to a rotating motor. The disk can, during its rotation, be turned at any angle required in cutting a space between teeth.

Serge Ar'mure. (*Weaving.*) A style of weaving made on a three-harness loom, and producing the serge tissue. (See ARMURE.) In one form of French worsted goods, for instance, the warp has a serge armure of 2 and 1 and the weft a serge armure of 1 and 2.

Ser'pen-tine Mold'ing Ma-chine'. One for carving parlor frames, lounge, sofa, and chair backs, and other crooked work. One form has right and left-handled spindles to allow of turning with the grain of the wood. A guide-piece regulates the depth of cut. The work is held and fed by hand, and the tables are adjustable in height. The machine runs about 5,500 revolutions per minute.

Serres-fines. Ordinarily electricity is applied to the surface of parts only, whether these be external or internal. In some more uncommon cases, however, it is found desirable to penetrate the substance, and pass the current in among the tissues; which is done by certain fine needles, in form and size somewhat as in the engravings here annexed. These are used when it is desired to produce a more speedy effect on certain chronic swellings, as the goitre, when the negative pole is attached to the needle, and certain changes of a chemical nature, with a disintegration of tissue, are effected; so as to cause a resolution, and more rapid absorption, of the gland or part. These may be passed in singly, or two or more be used simultaneously, as in acupuncture. They are made of platina, or steel heavily gilt.

Fig. 2228.

Serres-fines.

Fig. 2229.

Garrigues' Serres-fines.

Dr. Garrigues' improved serre-fine is a form for use where the needle cannot be well used. The chief objections urged against the old form of serres-fines in the treatment of rupture of the perineum had been, that they slipped, caused intolerable pain, did not catch sufficiently deep, cut through, and that the wound did not heal. He thought the chief reason why these objections had appeared was because of the shape which the instruments had heretofore had. If they have no claws, or too short legs, they will slip. They give pain and cut through if the wire is too strong, and the edges of the wound do not unite if the legs of the serres-fines are too short.

The instruments shown have legs which project half an inch, and are armed with minute claws, the spring force is so small that they can be attached to the flesh anywhere, and be worn without pain. The advantage claimed for these serre-fines in the treatment of ruptured perineum is, that they are so simple that it is not necessary even to tell the patient that they are applied.

Ser'vice Box. In the pipes used in the Holly system of generating steam at a central station, and distributing it through underground mains over the city for heating and cooking purposes.

An expansion junction service box is placed at intervals of 100' to 200'. This provides for the free longitudinal expansion and contraction of the mains, and from this box the service pipes are carried underground to the basement of buildings to be heated. The service pipes, having an adjustable hood inside the junction box, may be turned downward, thus taking up the water of condensation as fast as it accumulates, and carrying it forward to the regulator valve inside the cellar walls. At this point the water of condensation being at the degree of heat due to 50 lb. pressure to the square inch, is wire drawn, and by this reduction of pressure it is largely reconverted into steam, and is carried on to the radiators, where it is again condensed. By this device it will be seen that although 50 lb. pressure is carried in the mains, it may be reduced to one or two pounds in the building, and therefore in a house two or three miles distant from the boiler there will be precisely the same result as in a building only a few feet away. The consumer living near the boiler house will have no advantage over the consumer living a mile away, since each will ordinarily carry the same house pressure, and consequently at the same temperature. The system was first tried with a three-mile main in Lockport, N. Y., in 1877, but has since been introduced into a number of other cities.

Ser'vice Clean'er. (*Gas.*) An air pump on a bell-shaped receiver fitted with a cock and having attached a strong caoutchouc hose. The object is to free service-pipes of obstructions arising from condensation of hoar frost or otherwise. The mode of using is to use the pump awhile, then open the cock quickly and allow the air condensed in the receiver to suddenly expand into the pipe, when it drives before it the obstruction.

Ser'vi-ette Ma-gique'. A cloth for polishing metallic ware. A piece of woolen cloth is saturated with soap and tripoli and colored with fuchsine.

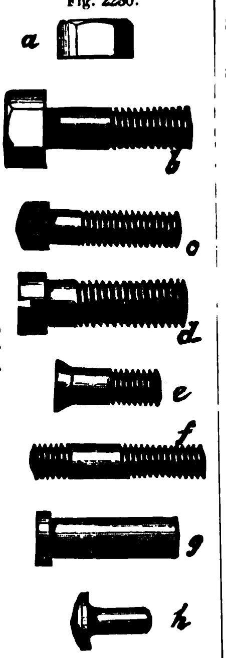
Sixty grains of Marseilles soap to 300 grains of water and 30 grains of tripoli. Saturate the cloth and then dry it.

Set. (*Leather.*) To set a side of leather, it is spread upon the table or stone when wet, and is smoothed out on it by the vigorous use of the slicker, and, owing to its wet condition, the air is easily excluded from under the leather, and it sticks to the table. A thin layer of oil will serve the same purpose.

Set Line. (*Fishing.*) A line laid out in the water in contradistinction to a *hand-line*. See TRAWL LINE.

Set Screw. One to hold some adjustable tool or piece of machinery in place or move it into position.

Fig. 2230.



Set Screws.

a. Hexagon nut.
b. Hexagon-headed set screw.
c. Square-headed set screw.
d. Cheese-headed set screw.
e. Countersunk or cone-headed set screw.
f. Turned stud.
g. Joint pin.
h. Oil pin.

Fig. 2231.

Setting Die.

Set'ting Die. For inserting patent rolled rim conical pointed sheet brass grommets. Fig. 2231 shows setting die for oblong grommets.

Sew'er. A subterranean channel to carry off the refuse slops, surface waters, and other waste liquids and excrement in cities.

See "*Mech. Dict.*," 2097, 2098, and article "*Égouts*," * tome iv., ed. 1877, Laboulaye's "*Dict. des Arts et Manuf.*"

Prof. Corfield's "*Sewerage and Sewage Utilization*," New York, 1875.

Menzies, Wm. "*Management and Utilization of Sewage.*"

Birch, R. W. P., C. E. "*The Disposal of Town Sewage.*" London, 1870.

Corfield, W. H., M. A. "*A Digest of Facts Relating to the Treatment and Utilization of Sewage.*" Prepared for the Committee of the British Association. London, 1871.

Krepp, F. C. "*The Sewage Question*," being a general review of all systems and methods hitherto employed in various countries for draining cities and utilizing sewage, with a description of Liernur's System, etc. London, 1867.

Phillips. "*On the Drainage and Sewerage of Towns.*"

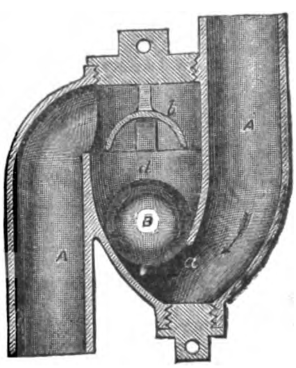
Sewers, construction of. *Smith*, "Iron"	"*Van Nostrand's Mag.*," xx. 390.
Schirrmeister	"*Scientific American*," xliii. 82.
Sewerage works, Croydon, Br.	* "*Engineer*," xlvi. 112.
Sewerage and water supply devices, *Rawlinson*, Br.	* "*Engineer*," xlix. 420.
Sewerage and water supply, *Rawlinson*, Br.	* "*Engineer*," l. 25, 82.
Sewer basin and stench-trap, *Dark*	* "*Scientific Amer.*," xxxviii. 281.
Sewer gas stopper. *Wemple*	* "*Scientific American*," xli. 40.
Sewage question. *Bazalgette*	"*Van Nostrand's Mag.*," xvii. 106, * 213, * 289.
Sewage system, pneumatic, *Shone*, Br.	* "*Engineering*," xxviii. 51.
Sewage system of Paris. "*Engineering*"	"*Van Nostrand's Mag.*," xix. 124.
	"*Scientific American Sup.*," 2238.
Sewage treatment	"*Scientific American Sup.*," 1022.
Sewage, treatment of. Manchester, Engl.	"*Scientific American Sup.*," 1251.
Various systems. *Bazalgette*	"*Van Nostrand's Mag.*," xvi. 302.
Sewage works for small towns, *Baldwin & Co.* Engl.	* "*Scientific American Sup.*," 1192.
Sewage works in Germany, "*Builder*"	"*Van Nostrand's Mag.*," xx. 262.
Sewage, appa. for removing suspended matter from	* "*Engineer*," xlix. 456.
Sewage cleaning appa. *Parrot & Good*, Engl.	* "*Scientific American Sup.*," 3872.
Sewage drying apparatus. London	* "*Engineering*," xxii. 427.
Sewage farm, Bedford, Engl.	"*Scientific American*," xxxix. 197.
Sewage irrigation	* "*Scientific Am.*," xxxvi. 352, 367.
Sewage into cement	"*Scientific American*," xxxix. 200.
Sewage process, phosphate, Br.	"*Van Nostrand's Mag.*," xvi. 34.
Sewage pumping engines. Single action plunger, Twickenham, Br.	* "*Engineering*," xxix. 22.

Sew'er En'trance. A pivoted trap-door fitting lightly in a box to prevent the escape of gases and afford an entrance to the sewer.

Sew'er-gas Check. A valve to keep reflux water from rising in the pipe.

The ball *B* sets in the bottom of the U-shaped bend *d*, and rises with the outward flow of water, being checked by the cowl *b*. When the

Fig. 2232.



Sewer-gas Check.

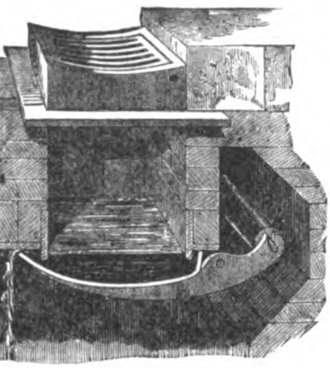
outward flow ceases, the ball drops into its seat, fitting closely, and preventing a reflux of water or the rising of gas. See SEAL, *supra*.

* "*Scientific Amer.*," xxxviii. 243, * 106.
Basin trap * "*Mech. Dict.*," Figs. 238, 239, p. 82, *supra*.

Sew'er Trap.

Fig. 2233 shows a swinging trap balanced at one side of the sewer. The rear end is recessed into the wall, and heavy enough to hold the front part up against a shoulder provided.

Fig. 2233.

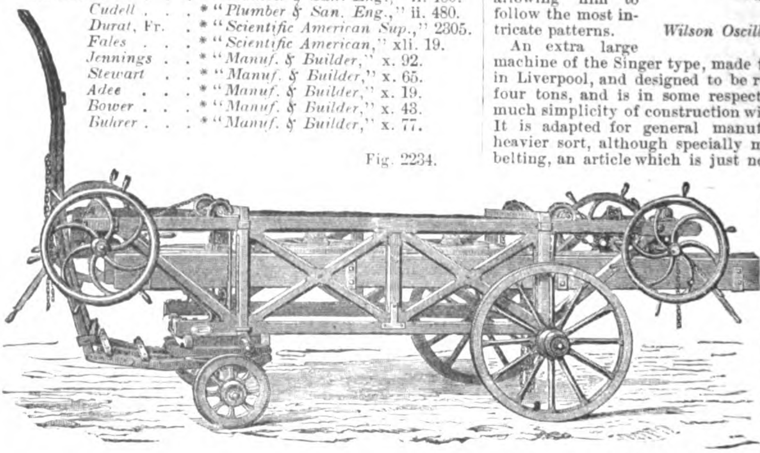


Sewer Trap.

The trap has a concave upper face to retain water enough to seal the outlet from the upward flow of gases or stench, but yields to allow surplus water to flow down.

Sewer-gas trap, *Bower*	* "*Engineer*," xlv. 110.
Bedell	* "*Scientific American*," xxxv. 182.
Buhrer	* "*Iron Age*," xxi., April 25, p. 9.
Campbell	* "*Scientific American*," xxxiv. 118.
Sewer mold, *Burns*	* "*Scientific American*," xlii. 162.
Sewer trap, *Bower*	* "*Plumber & Sanitary Engineer*," ii. 165, 445.
Clement	* "*Plumber & San. Eng.*," ii. 458.
Maddock	* "*Plumber & San. Eng.*," ii. 147.
Bedell	* "*Plumber & San. Eng.*," ii. 458.
Jennings	* "*Plumber & San. Eng.*," ii. 146.
Hellyer	* "*Plumber & San. Eng.*," ii. 459.
Stewart	* "*Plumber & San. Eng.*," ii. 480.
Pitt	* "*Plumber & San. Eng.*," ii. 164.
Gorman	* "*Plumber & San. Eng.*," ii. 480.
Cudell	* "*Plumber & San. Eng.*," ii. 480.
Durat, Fr.	* "*Scientific American Sup.*," 2305.
Fales	* "*Scientific American*," xli. 19.
Jennings	* "*Manuf. & Builder*," x. 92.
Stewart	* "*Manuf. & Builder*," x. 65.
Adee	* "*Manuf. & Builder*," x. 19.
Bower	* "*Manuf. & Builder*," x. 43.
Buhrer	* "*Manuf. & Builder*," x. 77.

Fig. 2234.



Sewer Shaft Wagon.

Sew'er Shaft Wag'on. A form of wagon for hauling and lowering into the ditch a section of sewer or drain tubing, as shown in Fig. 2234. The axle is bent so as to swing the box below it, elevators at each end hoist or lower the box suspended by the chains at will.

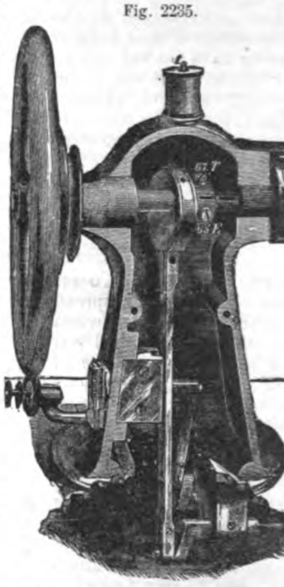
Sew'ing Ma-chine', Dress Pro-tect'or for. Mrs. E. F. Shaw's dress protector for sewing machines is a shell-shaped shield before the crank and pitman connection to keep oil from splashing upon the dress of the operator.

Sew'ing Ma-chine' Tread'le. Wilbrie & Osborn's treadle is made adjustable on the arc of a circle to adapt it to the requirements of different operators.

Sew'ing Ma-chine'. Sewing machines have arrived at that degree of perfection that in their various kinds they do about every kind of work that can be done with a needle. They are deemed almost an indispensable article in every household. See pp. 2098–2124, "*Mech. Dict.*"

Figs. 2235-2237 show the operating devices of the Wilson Oscillating Shuttle Machine, with the shuttle carrier and shuttle. An eccentric on the driver revolves the feed shaft through the vertical lever; a secondary lever, pivoted to the vertical lever midway of its length, operates the rock shaft which oscillates the shuttle; a pin on the vertical lever works in a slide to regulate the motion of the lever. An automatic cut-off in the wheel prevents the machine from running backward and allows the winding of the bobbin with the needle standing still in the work.

Fig. 2235.



Wilson Oscillating Sewing Machine.

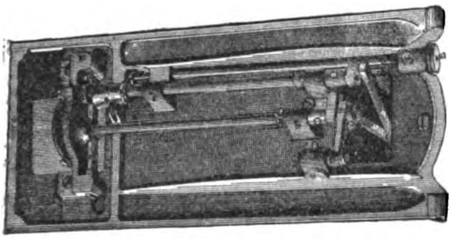
Cole's Universal Feed Sewing Machine does plain and fancy stitching, braiding, etc., stitching in any direction at the will of the operator, allowing him to follow the most intricate patterns.

An extra large machine of the Singer type, made for a manufacturing firm in Liverpool, and designed to be run by steam, weighs over four tons, and is in some respects of new design, uniting much simplicity of construction with great strength of parts. It is adapted for general manufacturing purposes of the heavier sort, although specially made for stitching cotton belting, an article which is just now taking the market as a cheap and serviceable substitute for gearing and the ordinary leather belting.

The material used is of great strength and toughness, and is sewed together in plies or layers up to an inch in thickness. The belting in being sewed together is passed through heavy feed rollers some 9″ in diameter, and more than 8′ in length, getting stretched and pressed in the process. There are two needles at work with shuttles, and the shuttles can be removed from the bottom without disturbing the overlying plies or belting.

The rollers between which the work passes are actuated by reversible worm and cam motions, and the machine has, in addition to these roller feeds, what is known as a top-feed motion, suitable for a higher class of work. The stitch, as in the ordinary sewing machine, can be adjusted from one-eighth inch upward, and the pressure of the rollers on the work passing through the machine can be regulated at the will of the operator.

Fig. 2236.



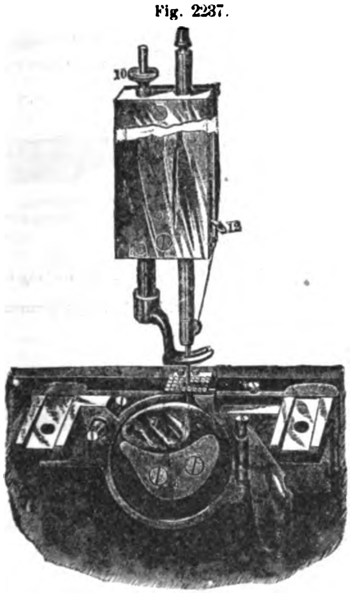
Wilson Oscillating Sewing Machine.

Pitt's circular feed machine is adapted to sewing elastics in old boots, stitching round goloshes and down the fronts and backs of boots, and other repairs. The operator has control of the stitching motion, and can change the direction without stopping the machine.

Hist'y of, Centen. Rept. "*Scientific American*," xxxvi. 820.
Legat . . . . . . * "*Technologiste*," xl. 70.

A consecutive account of the various operations in making sewing machines, may be found in Fairfield's "*Report Vienna Exposition*," vol. iii.

Fig. 2237.



Wilson Oscillating Sewing Machine.

G. W. Gregory's Report in Group XXII., vol. vii., "*Centennial Exhibition Reports*," gives the best history extant of the invention of the sewing machine and describes the following: —

Howe	United States.
Wheeler & Wilson	United States.
Singer	United States.
Weed	United States.
Wilson	United States.
"Domestic"	United States.
Grover & Baker	United States.
Remington	United States.
St. John	United States.
"Victor"	United States.
Whitney	United States.
"Florence"	United States.
"Lyall"	United States.
Cole	United States.
"American Button Hole, etc., Co."	United States.
Johnson, Clark & Co.	United States.
Goodes	United States.
Davis	United States.
McLean & Bennor	United States.
Wardwell	United States.
De Laney	United States.
Wilcox & Gibbs	United States.
Willis	United States.
Walters	United States.
Baker	United States.
Pearson	United States.
"United States Sewing Mach. Co." .	United States.
Eickemeyer	United States.
Kimball & Morton	Scotland.
Newton, Wilson & Co.	England.
"*C. W. Williams Manufact. Co.*" .	Canada.
Lawler	Canada.
Wanzer	Canada.
"Hus-qvarna Arm Manufact. Co." .	Sweden.
Hedland	Sweden.
Muller	Germany.
Pollard & Schmidt	Germany.
Wilkie & Osborn	Canada.
St. Amant	Canada.
Kiehle	Germany.
Hendrickson	Denmark.
Cornely	France.
Petit	France.
Turner	Belgium.

Factory, *Wheeler & Wilson* . . . . . . * "*Scientific American*," xl. 271.
Motor, electric, *Edison* "*Telegraphic Journal*," vi. 118.
Howe . . . . . . * "*Telegraphic Journal*," vi. 145.
Spring, Austria . . * "*Engineer*," xlvi. 88.
Sewing machine . . . * *Fairfield's* "*Vienna Exposition Rept.*," iii.

* *Howe*. * *Weed*.
* *Wilcox & Gibbs*. * *Singer*.
* *Secor*. * *Wheeler & Wilson*.
* *Wilson*.

"Little Monitor" . * "*Scientific American*," xxxiv. 255.
Overhead, *Lang* . . * "*Scientific American*.," xxxvii. 146.
Wilson . . . . . * "*Scientific American*," xxxix. 278.
Wheeler & Wilson, No. 6 * "*Scientific American Sup.*," 853.
Treadle, Van Wyck . * "*Scientific American*," xliii. 198.
Weed . . . . . . * "*Scientific American*," xlii. 175.

Sew'ing Silk. A kind of silk thread, made two-cord and twisted from left to right.

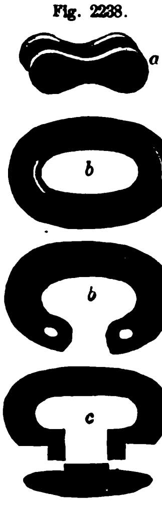
Sewing silk, manufact. of "*Scientific American Sup.*," 1968.

Sgraf-fi'to. See Grafito.

Shack'le. A link by which portions of objects, or lengths of chain are connected. Several types are shown in Fig. 4888, p. 2125, "*Mech. Dict.*"

The term includes also hinged or jointed links, open rings, many forms of loops, lap rings, etc. Fig. 2238 shows three forms of shackle or link: *a* is a "flat link"; *b b* is a link in two sections to be laid upon each other and riveted; *c* is a link closed by a side-piece fitting upon studs. See also Platform Spring.

Fig. 2238.



Shackles.

Shack'le Flap. A man-hole cover attached to the plate by a shackle.

Shack'le Jack. A clamp to compress the anti-rattling rubbers while inserting in the carriage shackles.

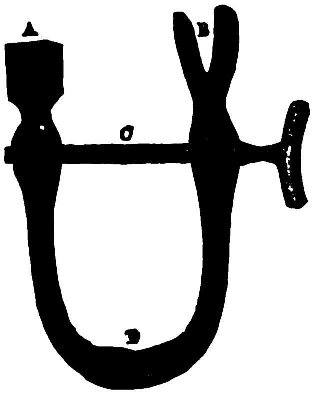
The operation of the jack shown in Fig. 2239 is as follows: Place recess *A* on the back of axle bed, yoke the fork *B* on shaft or pole eye, turn the bolt *C* until the shackle bolts can be slipped easily through the clip hole; the joint *D* accommodates itself to the bolt *C*.

Shack'le Joint. A joint for coupling together the drilling rods in boring a well.

Shade. 1. (*Glass*.) A dome, bell, or other shaped glass cover for protecting clocks, artificial flowers, etc.

They are made in a similar manner to the blown cylinder glass, the glass being kept very evenly distributed by special care and reheating.

Fig. 2239.



Shackle Jack.

Oval cylinders are blown round and then passed between two parallel pieces of wood to flatten them.

Square shades are made by four pieces of wood instead of two.

Round cylinders may be cut before annealing, but other forms require to be first annealed.

Fig. 2240.

Eye Shade.

2. A screen attachment to a lamp to throw the light on to the book or work, and to protect the eyes from the direct rays.

Fig. 2240 shows a form of hood on a magnifying glass to protect the eye from the upper rays.

Shaft. (*Mining.*) The perpendicular, well-like excavation in mines, from which the levels are run.

Twenty years ago the deepest mining shafts in the world reached only about 2,000′ below the surface. The very deepest, we believe, was a metalliferous mine in Hanover, which has been carried down to a depth of 2,290′. The deepest perpendicular shaft to-day is the Adelbert shaft in a silver-lead mine in Prizibram, in Bohemia, which has reached a depth of 3,280′. The attainment of that depth was made the occasion of a three days' festival, and still further noticed by striking off a large number of commemorative silver medals of the value of a florin each. There is no record of the beginning of work on this mine, although its written history goes back to 1527. Quite recently an elegant commemorative volume has been written and printed, which is most interesting to those who have a taste for either the actualities or antiquities of mining industry. There are two other localities, however, where a greater depth has been reached than at the Adelbert shaft, but not in a perpendicular line. These are: 1. The Rocksalt bore-hole, near Sperenberg, not far from Berlin, which, a few years ago, had been bored to a depth of 4,175′. 2. The coal mine of Viviers Remus, in Belgium, where the miners, by shaft-sinking, together with boring, have reached a total depth of 3,542′. Turning from these two mines, no shaft, in unbroken perpendicular line, has as yet exceeded the depth of 3,280′. Taking each singly, the deepest shafts in the world at the present moment, group themselves according to the following order: —

1. The already mentioned Adelbert shaft, 3,280′ deep. As the top of this shaft is 1,732′ above the sea level, the bottom is, of course, 1,548′ below it.

2. Two shafts near Gilly, in Belgium, are sunk to a depth of 2,847′. At this depth they were both connected by a horizontal drift, from there an exploring shaft is sunk to a further depth of 666′, and from there again a trial hole, 49′ in depth, is put down, so that the total depth reached is 3,542′. As they did not, in the bore hole, discover the sought-for coal seam, they have returned to the shaft at the 2,847′ level.

3. The Eimgkerts shaft of the Lugauer coal mining company, Rhenania, Lugau, in the kingdom of Saxony, is 2,653′ deep.

4. The Sampson shaft of the Oberhartz lead and silver mining works, near St. Andreasberg, Hanover, has a depth of 2,437′, and is at present the deepest shaft of Prussian mining.

5. The winding shaft of the Rosebridge colliery, near Wigan, Lancashire, England, has a depth of 2,458′. Coal is drawn from the "hanging on" at the 2,418′ level; the time of the cage running this distance being 55 seconds; the winding rope has, therefore, an average speed of 44′ per second.

6. A shaft at the coal mines of St. Luke, near St. Chaumont, in the Loire department, France, reaches 2,253′.

7. The shaft of the Dunkirk colliery, near Dunkinfield, Lancashire, is 2,069′ deep, but the mining is prosecuted to a further depth of 755′ by shafts from the lower levels, making a total depth of the mine of 2,824′.

8. The deepest shaft of the collieries, near Ronchamp, in France, is 1,881′. A similar depth has been reached by the argentiferous mine near Kongsberg, in Norway. The mines belonging to the Roros copper works, in Norway, have worked to the depth of from 2,540 to 3,270′.

The deepest bore-hole in the world is the artesian spring at Potsdam, in Missouri, which reaches a depth of 5,500′.

The deepest coal shaft in the United States is the mammoth vein, Philadelphia and Reading Coal Co., Pottsville, Pa., 1,855′ deep.

(*Machinery.*) Screw propeller shafts are sometimes made of fluid-pressed steel and forged hollow, saving some 50 or 60 per cent. in weight.

Shaft Bolt. See Fig. 4710, p. 2063, "*Mech. Dict.*"

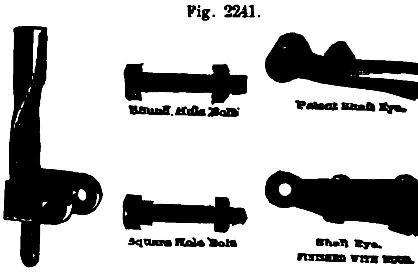
Shaft Bor′ing Ap′pa-ra′tus. See SHAFT EXCAVATOR.

Belgian . . . . . * "*Scientific American*," xxxv. 232.
Kurd-Chandson, Belgian * "*Eng. & Min. Jour.*," xxiii. 434.

Shaft Coup′ling. (*Vehicle.*) The connection formed between the thills and the clips of a buggy.

Fig. 2241 shows the clip with a straight ear, and supporting lug to hold up the shafts. The bolt may be either round or square.

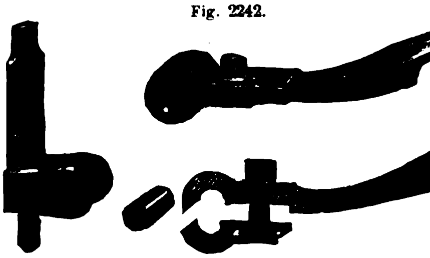
Fig. 2241.



Shaft Coupling.

Fig. 2942 shows the same ear, but having a permanent pin instead of the bolt. The thill eye is made in two pieces, held and tightened on the pivot by a set screw. A rubber packing surrounds the pin to prevent rattling.

Fig. 2242.



Shaft Coupling.

See 20 examples of machinery shaft coupling, Fig. 4896, p. 2127, "*Mech. Dict.*"

12 examples thill coupling, Figs. 6380, 6381, pp. 2553, 2554, *Ibid.*

* "*Scientific American*," xxxv. 19.
Paper on . . . * "*Boston Journal of Commerce*," xx. 171.

Shaft Ex′ca-va′tor. A system of apparatus designed for sinking the shafts in coal mines.

The machines are of colossal size and form, the most prominent feature of the vicinity. A trepan weighing 15 tons, is made of forged iron, and fitted with cutters secured by taper keys, so as to make a cut 6′ long. The trepan is raised by steam power to a height of 3′, and dropped. It is turned at each elevation so that a circle 6′ in diameter is cut. The advance in soft sandstone is said to be 3′ per day. The trepan being withdrawn, a massive iron bucket is fitted into the hole to remove the *débris*. After the first tool has penetrated about 30′, a second trepan, much heavier than the first and having a central guide working in the opening made by the first, is used, and, in the stone above mentioned, it progresses at the rate of about a foot per day. A grapple for recovering broken rods, and a sweep to catch the sections of lifting bars, are also used. There is, besides, a grapple for stones, etc., which is an ingeniously constructed pair of double lazy tongs arranged so that the arms extend to the sides of the hole as the device is being lowered, and scour the bottom as it is being lifted.

When the cutting is finished, circular plates are let into the opening, the bottom plates or cylinder sliding inside of a second ring, and being surrounded with a moss gasket compressed between the flanges. This keeps the water out of the bottom. The second ring is convex beneath and floats on the accumulated water. Then, as ring after ring is added, the water is allowed to escape, the rings sinking gradually. Guides prevent the casing from tilting until it is secured to hard impervious strata, when the shaft is pumped out and is then ready for use.

Shaft-sinking, Belgian system . . "*Van Nostrand's Mag.*," xxiii. 504.

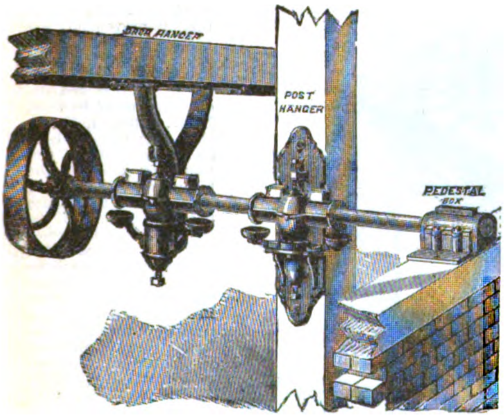
Shaft Eye. The hole in the end of a thill or recess or hole in other shafting through which the coupling pin or key passes.

Shaft Fur'nace. (*Metallurgy.*) The *stücköfen* or *Wolföfen* of Styria was considered the first representative of the high furnace, and the progenitor of the modern *blast* furnace for cast iron. The iron from a single turn of the furnace was taken away in a mass (*stück* or *wolf*) at an opening made at the hearth, and weighed from 1,000 to 1,400 pounds. Some fluid carburized iron ran out, and here the cast-iron continuous process, doubtless, had its commencement, or suggestion. Such furnaces, shaped like two cones joined at their bases, and from 10′ to 16′ high, were common in Styria in the seventeenth century. In 1760 the *flossöfen* was introduced; it was 25′ high, and produced cast iron by continuous process. The *blanöfen* succeeded it, and two tapping tools, for iron and slag respectively.

Shaft Hang'er. A swinging or stationary bracket to support the shaft.

The drop hanger in Fig. 2240 is adjustable, vertically and horizontally, and self-adjusting to any angle, the box working in a socket, and is self-lubricating. The post hanger is also self-adjusting to any angle, and is adjustable vertically and horizontally, the box being moved to or from the post by means of check bolts, without disturbing the plate of the hanger, which is bolted to the post or timber. It also has the improved lubricating box, and both hangers are neat and ornamental in design.

Fig. 2243.



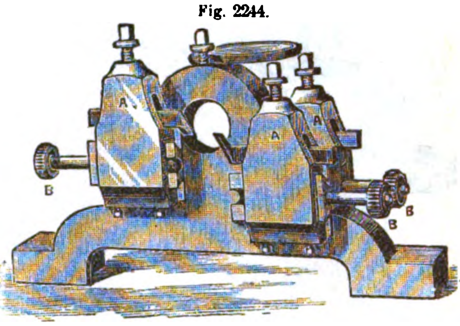
Shaft Hanger.

Shafting cup . . . . "*Scientific Amer.*," xxxix. 100.
Hanger . . . . . . * "*Mech. Dict.*," p. 1059.
* "*Mech. Dict.*," Figs. 4899, 4901, p. 2129.
Ball and Socket . . * "*Engineer*," xlii. 61.
Bancroft . . . . . *Thurston's* "*Vienna Rept.*," ii. 215.
Shafting adjusting line * "*Scientific American*," xxxvi. 24.

Shaft'ing At-tach'ment. An adjunct to a lathe used especially in turning shafting.

It consists of a heavy arch piece bolted on to the rest, carrying three turning tools, two on the front and one on the back of shaft, and having a hole bored out in the upper part of arch to receive bushes for steadying the shaft while turning, or to hold fluted rings for finishing the shaft. The first tool on the front takes off the first chip, and the tool on the back turns the shaft to its proper size. After it passes through the bush the water polishing tool finishes the shaft, leaving it perfectly round and smooth. Each tool is adjusted by a separate screw operating the tool block that carries it. (See Fig. 2244.)

Fig. 2244.



Shafting Attachment.

Shaft'ing Lu'bri-ca'tor. A device for supplying oil to a bearing in which a shaft rotates.

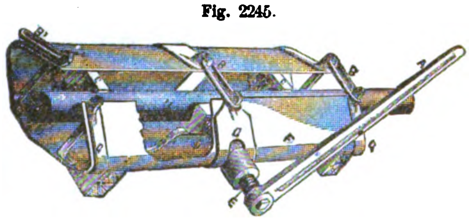
See LUBRICATOR, OILER, SELF-OILING BEARING, *supra.*

Shaft Rub'ber. An anti-rattler. One form is a rubber block with a concave face to fit round the end of the shaft, and hold it in place. See Fig. 4889, p. 2125, "*Mech. Dict.*," and SHACKLE JACK.

Shaft Straight'en-er. Straightening device or bender for shafting, axles, tubes, rails, etc.

The accompanying cut, Fig. 2245, represents a wrought iron frame bound by the bands *G*. These are held together by the links *B* when the machine is being operated, and are thrown back, as shown at *B′*, when the work is to be inserted or taken out. The shaft *H* to be straightened rests against the two movable dogs *C*, and the dog *D* is brought to bear upon the middle and opposite side, then by turning the screw *E* by means of the lever *A*, the shaft *H* may be crooked to any extent.

Fig. 2245.



Shaft Straightener.

Shaft Tip. The ferrule at the end of a carriage shaft.

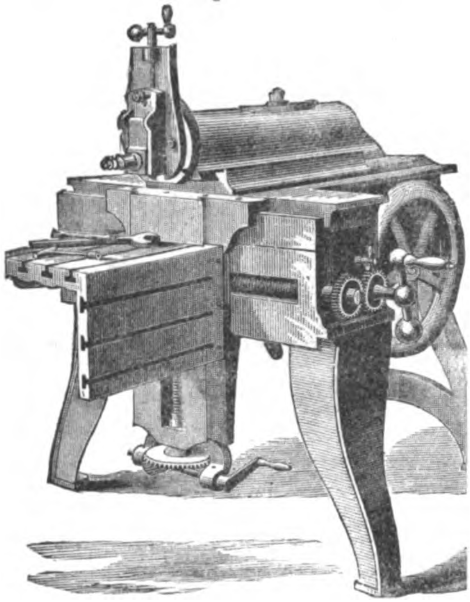
Sha-green'. Hard, colored, metallic spots found on the surface of iron castings; probably produced from the pellets or small spherules found in cavities in pig iron. The analysis of the *pellets* and *shagreen* is similar, showing abundant phosphorus and carbon, and diminished silicon and graphite.

Shank Spring. A spring steel piece to unite the sole and heel of a boot, giving an elastic support to the arch.

Sha'per. A combined lathe and planer.

Fig. 2246 shows Hill, Clark & Co.'s shaper with a 12″

Fig. 2246.



Shaper.

stroke, 22″ cross traverse of table, Whitworth quick return, and rotary planing attachment with self feed.

Manville	* "*Scientific Amer.*," xxxviii. 358.
	* "*Manuf. & Builder*," viii. 30.
Pratt & Whitney . .	* *Thurston's* "*Vienna Rept.*," ii. 221.
Sharpe, Stewart & Co., Br.	* "*Engineering*," xxvii. 444.
Collier & Co., Br. . .	* "*Engineering*," xxiii. 314.
	* "*Scientific American Sup.*," 1185.
MacCord	* "*Scientific American Sup.*," 248.
Ferris & Miles . . .	* "*Iron Age*," xx., Sept. 20, p. 1.
And molding machine, (wood), *Richards* .	* "*Engineering*," xxiii. 489.

Sha'per Plate. A pattern plate in a lathe, for instance, which governs the cut of the tool.

Such are found in gun-stock, last, and baluster lathes, etc.

Sha'per Vise. One adapted to hold work to a planer, at any horizontal angle.

In Newell's design the vise turns on a graduated base, so the work may be adjusted at any horizontal angle. One of the jaws is V-shaped for holding circular pieces, and swivels to present either that or the straight face. The actuating screw is protected from chips and dirt and the jaws are faced with hardened steel.

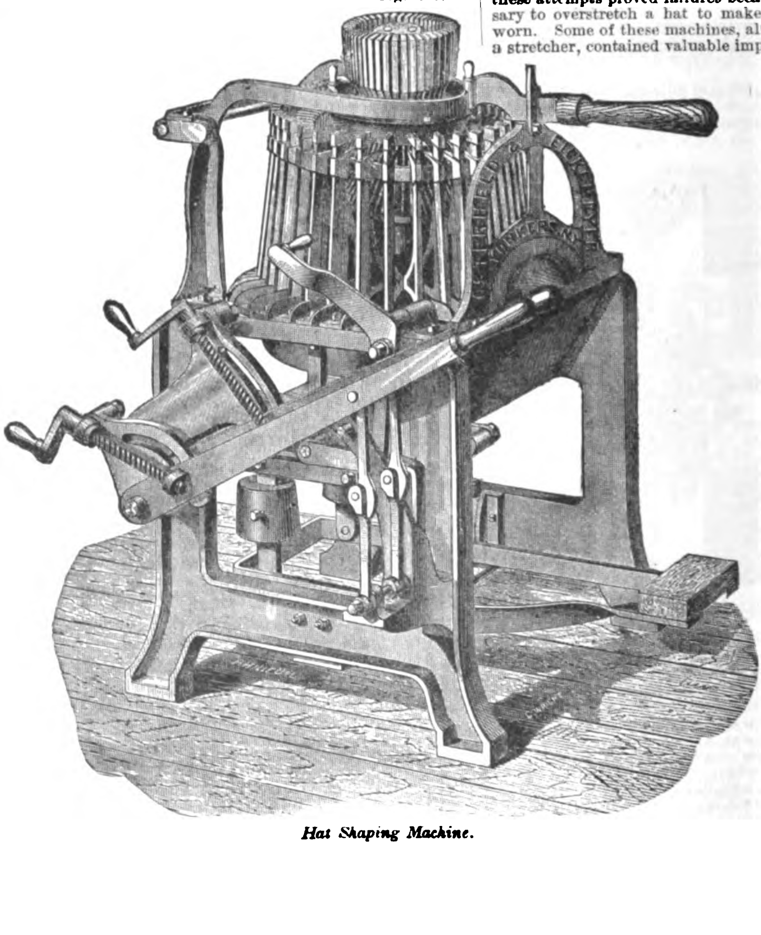
Sha'ping Ma-chine'. To complete the operation of blocking fur hats, after the tips and brims have been stretched on special and separate machines, a finishing blocking machine is employed.

This is represented in Fig. 2247, the invention of R. Eickemeyer.

To block a fur hat it is necessary to bring it much nearer to the size and shape of the finished hat than is necessary in the case of a wool hat, which is more elastic and can be more readily shaped when put on the finishing block, and it is therefore necessary to use blocks and rings of the right oval to shape fur hats.

Many attempts were made to construct machines to block or shape fur hats without previous stretching, but all of these attempts proved failures because it is absolutely necessary to overstretch a hat to make it retain its shape when worn. Some of these machines, although of no use without a stretcher, contained valuable improvements. The first important change was the substitution of tongs to clamp the hat brim in combination with the banding ring and block, in place of the clamping plates, banding ring, and block in the wool hat blocking machine, and this improvement was patented February 26, 1867, by Joseph De la Mar, of Brooklyn, N. Y. W. H. Behrens and Jacob Surerus, of Newark, N. J., patented, May 3, 1870, a machine in which an out-stretching motion was given to the brim tongs, thus adding another desirable feature to the machine. All the improvements of former machines are embodied in the present machine and such others added as were suggested by the experience in its use for a number of years. The hat block, which is composed of 48 pieces, and can expand from 6″ to 8″ average diameter, is in this manner adjustable for all the usual sizes of hats. 36 tongs grip the edge of the brim, taking hold about 3-8 of an inch of the hat body. The tongs being movable to and from the center of the hat block are arranged equidistant around the oval banding ring and the brim is thus drawn out, of equal width all around. The height of the block can be varied between 2½″

Fig. 2247.



Hat Shaping Machine.

and 7″, while the brim tongs have a range of from 2″ to 5½″ of the width of brim.

To shape a hat, or more properly to develop the band, the hat body, the tip and brim being previously stretched, is well soaked in hot water and is then put on the block. The latter has been previously contracted to its smallest diameter and the tongs are resting close to the block. The operator now puts his foot on the treadle and spreads the tongs until the brim slips off the loose jaws and rests upon the lower jaws, when he allows the tongs to close up to the edge of the brim. The loose tongs are now closed upon the edge by a turn of the short hand lever on the left side of the machine. The hand lever to which the banding ring is attached is thrown over the block and fastened by the hook in front of the machine.

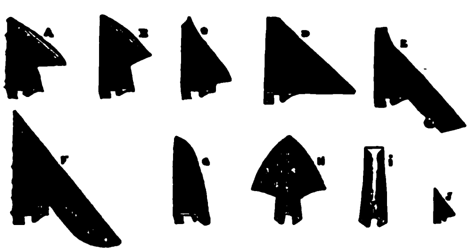
The hat brim is now firmly held by the tongs, the operator raises the block by the outer hand lever, and, while depressing the treadle by his foot, spreads out the block to the desired size. The hat is then cooled and taken off, and the operation repeated on the next hat.

Four to six dozen can be readily blocked per hour by a good operator, and, as all the adjustments, — namely, the the size of band, height and diameter of crown, and width of brim, — are made by gages attached to the different levers, the operator can set each part in a few moments.

All sizes of hats from the largest to the smallest can be blocked on the same machine.

Share.

Fig. 2248.



European Plow Shares.

- *A.* Square work. *Labour rectangulaire.*
- *B.* Crested work. *Labour trapézoidal.*
- *C.* Stony land. *Terres pierreuses.*
- *D.* Deep land. *Labour profond.*
- *E.* Wide work. *Large labour.*
- *F.* Paring. *D'chaumer.*
- *G.* Setting-out. *Traçage.*
- *H.* Ridging. *Billonnage.*
- *I.* Subsoiling. *Sous-sol.*
- *J.* Skim colter. *Couteau.*

Shares Har′row. One having shares instead of the ordinary teeth.

Shar′py. (*Fishing.*) Local. A long, sharp, flat-bottomed sail-boat.

Shav′ing. (*Leather.*) In this operation the currier's knife is driven from the top to the bottom of the beam, thus taking off shaving after shaving, removing all the inequalities left after skiving, and making the leather of uniform thickness, also leaving a beautiful smooth face on the flesh side. This operation is sometimes called *flattening*. The shaving or flattening is done almost at right angles to the skiving.

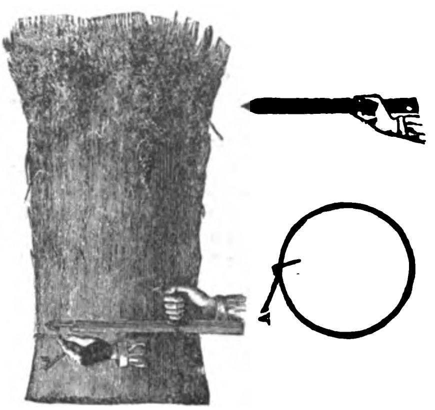
Shav′ing Ma-chine′. (*Stereotyping.*) Hand-machine for shaving stereotype plates, Fig. 5795, p. 2379, "*Mech. Dict.*" Power machines for the same purpose, p. 125, * R. Hoe & Co.'s catalogue, edition 1881.

For shaving hats, in the finishing process. See Pouncing Machine, *supra.*

Sheaf Bind′er. A hand implement for binding the sheaf with cord.

Fig. 2249 shows a French hand-binder. The string is strained around the sheaf by means of the stick. The band is composed of two cords knotted together, forming loops. The point of the tool is introduced through a loop at or near one end, and is thrust as far as the handle permits. The band being placed around the sheaf, the point of the tool is thrust through such one of the other loops as will give the tightness to the band, and the handle end of the tool is then carried over, describing an arc upon the point which is in the sheaf: the loop slips down from the handle to the point end,

Fig. 2249.



Sheaf Binder.

and the loop caught in the notch is then drawn through the loop on the stick, and the latter is withdrawn, allowing the knot drawn through to catch in the loop, where it is held by the expansion of the sheaf. The cords are 5′ long.

At the Paris Exposition were shown various attempts to obviate the use of the bunch of straw taken from the sheaf to form a band. One man proposes to use the bark peeled from osiers, two or three twisted together; these are sold very cheap. Another has cheap hempen strings cut to length and sold in bundles of one thousand each.

It is estimated that the annual crop of France is about 4,000,000,000 sheaves of grain, and that 50 straw bands contain one franc's worth of grain, the whole representing 80,000,000 fr., most of which is lost by shelling out on to the ground or mildewing under the band. Add to this the loss of time in making and applying, and the injury to the grain in the size of the band, which causes dampness to the sheaf. The figures seem formidable, and the *automatique* band is presented to solve the difficulty. The estimate is French, and in the interest of the hempen-band sellers; it is probably somewhat exaggerated.

Fig. 2250 shows a grain-band having a string attached to a block, and after passing around the sheaf rove through a ring. The mode of using it is evident from the engraving: the wooden block being held in one hand, one knee of the operator is placed upon the sheaf to compress it, while the other hand draws the cord through the ring. The expansion of the sheaf pinches the cord between the ring and the block, and makes a perfectly tight fastening.

Fig. 2250.

Sheaf Binder.

The cord and block are treated with tar, and are smoked to render them indestructible by humidity and noxious to insects, rats, and lizards.

See Binding Reaper and Shelf Binder, *supra*, and Reaper, "*Mech. Dict.*," pp. 1889-1898.

Sheaf band cutter, *Wood* * "*Engineering*," xxv. 182.
Sheaf binder, *Burgess*, Br. * "*Engineering*," xxviii. 28.
Landelle, Engl. . . * "*Scientific Amer.*," xxxix. 146.
Toulousain, Fr. . . * "*Scientific Amer.*," xxxix. 179.
Wood . . . . . . * "*Engineering*," xxv. 182.
* "*Engineering*," xxi. 68.

See also Binding Reaper.

Shear′ing Ma-chine′. Apparatus for cutting by power.

Shears . . . . . . * "*Scientific Amer.*," xxxiv. 132.
Hydraulic Shears, Toulon Arsenal . . . * "*Engineer*," xli. 208.
Tweddell, Br. . . . * "*Engineer*," xliv. 98.
* "*Scientific American Sup.*," 852.

Cardboard, Figs. 539-541, p. 166, *supra.*
Sheep. See Figs. 4942, 4946-4951, p. 2140, "*Mech. Dict.*"

Surgical. See SCISSORS, Figs. 4671, 4672, p. 2054, "*Mech. Dict.*," *et supra.*
See also BAR SHEAR.
PLATE SHEARING MACHINE, Fig. 1962, p. 691, *supra.*
PUNCH AND SHEAR.

Shearing machine bar.
Collier . . . . . . * "*Scientific American Sup.*," 467.
Heavy, *Collier*, Br. . * "*Engineering*," xxi. 477.
Plate, *Sellers* . . . * "*Scientific American*," xli. 259.
Shearing & punching machine, hydr., *Tweddell* * "*Engineering*," xxvi. 270.
Double, *Wagner* . . * "*Sc. American*," xxxviii. 163.
Shearing, punching and straightening machine.
Wagner, Ger. . . . . * "*Engineering*," xxiv. 489.

Shears. (*Glass.*) The scissors of the glass-blower to remove superfluous parts of the viscous glass under treatment, such as cutting of the irregular margin of the mouth of the goblet, etc.

Shears, Scis'sors, etc. See under the following heads: —

Bent trimmer.
Candy shears.
Cartilage scissors.
Clippers.
Cutting nippers.
Flower gatherer.
Fluter.
Fluting scissors.
Horse clipper.
Lateral scissors.
Pruning shears.
Revolving scissors.
Sardine shears.
Scissors.
Seizing scissors.
Shearer.
Snap.
Surgical scissors.
Tenaculum scissors.
Tinner's snips.
Trimmer.
Vine shear.
Vivifying scissors.

Shears, Double, *Laws* . * "*Sc. American*," xxxviii. 134.
Iron, *Cleveland Hardware Co.* . . . . * "*Iron Age*," xxi., May 2, p. 25.
Power, *Pratt & Whitney* * "*Manufact. & Builder*," xii. 16.
Pratt . . . . . . * "*Am. Man.*," August, 1879, p. 16.
Stiles . . . . . . * "*Iron Age*," xxiii., Jan. 16, p. 5.
For brass, Hydraulic.
Tweddell, Br. . . * "*Engineering*," xxvii. 67.

Sheath Knife. The fisherman's knife, worn in a sheath.

Sheer Boom. (*Hydraulic Engineering.*) The word is taken from the sheer-boom for logs, used by lumbermen, p. 2141, "*Mech. Dict.*"

A floating structure moored aslant in a stream to direct the current in a given direction to prevent erosion on a certain shore, for instance. Such a boom 750′ in length and furnished with 44 rudders, 20′ long and 16′ apart, is operated by wire ropes and crabs near Rock Island, Ill. See "*Report of Chief of Engineers, U. S. Army*," 1878, * ii. 710.

Anderson's booms are designed for gathering and storing away in an inclosure logs floating down with the current of a river; and the nature of the invention consists in combining, with a sheer-boom adapted to float upon the surface of the water, and to be pivoted to a pier-head, a number of horizontally-vibrating fins or blades pivoted to the said boom, whereby they are adapted to be vibrated outward for the purpose of utilizing the force of the current for placing the sheer-boom in position for work, or inward toward the said boom, for the purpose of causing it to swing down stream out of the way when not in use, or to allow the passage of steamers or other vessels in navigable rivers.

Sheer Pole. One of the spars of a sheer, or a single one with guys and used as a substitute for regular sheers.

Sheet Cal'en-der. A machine for pressing paper, rubber, etc., into sheets and giving it surface. See CALENDERING MACHINE, *supra.*

Sheet De-liv'e-ry. Delivering the printed sheet from the form to the fly.

Cottrell's air sheet delivery floats the freshly printed sheet down the gages, without the use of tapes, to avoid the blurring or smutting sometimes produced by these.

Two pipes leading from the hollow piston of the air-plunger, one conveys the air to the governor, and the other to an air receiving cylinder located under the track. The air in this receiving-cylinder is permanently kept at the highest pressure, which is attained by a check valve in the pipe leading to it. From the air cylinder is an upright pipe connecting with the perforated tubes. In the upright pipe is a trip-valve, operated by a cam, which opens the valve at the precise instant the sheet comes over the wheels, inducing a puff of air sufficient to carry it down to the gages on the fly, and without touching the fingers.

The exact amount of air required to float the sheet can be regulated instantaneously by the pressman, so that the printed sheet is always under perfect control.

The Adams press uses a bellows for same purpose.

Sheet-i'ron Work.

See *Blinn's* "*Practical Workshop Companion for Tin, Sheet-iron, and Copper-plate Workers.*"
Perkins & Stowe's "*A New Guide to the Sheet-iron and Boiler Plate Roller.*"

Sheet iron, thin . . . "*Scientific Amer.*," xxxiv. 356.
Russian . . . . . "*Eng. & Min. Jour.*," xxvi. 199.
"*Scientific American Sup.*," 2449.
"*Iron Age*," xvii., Jan. 20, p. 1.

Sheet Lead. Lead made in sheets by hammering or casting.

The making of sheet lead for the lining of tea chests, etc., is a somewhat important industry of Hong Kong. It is made principally in sundry establishments to the westward. On entering one, workmen will be seen with shears busily employed in cutting out the sheets of lead into the required sizes and shapes. The shears are simply a large pair of scissors, firmly fixed to a solid block of wood some 2′ in height. The lower blade of the shears terminates in a square piece of iron instead of being pointed, as is the upper blade. The sheets of lead will also be observed to be of small size and somewhat irregular in shape, and this arises from the method of manufacture, as will subsequently be seen. Going further into the shop will be seen an iron pan raised 12″ or so above the ground and carefully finished off. Beneath this iron pan is a furnace, and at the side of the pan next the wall is the flue communicating with it. In this pan the lead is melted, and when judged to be hot enough, the workman takes two of the large square paving tiles, which may be seen almost anywhere in the colony, and these are then smoothly and carefully covered with several layers of unsized paper. Having placed these two tiles before him, one above the other, the workman raises the upper tile with his left hand, and, taking a ladle of the proper size in his right, he dips it in the melted lead and then pours its contents on to the lower tile. He then drops the upper tile and quickly presses the lead out into the form of a sheet. The paper being a bad conductor of heat, the lead does not solidify immediately it leaves the ladle, and, as by long practice the workman always ladles out exactly the same quantity of lead, the sheets made vary but little either in size or thickness.

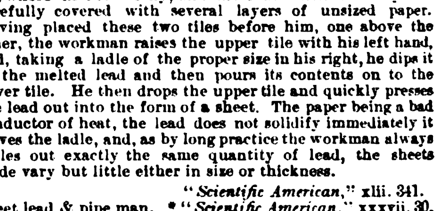
"*Scientific American*," xlii. 341.
Sheet lead & pipe man. * "*Scientific American*," xxxvii. 30.
Sheet lead rolling mill . "*Manufact. & Builder*," ix. 172.

Sheet Point'ing Ma-chine'. A machine for preparing printing sheets for cutting. The needles which project above the surface of the table are adjustable to suit the perforations made by points in process of printing. When a sufficient number of sheets are placed the points are drawn down, leaving the paper accurately piled and ready for the cutting machine.

Page 160, * R. Hoe & Co.'s Catalogue, ed. 1881.

Sheet Trav'el-er. (*Nautical.*) A grommet punched from sheet metal, adapted to slide on a spar, rope, bowsprit, etc.

Fig. 2251



Sheet Traveler.

Shelf' piece. (*Nautical.*) A strake of plank running internally in a line with the decks to receive the ends of the beams.

Shell. 1. (*Nautical.*) The body of a tackle-block. The groove outside is the *score.* The space occupied by the *shears* is the *swallow.*

2. A metallic or paper cylinder, inclosing a cartridge.

Shell truck	* "*Scientific American Sup.*," 514.

3. A Russian tool for turning insides of hollow projectiles. Fig. 26 accompanying Appendix I., "*Ordnance Report*," 1877, and page 528.

Shell Piece. (*Spectacles.*) One of the shields of tortoise-shell or horn, used with spring eye-glasses which clasp the nose.

Shell Re-du'cer. A device for reducing or expanding a cartridge shell.

The instrument is held in the right hand, open far enough to allow the shell to be entered sideways into its seat, catching the flange under a hook in a top piece and entering the open end of the shell into a die. The handles are then pressed together to reduce the shell at the mouth. By opening the handles the shell will be withdrawn from the die; and as it then may be a little too small it can be brought to the exact size of the bullet by the repetition of the same process, using a plug instead of the die.

Shift'ing Lo-co-mo'tive. A yard locomotive. See SWITCHING LOCOMOTIVE.

Shin'gle Ma-chine'. Burt's 12-Block Rotary Shingle Machine has an iron frame carrying two horizontal circular saws at opposite sides of the iron frame, above which, mounted on rollers and revolving above the saws, is a circular carriage divided by radial ribs or arms into 12 sectors of varying widths. At the inner end of each sector is a dog which advances and retreats in the horizontal plane twice in each revolution; this being effected by belt crank levers and inclined planes. A block being placed in a sector at a point midway between the saws, the dog holds it; and the table, revolving, carries the block to the saw, which cuts a shingle off the bottom; the dog then loosens the block and allows it to drop, again gripping it just in readiness for the next saw. The 12 sectors may all be filled at once, two shingles from each being cut at each revolution (or 24 in all).

The shingles may have any desired taper, and may be either 16 or 18 inches long. The capacity of the machine is stated at 200,000 white pine or cypress shingles per day, 30 horse power driving the machine, drag saw, jointer, bolter, etc.

Shingle cutting machine.	
Trevor & Co.	* "*Scientific American*," xli. 22.
Shingle machine, *Burt* .	* "*Engineer*," xli. 430.
Metallic	* "*Iron Age*," xxii., Sept. 5, p. 5
	* "*Man. & Builder*," xi. 31; xii. 269.
Shingle sawing machine.	
Trevor & Co.	* "*Scientific American*," xli. 22.

Ship. A sea-going vessel; especially a three-masted square-rigged one.

Fairbairn, Wm. "*Treatise on Iron Shipbuilding, its History and Progress.*"

Fincham, J. "*An Outline of Shipbuilding.*" In four parts. Part I. Method of Constructing the Body, and Instructions for Making Calculations; with Examples. — Part II. On the Actual Building of Ships. — Part III. On the Principal Materials used in Ship-Building. — Part IV. A Vocabulary of Terms.

Grantham, J. "*Iron Shipbuilding.*" 5th edition. London, 1868. (Weale's series.)

Marett, P. R. "*Yachts and Yacht Building.*" Being a treatise on the construction of yachts and matters relating to yachting. 2d edition. London, 1872.

Meade, Com. Richard W., U. S. N. "*A Treatise on Naval Architecture and Ship-Building, or an Exposition of the Elementary Principles involved in the Science and Practice of Naval Construction.*" Compiled from various standard authorities. Philadelphia, 1869.

Murray. "*Ship-Building in Iron and Wood,*" by Andrew Murray, and "*Steamships,*" by R. Murray.

Nystrom, N. W. "*On Technological Education and Ship-Building, for Marine Engineers.*"

Nystrom, N. W. "*A Treatise on Parabolical Construction of Ships and other Marine Engineering Subjects.*"

Peake, J. "*Naval Architecture.*" (Weale's series.)

Reed, E. J., C. B. "*Our Iron-Clad Ships; their Qualities, Performances, and Cost. With Chapters on Turret Ships, Iron Clad Rams,*" etc. London, 1869.

Smith, Thomas, M. J. N. A. "*The Hand-Book of Iron Ship Building.*" London, 1869.

Sommerfeldt, H. A. "*Elementary and Practical Principles of the Construction of Ships for Ocean and River Service.*" (Weale's series.)

Ship, arrangement of machinery, in sloops .	* "*Scientific American Sup.*," 900.
A Viking's, "*Architect*"	"*Van Nostr. Mag.*," xxiii. 320.
Cord, self-trimming, Engl.	* "*Scientific American Sup.*," 1157.
Despatch, "Iris," Engl.	"*Scientific American Sup.*," 1728.
"Hussar"	"*Scientific American Sup.*," 493.
"Inflexible" and her armament	* "*Scientific American Sup.*," 122.
"Iris," Engl.	"*Scientific American Sup.*," 1921.
Raising apparatus, "Edith," Br. . . .	* "*Engineer*," xlv. 254.
Railway, *Eads* . . .	"*Scientific American*," xlii. 192.
Keiffer	"*Iron Age*," xxiv., Aug. 14, p. 7.
Flad	* "*Railroad Gazette*," xxiii. 429, 469.
Steel, "Comus" . . .	* "*Scientific American Sup.*," 2841.
Speed indicator.	
Normanville, Engl.	* "*Scientific Amer.*," xxxvii. 259.
Solid timber war- . .	* "*Iron Age*," xxi., Jan. 3. p. 16.
Shipbuilding, Clyde . .	"*Scientific American Sup.*," 951.
Steel (Clyde)	* "*Scientific Amer.*," xxxvi. 85.
London "*Times*" .	"*Scientific American Sup.*," 1144.
Steam, "Vera Cruz"	* "*Scientific American Sup.*," 870.
Ships of the World, merchant	"*Scientific American Sup.*," 1992.
War, of Europe . .	"*Scientific American Sup.*," 1729.
War, report by Chief Engr. King, U. S. N.	1877.
Cellular system for.	
Boolds	* "*Scientific American Sup.*," 362, 363.
Boold, Br.	* "*Engineer*," xli. 246.
Compartment, merchant and navy.	
Thompson, Engl. .	* "*Scientific American Sup.*," 2000.
Japanese war, "Foo-So," "Kong-go" .	* "*Scientific American Sup.*," 1677.
Longitudinal girder and bulkheads.	
De Russett . . .	* "*Engineer*," xli. 311.
Multifold shells.	
Egerton, Br. . . .	"*Engineer*," xli. 265.
Of British Navy, table of data	* "*Engineering*," xxv. 224.
Ship's Lines, *Jackson* .	* "*Sc. American Sup.*," 1231, 1523.
Shipping of the world .	"*Scientific American Sup.*," 1633.

Ship Float. 1. A lighter.

2. The splashers of a paddle-wheel.

* "*Engineering*"	xxiii. 369-371.

Ship Rail'way. A railway composed of several tracks, with a carrying cradle for transporting small coal-laden vessels overland from one body of water to another.

Capt. J. B. Eads's plan of a proposed ship railway across the isthmus of Panama consists essentially of a series of some eight or ten tracks, having a carrying car or cradle consisting of some five sections. These to have 1,000 wheels. Estimating the weight of a large merchant ship and cargo at 10,000 tons, and distributing it over an area of 40 × 500′ would give a pressure on the road-bed of about 1,200 pounds per square foot, cars and all, not half the pressure on the earth under each tie as there is when the driving-wheels of an ordinary locomotive pass over it. A ship railway across this isthmus has been the subject of much discussion, for more than thirty years, in fact.

Eads, "*Scientific American*," xli. 64, 68, 97, 144, 160; xliii. 303.

Ship Scra'per. A triangular or square piece of steel, handled, and with sharpened edges for scraping the keels and decks of vessels. See SCRAPER, "*Mech. Dict.*"

Ship's Tim'ber Saw. A machine for giving the proper lines to ships' timbers. See BEVEL SCROLL SAW, Fig. 669, p. 279, "*Mech. Dict.*," and SAWS, *Ibid.*

Shirt Frame. A Guernsey, or shirt knitting machine.

Shod'dy Ma-chine'. See RAG PICKER.

Shoe Bolt. One with a countersunk head for cutter and sleigh runners.

Shoe Em-boss'ing Ma-chine'. For embossing the vamps of boots. The stamp is heated by steam or lamp, and the boot, which is held on a goose-neck, is forced up against the die by a treadle.

Shoe-ma'ker's Wax. A wax used in making the waxed ends used in sewing leather.

Shoemaker's wax, when made for hand-work, is composed generally of equal quantities of pitch and resin, with 10 per cent. of tallow; after boiling (if good wax), it is pulled until the wax assumes the color of pale resin. The pulling takes out, or, more properly, bleaches, the ingredient pitch, and thereby takes out the coloring all pitch contains. Wax used for machines has all of it too much pitch and tar for clean work; the coloring matter in pitch and tar comes up through the grain; once in it cannot be got out — and wax boiled or heated again, unless in a perfectly clean vessel, and even then, partly recovers the coloring bleached out by hand-pulling. Wax that will work up the pure bronze color so much liked by shoemakers may be made of 4 lbs. resin, 1 lb. pitch, 4 oz. beeswax, 3 oz. tallow — the tallow to be refined, otherwise 3 oz. best sperm oil. The beeswax seems to destroy the coloring matter of the pitch when in that proportion. A good resin wax is superior to any other composition for wear, because it decomposes on exposure and wear into a stony substance in appearance, and looks not unlike pegs of amber when put under the microscope. Wax, with any tar in, or much pitch, when heated continuously, becomes only a dirty discoloring matter, as the oil evaporates, carrying with it all the valuable adhesive or glutinous properties of the pitch, and such wax will most readily soil or discolor the flange of the channel that is laid over it. The above recipe makes a wax which will give satisfaction.

Shoe Pad. A cushion to lessen the shock on a horse's foot.

Shoe Peg'ging Ma-chine'. A machine which takes the pegs in the strip, feeds and cuts them, and pegs on the sole. The preparatory machinery, in getting out the pegs from the log, consists of the slabber, heading machine, boring machine, pointer, splitter, bleacher, fan-blower, steam dryer, polisher, separator, winnower. See PEGGING MACHINE, *supra*.

Shoe Sew'ing. A sewing-machine having a thread-carrying hook in the end of a horn small enough to be inserted inside of the shoe at all points. The hook, acting in conjunction with the needle, sews the sole to the upper with remarkable celerity. See "*Mech. Dict.*," pp. 2162, 2163.

Shoe Sol'ing. Fastening the soles to the uppers by machinery. See "*Mech. Dict.*," pp. 462, 463, and PEGGING, *supra*.

Short'-cheek Bri'dle. A blind bridle having short cheek-pieces with rings at the lower ends, into which the bit-strap is buckled.

Short Cir'cuit. (*Electricity*.) The completion of a circuit by a shorter route or cross-way.

Short'en-ing Knot. (*Nautical*.) A form of knot shown at 40, 41, Fig. 2777, p. 1240, "*Mech. Dict.*"

Short'hair Knife. (*Leather*.) A keen-edged knife used in the beam-house to remove short hairs (new growth) from the hides.

Short Splice. (*Nautical*.) The junction of two ropes intertwining the strands for a relatively short distance. See *i*, Fig. 5435; also *a*, *b*, *c*, Fig. 5434, p. 2279, "*Mech. Dict.*"

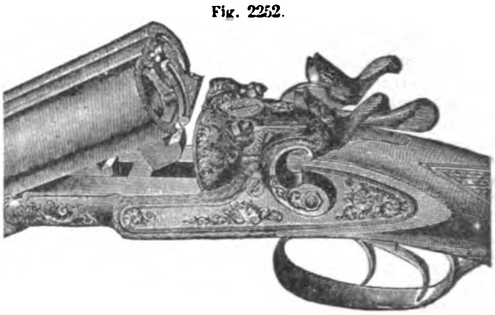
Short Stay. (*Nautical*.) In weighing anchor, it refers to the position of the anchor when nearly under foot in heaving in.

Shot Com-press'or. (*Surgical*.) A forceps to fasten leaden shot upon the ends of a ligature as a substitute for tying. The shot is partially split with a knife, put over the ligature threads close up to the suture, and the shot pinch-closed upon them.

Shot Gun. Fig. 2252 is a breech loading shot gun manufactured at Colt's armory. The parts are interchangeable, and so accurately made that parts of different guns may be intermixed and a gun may be put together from parts taken haphazard. The lock is of the rebounding style, and the firing pins are without springs.

The action bolt which retains the barrel in its place is moved by a lever, back of the hammer, through the medium of internal parts not shown in the engraving. This bolt engages two hooks on the barrels and retains the barrels rigidly in place.

Fig. 2252.



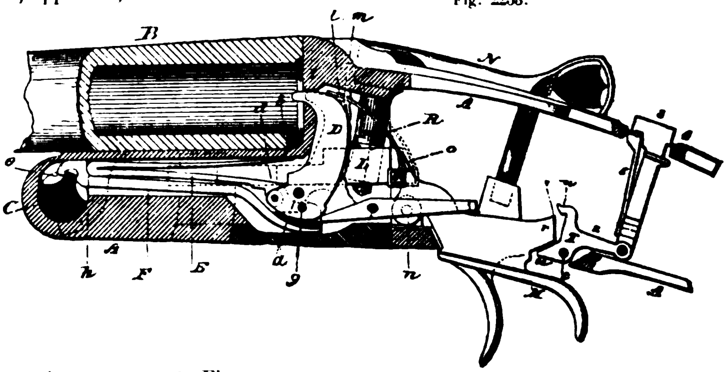
Colt's Breech Loading Shot Gun.

The bolt carrying the shell extractors is engaged by a cam on the bolt, connecting the stock and the barrel, and when the barrel is released by drawing the action bolt and tipped as shown in Fig. 2252, the shell extractor is operated.

Fig. 2253 shows that form of the Colt shot gun, having concealed hammers which are cocked by the *breaking down* of the barrels. The hammers can be locked in this position, to prevent accidents, by a forward motion of the trigger, and released at will by a forward and downward motion of a strp on top of the stock.

The shield or shell-shaped piece formerly placed upon the breech piece of muzzle-loading guns to prevent particles of the cap from being blown into the eye has been entirely dispensed with upon the Colt gun. It was a curious instance of the persistence of a form after its use has entirely departed.

Fig. 2253.



Colt's Concealed Hammer Breech Loader.

Colt . . . . * "*Scientific American*," xlii. 342.

Shot Line. (*Life Saving Apparatus*.) The cord attached to a projectile fired from a piece to fall over a wreck or stranded vessel and thus establish communication between ship and shore.

See pp. 200 and 251, "*Ordnance Report*," 1878, Appendix P.

Braided linen lines, Nos. 3½ to 7, are preferred.

Shroud Knot. (*Nautical.*) A form of knot shown at 48, Fig. 2777, p. 1240, "*Mech. Dict.*"

The shroud knot is a species of splice that, instead of lying smoothly, stands out boldly in an even, well-shaped knot. To make it, unlay the ends of the rope for a couple of feet or so, and then interlace them; then make a single wall-knot with the ends on each part, and finish by laying away and tapering the ends as in a tack-knot.

Shunt. When an electrical current passes by more than one path, that specially intended for its passage is termed the main circuit, while the rest are termed derived circuits.

The effect of introducing derived circuits is to diminish the strength of the current flowing in the main circuit, and when a single derived circuit is applied for this purpose, it receives the technical name of a "shunt."

The law of shunts is as follows: —

The strength of current in any branch of a system of derived circuits, or "multiple arc," as it is termed, varies inversely as the resistance of that branch. Hence by varying the resistance of the shunt we vary the strength of current flowing through the main circuit.

The resistance of the shunt bears a mathematical relation to the current passing in the main circuit, and that by knowing the one the other can be calculated. Thus, in the case of a galvanometer with a variable shunt interposed between its terminals, by observing the deflection of the needle when the shunt is in circuit, we can determine what the deflection would have been without the shunt, by multiplying the reading by a variable factor termed the "multiplying power" of the shunt.

Another fact worthy of notice in connection with this portion of the subject is that by means of a variable shunt the same deflection of the needle of a galvanometer may be reproduced by currents widely differing in strength, and hence all errors due to inequalities in the value of an uncalibrated scale are entirely avoided.

When an electro-magnet situated on a line of telegraph is shunted by a rheostat or "simple shunt," that rheostat tends to become the path by which the extra currents are discharged, and so prolonged is the magnetization, that if the circuit be closed and opened with any degree of rapidity, the armature sticks or remains permanently attracted — a principle which has been employed in double current translation. This retardation is at its maximum when the resistance of the shunt equals that of the electro-magnet. But should the shunt be a second electro-magnet, or, in other words an "electro-magnetic shunt," then the extra current formed in it opposes that formed in the electro-magnet, and both send a current back into the line. The current from the shunt, however, may be so exalted as to neutralize and even overcome that formed in the electro-magnet itself. So that by a properly arranged electro-magnetic shunt, the magnetic retardation in the electro magnet itself may be reduced to a minimum, while a current is sent back into the line immediately after each signal, thus tending to increase the speed at which the line can be worked.

Shunt Box. (*Electricity.*) An English term equivalent to a switch box or board.

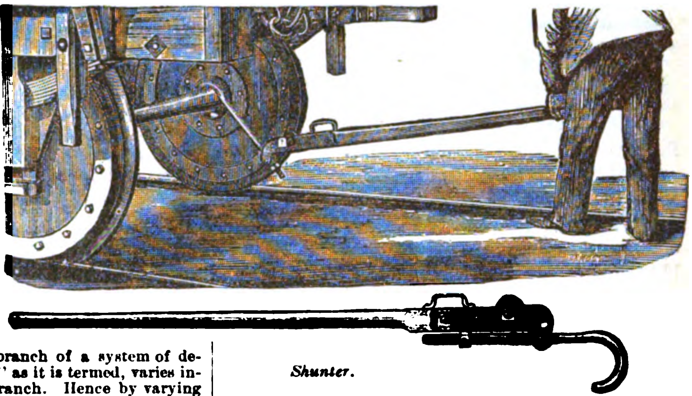
Rymer-Jones . . . * "*Telegraphic Journal*," vii. 128.

Shunt'er. A hand propeller for cars. See Pinch Bar, etc., Fig. 3725, p. 1706, "*Mech. Dict.*"

The illustration, Fig. 2254, will give a general idea of the "Shunter," which is a wooden lever, 6′ long, with a pair of side-plates fixed to it at one end, to which is attached a swivel, through which passes an iron rod, having a hook at one end which hooks over the axle. The other end has a screw with a loose nut, to shorten or lengthen the rod according to the size of wheel; from a saddle which crosses the lever and binds the side plates to the wood, project two lugs, shaped to fit the flange of the wheel. When the shunter is in position with the hook over the axle, the lug comes in contact with the flange of the wheel. Upon raising the lever the lug is pressed against the flange in proportion to the force applied, and becomes fixed; upon continuing to raise the lever, the wheel is caused to revolve in the same direction, and the carriage is propelled forward; upon lowering the lever, it immediately becomes loose, falls again, and the action being continued — every upward movement propels the carriage forward from 9″ to 15″.

To adjust the shunter for working, drop the hook over the axle, and hold out the wooden lever horizontally, then regulate the length of the hook by running the nut forward or back as may be required, so as to bring the projecting lug on the side of saddle about 1″ distant from the edge of the wheel; the length of rod being once adjusted will suit all wheels that do not vary more than 1″ in diameter.

Fig. 2254.



Shunter.

Shunt'ing En'gine. A British term for a yard or switching engine. See one type of such from "*Engineering*," reproduced in "*Scientific American Sup.*," * 4071.

See Switching Engine.

Shunting engine.
London & N. W. Ry., Br. . * "*Engineering*," xxx. 184.

Shut'ter Dam. A dam or gate operated by the water.

Some recent improvements in France of shutter dams, worked by hydraulic pressure, have attracted much attention among engineers, the system comprising — first, a series of great wooden water-gates, movable around a horizontal axis working in a cast-iron shoe secured to the floor of the dam; second, hydraulic presses applied on the down-river side of the floor, solidly anchored in the masonry and designed to work the gates — the piston of each press bearing a cast-iron cross-head working in slides, to which cross-head three rods are attached, for communicating the pressure to a cross-bar fastened in the center of the movable gate; third, a series of copper tubes which puts each press in communication with the generator or reservoir of power destined to transmit water under the pressure of the hydraulic presses; and fourth, hydraulic works built on the abutment of the dam — these comprising a turbine with a vertical axis, a double force pump which receives motion from the turbine, and a reservoir of force. The pumps and the reservoir communicate with each other, and with the presses, by means of three-way cocks, which let the water either into the reservoir or into the presses, or empty it into a discharging tube. The maneuvering of the gates is effected by simply moving these cocks. By putting in communication each press either with the pumps or with the reservoir of power under a sufficient pressure, an ascending motion of the piston is effected, and in consequence the gate rises. By opening the cock into the waste pipe, the water escapes under pressure of the gate, the "*corps de presse*" is emptied, and the gate sinks.

The reservoir force is a regulator of the play of the pumps and also permits the dam to be raised sufficiently, in case of need, to put the turbine in motion.

Shut'ter Eye. An eye for hanging a shutter to, having a projecting flange or support, which is built into the wall.

Shut'tle. A section of a movable dam in the modern system of movable dams. See Watson's Report, Vienna Exposition, vol. iii., "*Civil Engineering.*"

In M. Boule's design the shuttles are placed in tiers, between slight wrought-iron upright supports, 3½' apart, carrying the foot-path, so that the shuttles can be readily removed and replaced. In America shuttles hinged at the bottom, maintained in their places by props, and falling down flat on the apron of the weir when the props are removed, have been introduced.

See BARRAGE DAM.

Shut'tle Race. The inclosure in which the sewing-machine or loom shuttle travels.

Si-cil'i-enne. (*Fabric.*) A silk and wool French goods.

Sick'le Grind'er. A clamp and rest hold the sickle on the grindstone in such a position that all the teeth receive the same bevel.

See Fig. 3248, p. 1493, "*Mech. Dict.*"; Fig. 4205, p. 1898, *Ibid.*

Side Ac'tion. (*Fire-arm.*) One in which the locking fast of the barrel when closed is by a side lever.

Side Bar. A form of spring to give a buggy a sidewise, rolling motion instead of the forward pitching.

Side Bear'ing. Supports which are placed on each side of the center-pins of a car, and intended to prevent too much rolling or rocking motion of the car-body.

Usually there is a plate of iron or steel attached to the body-bolster on each side of the center-pin which is called a *body side-bearing*, and a corresponding plate, block, or roller on the truck-bolster which is called the *truck side-bearing*.

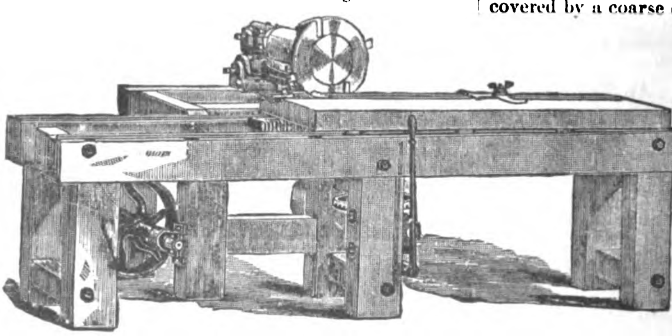
Side Con-dens'ing Lens. A condensing lens, for the illumination of opaque objects, fitting into any of the holes on the stage of a microscope. A pair of stage forceps also fits into the holes to hold small insects.

Side File. For trimming up the outside edges of the cutting points of saws after setting, to prevent setting.

Side-pla'ning Ma-chine'. Designed for planing or jointing the edges of short boards where an accurate glue joint is required, such as cabinet and piano-forte work, and for trying out pieces for small frames, etc. It consists of a long, narrow frame with a self-feeding carriage on which the stuff is fastened by adjustable dogs, and a wing to hold a cutter head.

These machines are usually made to work stuff 5' long, but can be made to work longer when ordered, at an extra cost. The cutter head is adjustable in all directions, has cast steel arbor, and patent self-oiling boxes.

Fig. 2255.



Side-planing Machine.

Si-der-aph'thite. The name of a new iron amalgam which is composed of 63 parts of iron, 23 nickel, 4 tungsten, 5 aluminum, 5 copper. It resists sulphureted hydrogen, is not attacked by vegetable acids, and only slightly by mineral acids. It is really more useful than standard silver, while it can be produced at a cost not exceeding that of German silver. For alloys which have to be silver-plated to prevent oxidation, the inoxidizable iron, as the above is called, is stated to be a perfectly successful substitute.

Fig. 2256.

Side Reflector.

Side Re-flect'or. A means of reflecting parallel rays, mounted so as to bring them to a focus on an opaque object under the microscope.

Si'der-o-stat. An astronomical instrument designed to keep a star within the same portion of the field of a telescope for observation.

An admirable example may be found in Léon Foucault's siderostat in "*L'Astronome Pratique et les Observatoires, en Europe et en Amerique,*" by *André & Rayet.* Paris, 1874.

Side Scut'tle. An opening in the side of a ship, to admit light and air, but which can be closed water-tight. In Fig. 2257 the glass is protected by two dead doors, one inside and one outside.

Fig. 2257.

Side Scuttle.

Sie'mens-Hals'ke Bat'te-ry. (*Electricity.*) A modification of the Daniell battery. In a glass vessel is a spiral copper element in a sulphate of copper solution kept saturated from the crystals contained in a tube through which passes the positive pole. Upon the copper rests a pasteboard disk supporting the diaphragm composed of acidulated paper pulp covered by a coarse cloth. Upon this is placed the zinc element from which the negative pole rises. The vessel is charged by being filled with water.

Prescott's "*Electricity*" . . . * 52.
Sabine's "*Electric Teleg.*" . * 226.
Niaudet, American transl. * 160.

Sie'mens-Mar'tin Steel. (*Metallurgy.*) Steel made by the Martin process; melting cast iron in a Siemens' reverberating furnace, and adding wrought iron until the required attenuation of the carbon is attained. Oxides and free oxygen are removed by ferro-manganese and the metal run into molds. See p. 2365, "*Mech. Dict.*"

"While the Bessemer process has been making rapid strides, a rival process has gradually grown up by its side, which I cannot pass over without remark. I allude to the open-hearth steel process, with which my name and the joint names of Siemens and Martin are associated. The conception of this process is really as old as that of cast steel itself. The ancient Indian steel, the Wootz, was the result of a fusion of a mixture of malleable and cast iron. Reaumur, as already stated, proposed to melt wrought iron and pig metal together, for the production of steel, as early as 1722; and G. B. Heath — to whom we owe the important discovery that by the addition of manganese to cast steel its malleability is greatly increased — endeavored to realize the conception of producing steel in large masses upon the open hearth of the furnace in the year 1839, and he again has been followed in these endeavors by Gentle Brown, Richards, and others in the same direction.

"When, in 1856, I first seriously gave my attention, in conjunction with my brother, Frederick Siemens, to the construction of a regenerative gas furnace, I perceived that this furnace would be admirably adapted to the production of steel upon the open hearth, and proposed it for such a purpose to Mr. Abraham Darby, of Ebbw Vale, in 1861. Ever since that time I have been engaged in the realization of this idea, which has been retarded, however, by those untoward circumstances which ever intervene between a mere conception and its practical realisation. Although two of my earlier licensees, Mr. Charles Attwood, of Tow Law, and the Fourchambault Company, in France, with whom was my late esteemed friend, Mons. Lechatelier, Inspecteur-General des Mines, succeeded, in 1865 and 1866, in producing steel upon the open hearth, they did not persevere sufficiently to attain commercial results; but it was not until after I had established experimental steel works at Birmingham that I was enabled to combat in detail the various difficulties, which at one time looked well-nigh insuperable. While thus engaged, Messrs. Pierre and Emile Martin, of Cereuil, — who had obtained licenses for furnaces to melt steel both in pots and on the open hearth, — succeeded, after a short period of experimenting, in introducing into the market open hearth steel of excellent quality.

"While Messrs. Martin thus gave their attention to the production of steel by the dissolution of wrought iron and steel scrap in a bath of pig metal, my own efforts were more especially directed to the production of steel by the use of pig metal and iron ores, either in the raw state or in a more or less reduced condition, which latter process is the one mostly employed in this country." — *C. W. Siemens.*

Sift'er. An apparatus to dust dry poison upon plants to destroy insects. For instance: —

Young's sifter to destroy cotton worms. See "*Comstock's Report on Cotton Insects,*" 1879, * p. 246.
Willis's sifter, *Ibid.*, * p. 248.
Davis's sifter, *Ibid.*, * p. 249.
Levy's sifter, *Ibid.*, * p. 250.
Eldridge's sifter, *Ibid.*, * p. 251.
Sifting reel for gunpowder, Br., * "*Engineering,*" xxv. 37.

Sight. "*Ordnance Report,*" 1877, Appendix L, Fig. 110, and p. 582, shows and describes the following: —

Werder (Bavarian).	*Vetterlin* (Swiss).
Comblain (Belgian).	*Chassepot* (French).
Mauser (Prussian).	*Werndl* (Austrian).
Berdan (Russian).	*Martini-Henry* (British).

Mauser rifle (Prussian) sight, Figs. 4, 5, 6, article "*Armes à feu,*" vol. iv., *Laboulaye's* "*Dictionnaire des Arts et Manufactures,*" ed. 1877.

There are various names of sights among which are the following; some of them are synonyms, and some merely refer to position, actual or relative.

Aperture sight.	Leaf sight.
Bar and Bead sight.	Muzzle sight.
Bar and slit sight.	Open bead sight.
Beach combination sight.	Open sight.
Bead sight.	Peep sight.
Buck-horn sight.	Pin-ball sight.
California sight.	Plain sight.
Clover-leaf sight.	Rear sight.
Covered sight.	Reflecting sight.
Front sight	Slit bar sight.
Globe sight.	Sporting sight.
Graduating sight.	Telescopic sight.
Hausse.	Vermer-scale sight.
Hind sight.	Wind gage sight.

Fire-arm, *Warfield* . * "*Scientific American,*" xlii. 245.

Sig'moid Cath'e-ter. (*Surgical.*) A catheter named from its resemblance to sigma (*s*). Fig. 1190 *d*, p. 204, "*Mech. Dict.*"

Sig'nal. A means of communicating between distant points by signs having a known meaning.

Captain Maryatt's code was used in England till 1857, when the English board of trade issued "The Commercial Code of Signals for all Nations," which is now in general use for marine signals. It requires 18 flags, 4 flags only to be used at a time, giving 20,000 messages.

The "Telegraphic Dictionary" and "Signal Box," United States code of 1857, had two books of signals, a distinguishing flag being used when the "Telegraphic Dictionary" was used.

In 1859 Costin's plan was adopted. See *Myer's* "*Manual of Signals,*" New York, 1866, for field work, varied information; or methods and codes by color flags, motion of flags, torches, or of lanterns, flashes, occultations, or puffs; semaphonics, rockets, colored lights, and by sound.

Ward's "*Semaphonic Color Signal,*" Philadelphia, 1866. Radical color patches in green, white, and red; read from the center outward across the concentric circles, which inclose numerals and letters.

Ward's "*International Code,*" Auburn, N. Y., 1867. Message indicated by dips of the flag, so many dips representing a given letter, and a code of abbreviations for possible messages.

Ward's "*Code,*" Auburn, N. Y., 1858. System of 10 flags and 3 repeaters, and a code of 11,000 possible messages.

Roger's "*American Code.*" New York, 1854. Ten breeze and calm flags with a dictionary of 60,000 possible messages represented by the number flags.

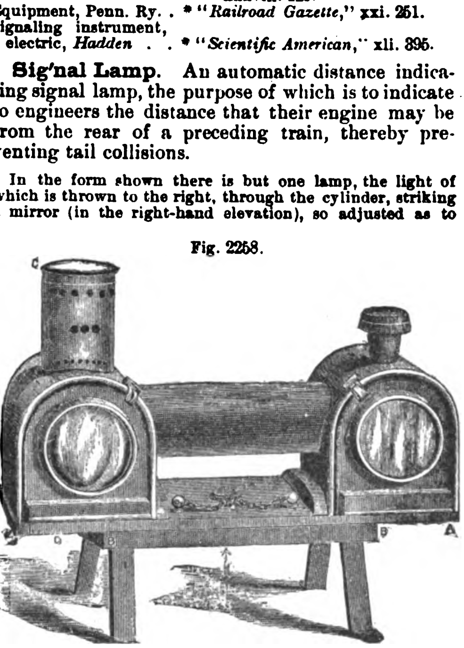
Jink's "*Brachial Telegraph.*" New York, 1852. By arm motions.

Block system, *Whyte* . . "*Van Nostrand's Mag.,*" xv. 89.
Box, district teleg., *Field* * "*Mining and Scientific Press,*" xxxiv. 281.
Buoy, *Courtenay* . . . * "*Scientific American,*" xxxv. 19.
Control appa., railway.
Thompson, Br. . . . * "*Engineering,*" xxx. 171.
Compass, fog, *Hughes* . * "*Mining and Scientific Press,*" xxxviii. 129.
Equipment, Penn. Ry. . * "*Railroad Gazette,*" xxi. 251.
Signaling instrument, electric, *Hadden* . . * "*Scientific American,*" xli. 395.

Sig'nal Lamp. An automatic distance indicating signal lamp, the purpose of which is to indicate to engineers the distance that their engine may be from the rear of a preceding train, thereby preventing tail collisions.

In the form shown there is but one lamp, the light of which is thrown to the right, through the cylinder, striking a mirror (in the right-hand elevation), so adjusted as to

Fig. 2258.



Signal Lamp.

reflect a strong white light, which at a distance of one mile and upward, is absorbed by the red light at the left, but inside of a mile, as the train approaches, the two lights separate, thus at ⅞ of a mile blending together, ¾ of a mile, 3″ apart; ½ mile, 12″ apart, ¼ mile, 20″ apart; and ⅛ mile, 28″ apart; thus enabling the engineer to tell when he is running faster than the preceding train, when he is running slower, when the train stops, or when it commences backing. The different conditions of the atmosphere do not interfere with the relative spaces between the two lights.

Lamp, Penn. Railway	* "*Engineering*," xxiii. 146.
Lantern, marine.	
Wymer, Br.	* "*Engineering*," xxi. 89.
Posts, standard	* "*Railroad Gazette*," xxiii. 631.
Tower, Penn. Railway	* "*Engineering*," xxiii. 143.
Wire compensator, Br.	* "*Engineer*," l. 32.
Great E. Railway, Br.	* "*Engineer*," xlvi. 414.

Sig'nal Lan'tern. For signaling by flashes of light.

Otter's signal lantern with registering apparatus is intended for transmitting signals at night, both at sea and on land, and at distances not exceeding eight to ten miles; the controller is for registering given or received signals, its aim being principally to prevent errors. The system used in telegraphing is the same which has lately been tried and partly adopted in several countries: but the means are different.

Morse's telegraphic lines and dots are represented by long and short flashes; letters and figures, by various groups of flashes. Flashes belonging to the same group are separated by dark intervals of short duration, groups and sentences by dark intervals of longer duration (pauses), the extent of the latter being limited by the skill of the operators.

Two strings are suspended from the lantern and passed through the controller. By pulling the one of these strings long flashes (lines) are produced, and by pulling the other, short flashes (dots).

By pulling a third string, hanging down from the controller, between the two strings from the lantern, a pause will be produced, and the signalized letters or figures are impressed on a self-acting strip of paper.

The strings should be pulled with even force and to their full extent, but without jerking.

Signaling between two or more places is effected in the most convenient and sure manner, by each receiver of a signal repeating on his lantern and controller the signs conveyed. The communication is thereby printed on the above mentioned strip of paper, without it being necessary for the receiver to understand the telegraphic characters.

The lantern may also be employed independently of the controller in transmitting signals and vice versa, the controller used independently of the lantern in receiving signals. In the latter case, three keys, attached to the upper part of the controller should be used instead of the corresponding strings.

A suitable weight attached to the block under the lantern brings into action a proposed new method of distinguishing lights from each other, rendered necessary by their increasing number. It is proposed that each light, on the principle of the above signals, shall describe its name every alternate or every third minute, by combinations of long and short flashes; for the exact reading of which a simple and easily worked apparatus is annexed.

These lights may be either revolving or fixed. In the former case the flashes will be produced by lenses, in the latter by Venetian blinds.

Sig'nal-ing Tar'get. A form used at railroad crossings and switches to indicate to the engineer which train has the right of way, or whether the main track or switch is open.

Two targets, generally a round and an oblong one, and generally painted red and white respectively, are set at right angles to each other on a revolving shaft. These are turned by the target-man by means of a hand-lever, so as to bring either one in a line across the road, in view of the engineer, and indicate to him whether the main track or a switch is open. At night a red or white light on the shaft gives the same information.

A common form at ordinary switches is an upright pivoted lever with target on top. The movement to the right or left indicates the position of the switches.

Sil'i-cate Board. An incombustible board for roofing. Saturate alternate layers of pasteboard with silicate of soda, and with a solution of chloride of barium or other salts, which produce insoluble silicates, such as salts of zinc, calcium, magnesium, and aluminium. The mass of the board becomes saturated with insoluble silicate of barium and silicic acid, which renders it fire and weather proof.

Sil'i-cate Cot'ton. A name for *slag wool.* See SLAG WOOL, "*Mech. Dict.*," p. 2198, and MINERAL COTTON, p. 1446.

Krupp, Essen . . . . . . "*Engineering*," xxi. 19.

Sil'i-con Steel. A steel in which silicon replaces a part of the usual carbon. For instance: —

Nes Patent, 102,068, Feb. 1871.

Carbon	0.600
Silicon	0.552
Iron	98.848

He claims a steel in which the proportion of silicon to carbon is not less than 1 to 2.

See also his patents: —

104,873,	108,287,	109,752,
123,191,	125,212,	145,005.

His silicon is a mica-schist magnetite containing from 30 to 40 per cent. of magnetic oxide of iron. The process of manufacture of steel consists simply in mingling the pulverized ore with molten cast or pig iron, and by oxidation reducing the percentage of carbon until it reaches the standard of low steel. The ore used is from York county, Pa. Views as to the value of this process differ widely, though it seems undeniable that rails made by it last longer than iron, and can be rerolled.

"*Iron Age*"	xxiv., Dec. 25, p. 3.
"*Van Nostrand's Eng. Mag.*"	xvii. 282.
"*Eng. and Min. Journ.*"	xxvi. 416; xxx. 251, 265.
"*Am. Manuf. and Iron World*"	xxiv., Feb. 28, p. 8; xxvi., Jan. 30, p. 8.
On, *Pourcel*, Fr.	"*Van Nostrand's Mag.*," xix. 560.

Silk. A fiber, the product of the silk worm.

The silk industry of America is growing to very satisfactory proportions, over 40 per cent. of the silk goods used in the country in 1882 being home made. There were some $40,000,000 worth manufactured, as follows: machine twist, $7,000,000; dress goods, $5,000,000; satins, $1,500,000; ribbons, $7,000,000; handkerchiefs, $5,000,000; fringes and dress trimmings, $6,000,000; sewing silk, $1,500,000; ties and scarfs, $1,000,000; tassels and millinery silks, $2,000,000; balance in upholstery and other trimmings. Of this amount nearly one half was manufactured in New Jersey, while Connecticut, Massachusetts, New York, and Pennsylvania produced three fourths of the remainder. The number of establishments manufacturing was about 400, employing nearly 9,000 looms, 6,000 spindles, and paying in wages, $10,000,000. Our manufactories import $10,000,000 to $13,000,000 worth of raw silk annually, and the duty on silk goods amounted in 1880 to $32,000,000, against $45,000,000 for woolen goods, and $51,000,000 for iron and steel. The production of the raw silk at home is increasing very rapidly, however, and we hope to see sufficient raised in the United States in a few years to supply the home demand. The southern States and many northern States are well adapted to the rearing of the silk worm and its food, the white mulberry tree; while a number of parties like Virion Des Lauriers, of New York, and the Women's Silk Association, of Philadelphia, are sending silk worm eggs and mulberry trees to all parts of the country, and buying the cocoons produced. The care of a few silk worms for a month in the spring is both interesting and profitable work, and can be managed exclusively by women and children.

Silk and silk culture in the United States, see *Hayes'* "*Centennial Report*," v. 92-111.

Silk culture, book on. Virion des Lauriers, 201 East 63d street, New York.

See "*Mech. Dict.*," pp. 2179-2182.

A long account of production and manufacture in *Laboulaye's* "*Dict. des Arts et Manufact.*," tome iii., article "*Soie.*"

Culture in Alabama	"*Scientific Amer.*," xxxviii. 391.
Finishing machines.	
Buffand, Lyons	* "*Engineering*," xxvi. 196.
Buffand, Fr.	* "*Scientific American Sup.*," 2369.
Industry of N. Italy	"*Scientific American Sup.*," 2662.
Europe	* "*Scientific American Sup.*," 1671.
Man. in United States	*Wycoff*, 10th "*U. S. Census.*"
Manufacture of sewing	"*Scientific American*," xl. 100.
Manufacture, American	"*Scientific American Sup.*," 3354.
Production	* "*Scientific American Sup.*," 1480.
Reeling, etc	* "*Scientific American Sup.*," 4779.
Silkworm eggs, electricity in hatching	* "*Scientific American*," xxxiv. 271.
Silk worm, treatment of	* "*Sc. American Sup.*," 2773, 2779.

Silk De-gum'ming Ma-chine'. A machine for treating the cocoons to deprive the filaments of their glutinous qualities, which, as first spun by the worms, cause the thread to adhere too closely.

The thread of silk as it unwinds from the cocoon is valueless for manufacturing purposes, several of them combined going to make the staple of commerce. The degumming in the silk districts is accomplished as follows: The cocoons are plunged into water near the boiling point, and moved about so that the gum which fastens the threads becomes uniformly and thoroughly softened. They are then beaten with a small birchen broom, having the tips split, so that the loose threads readily fasten to them. After beating a short time, the operator gets all the cocoons fastened, and taking the bundle of threads, shakes the cocoons till each hangs but by a single one. She now takes up five or more threads (*brins*) according to the quality of silk wanted, unites them, and introduces the combined staple or strand (*fil*) into a little glass eye on one side of the basin. She then forms a second similar strand and introduces it into a second eye on the other side. The strands are then brought together, twisted several times, separated above the twist, and introduced into two other glass eyes or ringlets, through which they are led, one to each end of the reel or *tambour* which is kept revolving in a steady, rapid manner, and to which is also given a certain back and forth side motion. The great object in reeling is to get the threads uniform, rounded, well joined, properly freed from moisture, and so crossed on the reel that they will not stick or glaze, as it is termed. These objects are attained by the twisting and the to and fro lateral movement of the reel, as also by properly regulating the distance between reel and basin.

The uniformity of the thread depends on the skill of the operator, who must supply a new thread as soon as one begins to give out. This is called nourishing the silk, and is done by dexterously casting, with the thumb, the new thread upon the combined strand, to which it immediately adheres. In this she must use much judgment, for the silk of a cocoon gradually gets lighter and finer as it approaches the end, and the uniformity of strand does not entirely depend on the uniformity in number of the individual threads forming it. Whenever the silk rises in locks the temperature of the water is known to be too hot, and when it unwinds with difficulty the temperature is, on the contrary, too low. The operator is supplied with a skimmer with which to remove all chrysalides and refuse silk; also, with a basin of cold water in which to cool her fingers, which are being constantly dipped in the hot basin. This constitutes the whole operation of unwinding; but before the skeins, as they come from the reel, are ready for the manufacturer they must undergo still farther manipulation. The staple is first passed through a cleanser, consisting of a clasp lined with cloth, which catches any loose silk or other matter that may be adhering to it. It is then further cleansed and purged by being passed through four similar cleansers (*purgeurs*), then twisted about 500 times to the yard, then doubled and twisted about 400 times to the yard. It is finally run on reels about 1½′ in diameter, and taken off and twisted in a peculiar knot or hank. Through all these operations the oscillating to and fro lateral motion is kept up, so as to produce the diagonal crossing of the strands, and it will be readily understood that each staple is, in the end, composed of 10 or more of the simple threads first spun by the worm.

Silk Ma-chin'er-y. Danforth Locomotive and Manufacturing Co. (Paterson, N. J.) use —

1. Winding frame for singles.
2. Silk spinning frame for singles; the spindles making 8,000 revolutions per minute.
3. Doubling frame in which the twisted singles are laid together on spools.
4. Reeling mill for spinning doubles; the spindles making 4,500 revolutions.

The size of the thread is according to the number doubled together, for the term is used whether 3 or 20 may be so laid up. Organzine may be two-thread doubles; tram may be 3 to 6 thread, or more. Spindle stop patent, March 24, 1876.

Nonotuck Silk Co.'s (Florence, Mass.) machinery for throwing and finishing spool silk consists of

1. Frame for winding on to spools from the imported skeins of raw silk. Machine has a glass eye for the singles to pass through. Hill's patent.
2. For doubling several threads (from 3 to 20) together as required to obtain the required thickness. This machine has Dimock's patent detachable drop-wire to stop the winding on that particular spool if either of the individual strands should break.
3. For spinning, or twisting the threads together; the machine having a self-oiling spindle.
4. A machine for doubling several of these spun strands together.
5. For spinning these doubled threads, forming a finished cord.
6. For reeling into hanks.
7. Dyeing follows.
8. A soft silk winding frame with Brown's patent rocking or oscillating motion to the top skein carrier to facilitate the work.

A Spool Printer and Spooling Machine, which see.

Silk Man'u-fac'ture. See manufacture of spun silk by Cheney Bros., South Manchester. *Hayes' "Centennial Reports,"* v. 100–102.

Of Paterson, N. J., *Ibid.*, 102-106.
Of Horstman, Phila., *Ibid.*, 107.
In U. S., Wycoff, 10th Census Report.

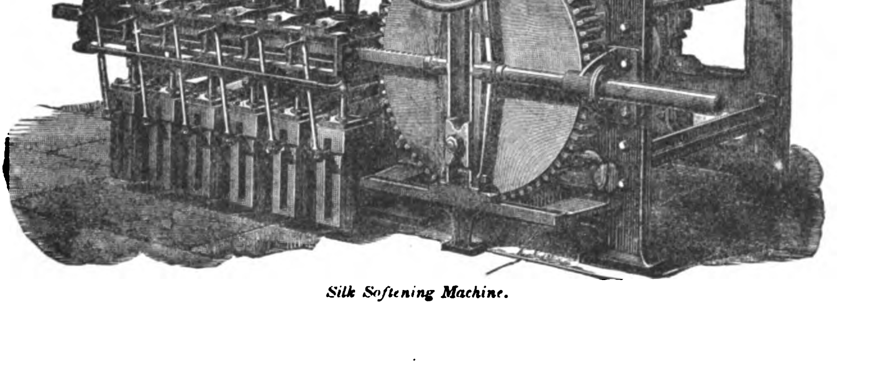
Silk Reel. A reel for winding the silk as it comes from the cocoons in the degumming process. The silk is passed through glass eyes, and through a guide having a transverse back-and-forth motion.

Silk, Sew'ing. See manufacture of sewing silks and machine twist, Nonotuck Co., Florence, Mass., and Danforth Manufacturing Co., Paterson, N. J., *Hayes "Centennial Reports,"* v., 98–100.

Silk Soft'en-ing Ma-chine'. A machine for softening and polishing silk after dyeing.

The skeins of silk are hung over two tiers of bobbins, the lower set free to move up and down, and are stretched by weights hung from the lower bobbins. This tier also moves faster than the upper ones, and has a reciprocating motion, horizontally, to twist and untwist the silk while revolving. See Fig. 2259.

Fig. 2259.



Silk Softening Machine.

Silk Sol′vent. For dissolving silk fiber to be mixed with wool, cotton, or linen fiber for imitation silk goods.

Schlossberger first suggested the use of an ammoniacal solution of protoxide of nickel for dissolving silk. Persoz proposed to use chloride of zinc, and Spiller used concentrated hydrochloric acid. J. Loewe recently described a new solvent, the cold alkaline solution of copper with glycerine, which is not inferior to the above, and with great dilution surpasses them. In very weak solutions, the silk is acted upon slowly; if moderately concentrated, the silk swells up on moistening it a short time; and with a larger quantity it soon dissolves to a thick liquid, which can be filtered, although it filters slowly. By adding hydrochloric acid to the filtrate, the dissolved silk separates in the form of a white jelly; frequently this separation is very slow, and the filtrate appears like a cold solution of gelatine. Wool, cotton, and linen, after being in contact with this solution for hours, is neither attacked by it nor taken up by it. It appears as if the solvent power of the alkaline glycerine and copper solution only extends to the silk. In mixed fabrics, the silk may be readily detected, and even quantitatively determined.

Silk Spin′ner. A machine for spinning and twisting singles for organzine. It has self-oiling spindles and steps. The latter are winged pieces which rest in cups, the wings preventing the vertical motion of the oil which might cause it to flow over the edge of the cup. A cover closes in the oil chamber and excludes dust. The spindles revolve 7,200 times per minute.

Silk Spool′ing Ma-chine′. A machine for winding silk on to merchant spools. See SPOOLING MACHINE; SILK SPOOLING AND MEASURING MACHINE.

Silk Spool′ing and Meas′ur-ing Ma-chine′. A machine for measuring on to bobbins the exact quantity of sewing or machine silk thread; say 100 or 200 yards, or other prescribed quantity.

The one used by Holland Manufacturing Company of Willimantic, Connecticut, has a finger which rotates on a dial-plate, moved by contact of an impelling roller which rotates in contact with the spool.

John D. Cutler & Co.'s (Paterson, N. J.) machine for spooling and measuring silk thread (Patent, March 3, 1874) has a friction wheel of determinate diameter resting against the thread, and communicates motion by worm-wheel to a train which actuates a printer on a graduated dial-plate.

Silk Stretch′ing. A machine for stretching and polishing after dyeing. See SILK SOFTENING MACHINE and Fig. 2259.

Silk Test′ing Ma-chine′. A spring balance has a bar graduated to a scale of weights for the purpose of testing the strength of the thread or filament. The thread is looped over the hook on the end of the spring-bar, and the ends being twisted around the finger, the thread is broken, a spring-catch detaining the bar so that the point at which it broke may be observed at leisure.

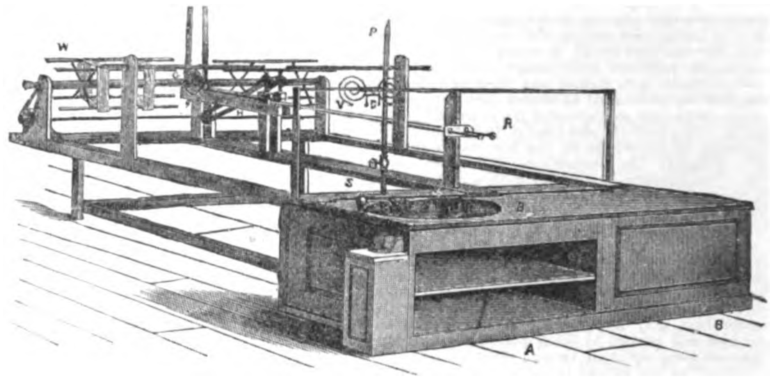
Silk Thread. Sewing-silk is two-cord and twisted from left to right, and machine-twist is three-cord and twisted from right to left.

Silk Wash′ing Ma-chine′. One in which the cocoons are passed to rid them of dirt, worms, glutinous and other refuse matter. See DEGLUTINIZING MACHINE above.

Silk Wind′er. For reeling the silk from the cocoons.

This apparatus, shown in perspective in the accompanying illustration, is double. Each half consists simply of a metal lined basin, *B*, supplied by a faucet, *S*, with cold water, heated to such temperature as may be desired, by steam from the pipe *P*. Immediately above and back of the basin is a transverse bar, *H*, which bears projecting horizontally from it, two stems carrying the *filières F*, which are porcelain disks half an inch in diameter, and each pierced in its center with a small vertical hole. The horizontal bar has a slight traversing motion. Above and across the machine is a transverse bar carrying the *croiseur* or *twister C*, which is a tiny reel with a vertical axis, and set in motion at will, by a train of clock-work. At each side of the *croiseur* is a *trembleur* or vibrator, *V*, which is a spiral spring bearing at its free end a loop fitted with a heart-shaped glass plate. Midway of the machine rise standards which bear a reciprocating cross-bar, fitted with a triangle of wire, apex downward. At the back of the machine are standards bearing a reel operated by a crank or by power, the belt being thrown into

Fig. 2260.



Silk Winder.

operation by a clutch actuated by the rod *R*. The cocoons (containing the dead chrysalides) being placed in a basin of hot water, are softened and rendered more easy to unravel. The free or outer ends of the cocoons are gathered by beating the floating mass gently with a stiff brush of twigs. Two sets of six each of these being selected, are passed upwards through the holes in the porcelain *filières F*, are crossed, passed through the loops on the *croiseur*, through the niche in the glass bushing in the vibrators, then through loops in the triangle, and then to the reel. The machine being then set in operation by the hand crank or by the belts, the delicate threads are unwound from the bobbing cocoons, brought together, intimately twisted, and wound on the reel, which is seen to contain two hanks of the twisted thread.

Silk′worm Nur′se-ry. A frame is made with light square vertical posts connected by horizontal parallel bamboo rods. The rods are placed at suitable distances to support a series of flat trays made of rice straw, in which the silkworms are reared.

Sil′ver. Equivalent 108, symbol Ag. (argentum), specific gravity 10.5, point of fusion, 1873° Fah. Generally occurs as a sulphide, and is often associated with other metals. The ore is ground and the silver separated by amalgamation. "*Mech. Dict.*"

Alloy	"*Scientific American*," xli. 103.
Silvering glass, *Draper* .	"*Scientific American Sup.*," 1670.
Siemens	"*Scientific American Sup.*," 1670.
Petitjean	"*Scientific American Sup.*," 1670.
Laval	"*Scientific American Sup.*," 1670.
Silvering iron	"*Scientific American*," xxxiv. 276.
Ware	"*Sc. Amer.*," xxxvi. 287, 291, 292.

See "*Mech. Dict.*," 982, 983, 2182–2185, and 406 *supra*.

Silver mill, *Boss* . . .	* "*Scientific American Sup.*," 2464.
Cerro de Pasco . . .	* "*Eng. & Min. Jour.*," xxvi. 436.
Silver plate works.	
Reed & Barton . . .	* "*Scientific American*," xli. 287.
Silver smelting processes.	Painter's "*Report Vienna Exp.*,"
Andreasberg . . .	iv. 115.

Pilram, 163, *Augustin* .	*Painter's "Report Vienna Exp.,"* iv. 134.
Schemnitz, 179, Silesian	*Painter's "Report Vienna Exp.,"* iv. 136.
Soldering	*"Scientific American Sup.,"* 1302.
Imitation	* *"Scientific American,"* xxxiv. 368.

Sil'ver Al-loy'. 65 parts of iron and 4 parts of tungsten are melted together and granulated; also 23 parts of nickel, 5 of aluminum, and 5 of copper, in a separate crucible, to which is added a piece of sodium in order to prevent oxidation. The two granulated alloys are then melted together. Both alloys resist the action of sulphuretted hydrogen.

See also *"Scientific American,"* xli. 103.

Sil'ver Glass. An ornamental ground and cut glass. This glass can be used in the place of plaster, marble floors, or wood inlaid work.

Patented February 2, 1875, *Jones*.

Sil'ver-ing. The formula for *silvering by dipping* is as follows: —

Dissolve 20 grams of silver in 60 grams of nitric acid, and precipitate with a solution of 20 grams of caustic potash in water upon a filter, and wash with water; then redissolve upon the filter with a solution of 100 grams of cyanide of potassium in water; then dilute the whole to 2 liters with distilled water, and use like the gilding solution described in Gilding by Dipping, under GILDING, p. 398, *supra*.

Silvering by Cold Rubbing. — Make paste by thoroughly grinding in a porcelain mortar, out of the light —

	Water	3 to 5 oz.
	Chloride of silver	7 oz.
	Potassium oxalate	10½ oz.
	Salt (common table)	15 oz.
	Sal ammoniac	3¾ oz.
Or,	Chloride of silver	3½ oz.
	Cream of tartar	7 oz.
	Salt (common)	10½ oz.
	Water, to form a paste.	

Keep in a covered vessel away from the light. Apply with a cork or brush to the clean metallic (copper) surface, and allow the paste to dry. When rinsed in cold water the silver presents a fine frosted appearance, the brightness of which may be increased by a few seconds' immersion in dilute sulphuric acid or solution of potassium cyanide. The silvering bears the action of the wire brush and of the burnishing tool very well, and may also be "oxidized." Should a first silvering not be found sufficiently durable after scratch-brushing, a second or third coat may be applied. This silvering is not so adhering on white or pure copper as upon a gilt surface.

For the reflector of lanterns the paste is rubbed upon the reflector with a fine linen pad; then, with another rag, a thin paste of Spanish white or similar substance is spread over the reflector and left to dry. Rubbing with a fine clean linen rag restores the luster and whiteness of the silvered surface.

The paste is sometimes mixed directly with the whiting and left to dry, or until nearly dry, then rubbed down as described.

Sil'ver-ing Glass. Prepare two solutions, says the *"Jeweler and Silversmith"*: —

1. Argentic nitrate is dissolved in distilled water and ammonia added to the solution, till the precipitate first thrown down is almost entirely redissolved. The solution is filtered and diluted so that 100 cc. contain one gram of argentic nitrate. 2. Two grams of argentic nitrate are dissolved in a little distilled water and poured into a liter of boiling distilled water; 1.66 grams of Rochelle salt is added and the mixture boiled for a short time, till the precipitate contained in it becomes gray; it is then filtered hot.

The glass having been thoroughly cleaned with (1) nitric acid, (2) water, (3) caustic potash, (4) water, (5) alcohol, and lastly, distilled water, is to be placed in a clean glass or porcelain vessel, the side to be silvered being placed uppermost. Equal quantities of the two solutions are then to be mixed and poured in, so as to cover the glass. This should be done while the glass is still wet with distilled water. In about an hour the silvering will be completed. Then pour off the exhausted liquid, carefully remove the glass, wash in clean water, rub off silver deposited where not required, allow to dry and varnish silver side with any thin varnish which does not contract much in drying. The time required for the operation depends on the temperature. If the solution be warmed to about 30° C., the silver is deposited in a few minutes, but it is safer to use them cold. The insides of test-tubes, bulbs, etc., are silvered by putting the solutions into them, no second vessel being then required. Throughout the whole operation the most scrupulous cleanliness is the grand essential.

Furnace, *Stetefeldt* . .	* *"Min. & Sc. Press,"* xxxiv. 349.
Silvering glass	*"Scientific American Sup.,"* 1928.
Laval	*"Scientific American Sup.,"* 921.
Ivory	*"Man. and Builder,"* xii. 167.

Sil'ver-ing Mir'rors. Some time since the Academie des Sciences offered a prize of 2,500 f. for a method of satisfactorily and permanently silvering mirrors, and which should save the workman the danger of exposure to the effect of mercurial vapors. The prize has been awarded to M. Lenoir, whose process is substantially as follows: —

The glass is first silvered by means of tartaric acid and ammoniacal nitrate of silver, and then exposed to the action of a weak solution of double cyanide of mercury and potassium. When the mercurial solution has spread uniformly over the surface, fine zinc dust is powdered over it which promptly reduces the quicksilver and permits it to form a white and brilliant silver amalgam, adhering strongly to the glass, and which is affirmed to be free from the yellowish tint of ordinary silvered glass, and not easily affected by sulphurous emanations.

Silvering mirrors . . *"Scientific Amer.,"* xli. 232; xliii. 73.

Sil'ver Pro'cess. The plan of Paul's dry-process mill, for working gold and silver ores, is —

1. The calcining furnace; 2, the self-feeder; 3, the stamp battery; 4, dust casing; 5, elevators (these are not used when the ground admits of the battery being set on a level with the pulverizing barrel; 7, hopper for pulverized ore; 8, amalgamating barrel; 9, hopper for conveying ore to the settler; 10, first settler; 11, amalgam safe; 12, hydrostatic settler; 13, concentrator.

The ore is reduced to powder by attrition of quartz, and the amalgamation is speedy. Ore is passed into self-feeders, and that is the last of the handling. The gold contained in it will be found in the amalgam safe, all ready for retorting. The machinery is ingeniously constructed, and works effectively. It is rendered perfectly automatic, so that, from the moment the quartz is put into the feeder until the gold comes from the machine in the shape of amalgam, the stuff is not handled. Only two men are necessary to run a 10-ton mill.

Sil'ver Steel. (*Metallurgy.*) A steel of fine quality with a slight alloy of silver.

Sil'ver Ware. Table ware made from or coated with silver. See CHASING; REPOUSSÉ; SNARLING; GILDING, etc. *"Mech. Dict."*

Silver ware . * *"Scientific American,"* xxxvi. 287, 291, 292.

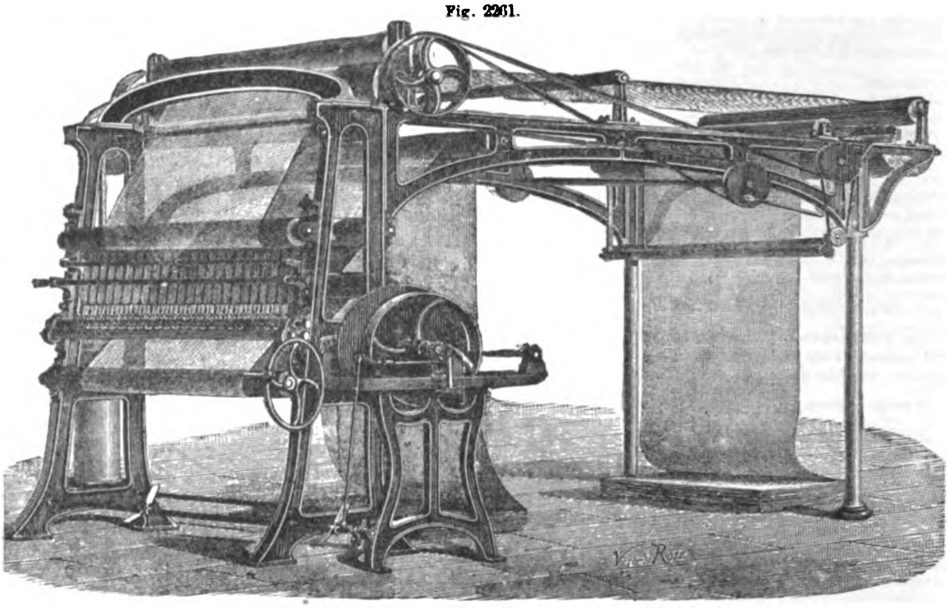
Singe'ing Ma-chine'. A gas singeing machine intended for removing or dressing the nap on woven goods.

In Fig. 2261, the workman has the work directly under his notice, and can vary at any time the intensity of the flame, or the speed at which the cloth is traveling.

The burners are so arranged that the application of compressed air takes place at the moment of the combustion of the gas, and by varying the pressure of the air all the different degrees of heat can be obtained, and thick and thin fabrics singed with equal facility. The upper part of the burner is open along its whole length, and cocks and other means are provided for regulating the line of flame, so as to make it perfectly even, or to reserve, if required, certain parts of the surface of the cloth from the action of the flame. The position of the line of flame can also be varied according to the effect which is required. Thus the flame applied directly under the roller singes the cloth thoroughly, and, it is said, brings out the grain, as is necessary in merinos, cashmeres, etc.; but in the case of delicate tissues, where it is necessary simply to dress the cloth lightly as with a shearing machine, the line of the flame is placed tangentially to the roller, and only takes off the projecting fibers.

The workman can, by means of a treadle, instantly stop the feed of the cloth, and at the same time reverse the line of flame so as to suspend its action; thus fringed shawls can be singed and accidents easily avoided.

Fig. 2261.



Gas Singeing Machine.

This system produces no smoke or soot, so that the most delicate tissues can be singed without altering the color, and after bleaching, dyeing, or printing, without changing the shade.

The mixture of compressed air and gas is effected, so as to produce great economy in gas, and at the same time a great intensity of flame. The intensity of the flame is increased by augmenting the pressure of the air without varying at all the quantity of gas, which latter only becomes then more perfectly consumed.

The general arrangement of the machine with a single flame, as usually made, is clearly shown in the above drawing, but machines are also arranged, when desired, with two or four flames so as to singe both sides of the stuff at one passage.

Sin'gle Coil Spring. One made of a single spring wire, coiled upon itself, with same diameter throughout.

Sin'gle Flu'id Bat'ter-y. (*Electricity.*) A term used for the battery with but a single fluid, in the double fluid battery invented by Daniell. See p. 2187, "*Mech. Dict.,*"

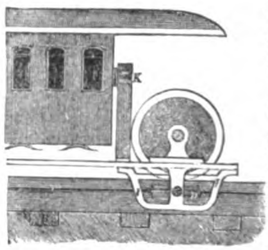
Air as a depolarizer in a single fluid cell is found in
Pulvermacher's . . * "*Telegraphic Journal,*" vi. 388.
"*Engineer,*" * xlvi. 143.
"*Scientific Amer. Sup.,*" 2213, 2247.
Pulvermacher, Fr. * "*Engineer,*" xlvi. 143.

Sin'gle Plate Wheel. (*Railway.*) A car wheel which has a single plate between the hub and the rim. The plate or disk is sometimes flat, or ribbed on one side, or corrugated.

Sin'gle-rail Rail'way. One in which the cars are supported and run on a single rail, and are braced or steadied by side-rails.

Figs. 2262, 2263 show the details of construction of a new and improved car for single-rail railways, invented by David B. James, of Visalia, Cal. The invention consists of one line of broad-faced wheels in the center to carry the load, and guide wheels to run each side of the rail on vertical axles projecting down from the car, these wheels being to keep the carrying wheels on the track and to prevent the cars from overturning, for which they are contrived to gripe the rail with more or less force The wheels are connected with a platform which is carried only enough higher than the rail to clear it properly, and the car is mounted on pivots arranged in the line of the wheels, and supported on the platform so that the load is balanced on the wheels, and the center of gravity is lowered as much as possible to prevent overturning. The guide wheels running against the sides of the rails are contrived to move forward and from the rail, and provided with springs to keep them in contact. In the locomotive they may be geared with the power and have a lever contrivance for gripping the rail tightly for traction on steep grades.

Fig. 2262.

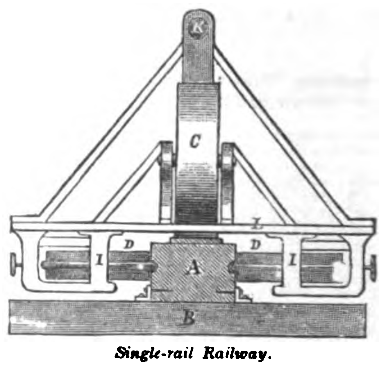


Single-rail Railway.

Fig. 2262 of the engravings is a longitudinal section elevation of the improved railway car, showing the guide wheels, ridged and running in a groove in the stringer. Fig. 2263 is a horizontal section, giving an end view of the car and track, stringer and ties, with side wheels, the ridges in which fit into the groove in the stringer.

In the engraving, *A* is the single rail, of wood, which may be of a single timber, or it may be shod on top with another, to be removed from time to time when worn, the removable one being, say from 2″ to 3″ thick. *B* represents the ties, which may be of any suitable kind. *C* represents the

Fig. 2263.



Single-rail Railway.

carrying wheels of the car; *D*, the wheels for guiding it, and preventing it from overturning, the latter wheels being mounted on vertical axles *F*, projecting down from the car body or supports, *I*, so that the wheels run against the edges of the rail, while the wheels *C* run on top. The axles *F* are mounted in bearings *G*, which are movable toward and from the rail, and have springs to press them against it, by which they are accommodated to variations in thickness of the rail, and allow the car to turn curves readily, without requiring the wheels *C* to be mounted on a pivot or fifth-wheel.

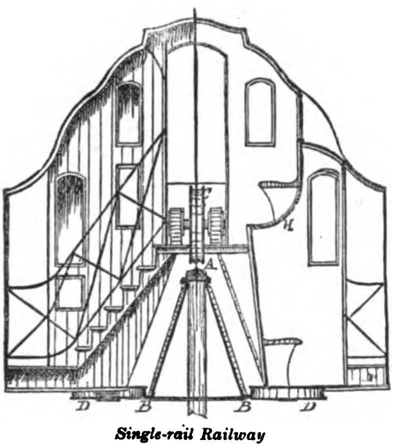
The car body *J* is mounted on the pivots *K*, supported on the platform *L*, which is suspended from the axles of the wheels *C*, the said pivots being arranged in the longitudinal plane of the wheels *C*, so the center of gravity of the load remains more on the wheels than it otherwise would, and the car is more certain of keeping erect in case the load is not trimmed nicely, or the car is jarred or otherwise forced laterally. But to prevent the car from rocking too much on the pivots, and also to prevent it from striking too hard on the platform in case it does rock, buffer springs *M* are attached to the under side of the car body, so as to strike the platform, or they may be applied so that the body may strike against them.

The platform will always run level on account of using only one rail and employing the guide wheels to direct the car, which avoids the necessity of tilting the car as on the curves of the roads of two rails, and thus the difficulty of carrying the cars upright on a single track is greatly diminished.

If considered necessary, the carrying wheels may be banded with rubber to prevent wear of the wood rails, and for running smoothly, but it is believed that the broad surfaces will wear so little as not to need it. By gearing the guide wheels of the locomotives with the driving wheels, and employing levers to cause them to gripe the rails, very steep grades may be ascended. Very abrupt curves can easily be overcome by means of this system, as well as steep grades. The engineering difficulties of a line in a mountainous country could therefore be overcome by it, as a narrow-gauge road overcomes the difficulties of a broad-gauge under such circumstances. The stringer is fastened to the ties with iron knees.

Figs. 2264, 2265 show a road that consists of a single bearing-rail, *A*, of the common T rail pattern laid upon a wooden stringpiece of about 4 × 8 timber, which rests upon the top of a row of posts, or piers, and is flanked by a pair of side rails, *B B*, which are dropped some 4′ 5″ below the level of the bearing rail *A*, and are 3′ 4″ from out to out. A system

Fig. 2264.



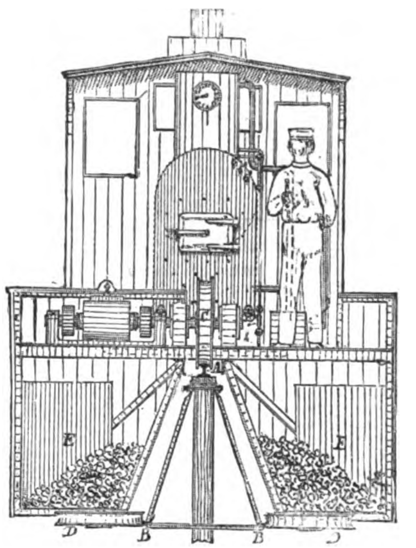
Single-rail Railway

of cross bracing from the main rail *A* to each of the side rails, supplemented by a similar set of braces between the rails *B B*, gives the whole the character of a triangular truss, of great strength.

The locomotive used on this road, of which Fig, 2265 is a rear view with casing removed, runs upon two driving-wheels shown at *C C*, of 28″ diameter; the boiler, of the style known as "locomotive," 12′ long and 34″ in diameter, with 4½′ fire-box, is dropped as low to the bearing-rail *A* as practicable. The frame of the locomotive is made of angle iron, and drops to the level of the side rails *B B* on either side, carrying on each side two guide-wheels *D D*, of 28″ diameter, which run upon vertical axes. Both the driving-wheels *C C* and guide-wheels *D D* are grooved, or, properly speaking, double-flanged, making it impossible for the locomotive to be taken off the track by any accident that does not first actually take the wheels off, and then lift the machine bodily nearly 5′, throwing sideways withal. The total length of the engine is only about 17′. The fuel and water tanks being below the level of the bearing-rail and upon the side-frames, assist in ballasting and steadying the machine. The engines proper are of the La France rotary pattern, the principle of which is that of two gear-wheels running in a tight case.

The road, as shown here, is designed for city and rapid transit where the height above the ground, as well as the length of the span between supports, is necessarily great, but for country roads a much simpler and more economical style of construction is recommended, wherein the roadway consists of a single bearing-rail *A* of iron, the side-rails *B B* being of hard wood, and the side-plates that support *B B* are brought together near enough to bolt directly to the posts,

Fig. 2265.



Single-rail Railway.

which should be of cedar. A road of this kind, capable of carrying a load of four tons per bearing-wheel, is estimated upon as follows. For each mile in length the company estimates: —

Steel bearing-rail, 40 lbs. per yard, at $65 per ton	$1,242.00
Splice-plates and spikes	135.00
Stringpiece 8 × 10, side-plates 5 × 6, side-rails 8 × 4, all of hard or Georgia pine	1,700.00
Lag bolts, plate bolts, and spikes	160.00
Cedar posts, 8″ in diameter, 12′ long, 550 per mile at $1	550.00
Setting in concrete base, 25 cents per foot	137.50
Mill work, squaring ends and boring bolt holes	250.00
Contingencies	825.50
Total	$4,500.00

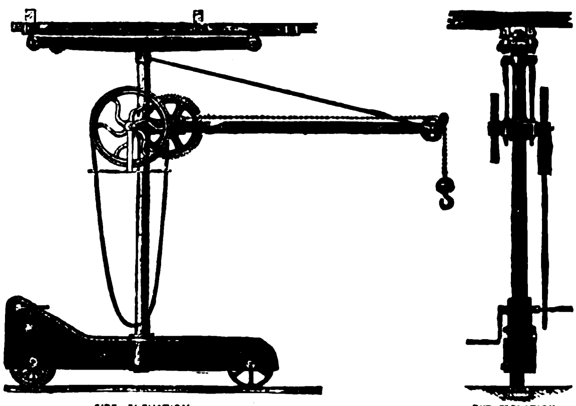
The above figures are obtained with reference to the south-eastern part of New Jersey, where the soil is sandy; but it is to be remembered that in no case is any amount of grading or earth work to be allowed for, no culverts to provide: the only difference required by small streams is a slight increase in length of posts perhaps (and this is the better rule for crossing all highways and railroads), also an increase of elevation and span, requiring only a little more lumber at such points to reënforce the stringer plates and posts, and no other extra expense; swamps or peat-bogs may require some crib work, but again it is only a call for more cedar, and nothing else. Such a roadway should only need renewal in from fifteen to twenty years. The bridging of highways and streams adds little or nothing to the first cost. The single bearing-rail is about 5′ from the ground as a minimum.

Single rail	* "*Sc. American Sup.*," 511, 694.
Uno-rail	* "*Mech. Dict.*," Figs. 1210, 6872, pp. 513, 2683.
Palmer	"*Mech. Dict.*," Fig. 1856, p. 792.
Baker	"*Iron Age*," xix., Feb. 8, p. 15.

Sin′gle Screw Turn′buck-le. A link having a nut at one end and a swivel at the other, used in lightning-rods. See TURNBUCKLE, *c*, Fig. 6794, p. 2659, "*Mech. Dict.*"

Sin'gle-rail Crane. A single, mounted rail carrying a crane for shifting to different parts of a room.

Fig. 2266.



Single-rail Crane.

This form of crane, shown in Fig. 2266, is for hand-power, but the general form is the same whether the crane is worked by hand or is driven by a high-speed cord or tumbler shaft. The under-carriage or bogey is fitted with two double-flanged wheels, one in front of the other, and traveling on a single rail, which is usually sunk so as to be flush with the floor, in order not to interfere with the free circulation of foot or wheeled traffic in any direction; the stability of the crane is maintained by the post being keyed securely into the carriage, its upper end being fitted with a horizontal wheel which works between a pair of guides fixed to the under side of a floor, or to the beams or columns; these guides are fixed in the same line as the single rail on the floor and plumb above it, and extend the full length that it is desired to travel the crane; the jib is hung on a shoulder on the post; the thrust of the jib being taken by a pair of friction rollers working against the post; it therefore turns very freely entirely round the post. The gearing is worked from the floor by hauling on the endless hand-rope, and the barrel-shaft is fitted with a self-acting arrangement, which maintains the load suspended directly the hand-rope is released. One of the traveling wheels is geared up to the handle shaft on the carriage, which is the proper height from the ground for easily turning.

It will be evident from the engraving and the foregoing short description that these cranes occupy so little space that they are peculiarly adapted for running between two lines of lathes or machine tools, or for lifting the smaller parts of machines in the erecting shop after the heavy portions have been put in position by the overhead traveler. Cranes of this type have been constructed for many of the leading engineers; they are also usefully employed in wool warehouses or furniture stores where goods are packed from floor to ceiling. For the platforms of railway or dock goods sheds this system affords very great facility for concentrating the crane-power at any given point, and the heavy outlay is avoided for a number of fixed cranes which can neither be always employed nor cover the ground so completely as portable cranes. These cranes lift a load and swing entirely round with it, or travel with it as readily as if it were on a truck on rails.

Sin'gle Shear Steel. (*Metallurgy.*) Blister steel, once reworked by heating, rolling, and tilting to improve the quality.

Sin'gle Whip. (*Nautical.*) A simple form of tackle formed by reeving a rope through a single block. *a*, Fig. 7196, p. 2770; *a*, Fig. 6159, p. 2480, "*Mech. Dict.*"

Sin'glings. The first to come over, the crude spirit of distillation.

Sink'er Bar. A medium length section of a long boring rod or auger stem for sinking shafts. A still shorter section is called a *substitute*.

Sink'ing Pump. A vertical pump adapted to sinking new shafts and recovering abandoned mines.

The pumps are of various capacity. The one here illustrated (Fig. 2267) is next to the smallest made, weighs one thousand pounds, and has a capacity of about eighty gallons per minute. It is built on the bucket-plunger plan, adapting it to gritty water. The removable barrel admits of easy renewal when worn, and swing-bolts give access to both pump-barrel and water-valves. It is also through its attachments made adjustable to the water level.

Fig. 2267.

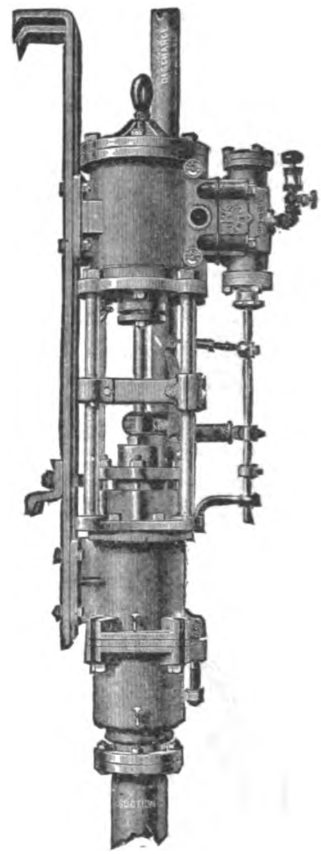
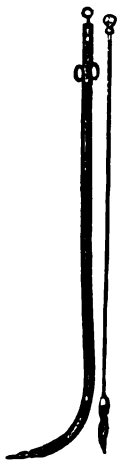


Fig. 2268.



Sinus Probe. *Sinking Pump.*

Si'nus Probe. A vermicular pointed uterine curved probe, used in its peculiar branch of surgical operations. Fig. 2268.

Si'phon. A unique application of the siphon, to enable the transmission of water over higher levels than its source, is described as follows: —

The most remarkable illustration of this principle on a grand scale is to be found at the water works at Virginia City, Nev. The water is brought in an 18″ flume, 4 miles long, to a spur overlooking the Washoe Valley 2100′ above the Truckee Railroad track. There it is received into an iron pipe which after descending into the valley ascends on the other side to the height of 1,540′.

The length of the inverted siphon is nearly 7 miles and conveys two million gallons of water per day. The leading of such a stream of water across such a valley has no parallel in hydraulic engineering. The pressure on the pipe is equal to a column of water 1,720′ high. The orifice of the pipe is 12″ in diameter, and the amount of rolled iron used in its manufacture is 1,150,000 pounds. A million rivets were used in its construction, and 50,000 pounds of lead in fastening the joints. The line of pipe is compelled to twist and curve to fit the inequalities of the ground and crosses 13 steep cañons. At the bottom of each depression a blow-cock is used to remove the sediment, and at each elevation is an air vent. The water when received into the pipe from the flume passes through wire screens and charcoal.

Stillwell	* "*Scientific American*," xxxv. 307.
Automatic, *Taylor* . .	* "*Scientific American Sup.*," 2717.
	* "*Scientific American*," xl. 216.
Condenser, *Sault*, Br. .	* "*Engineering*," xxii. 484.
Lubricator, *Weatherburn*, Br.	* "*Engineer*," xlv. 170.
Overflow, automatic. *Taylor*, Br.	* "*Engineer*," xlvii. 353.
Recorder, *Thomson*, Br.	* "*Engineering*," xxii. 115.
Verdon canal, across valley of St. Paul, Fr. .	* "*Engineering*," xxiii. 246.

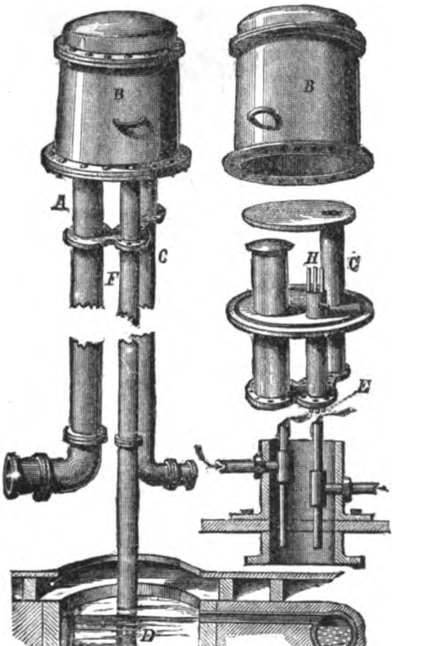
Si'phon, Au'to-mat'ic. A siphon the short arm of which being provided with a valve is actuated and set in motion by the alternate vertical movement given to it.

It is operated without withdrawing the air by suction, through the inertia and adhesion of the liquid.

Si'phon Con-den'ser. An ingenious device for producing a siphon vacuum, profitably employed in a low-pressure engine as a substitute for the air-pump and condenser.

The condenser is placed on top of a vertical tube (say 34' to 40' high) that has its lower end inserted in the hot well.

Fig. 2269.



Siphon Condenser.

Connected also with the condenser are the tubes that convey the exhaust steam from the engine on the one hand and the ordinary injection of cold water on the other.

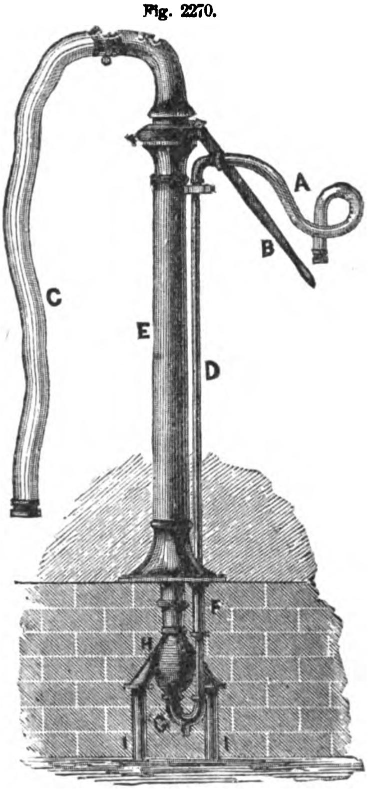
Si'phon Gage. (*Gas.*) A form of gage used in determining the pressure or vacuum in gas pipes. It consists of a convolved pipe in the U of which is a liquid acted upon by the gas admitted by a pipe. The zero in the graduated member is when no pressure is exerted and the liquid is at an equal height in each leg. Below and above this are graduations which indicate inches of water pressure or vacuum.

Si'phon Pipe. A curved pipe that on the principle of the siphon conveys liquids over inequalities in its track.

Si'phon Pump. A device for raising water by the direct action of steam. It combines the powers of a force and lift pump without piston, plunger, valve, or any movable parts, so as to have little about it to wear or get out of order.

Solid bodies of less diameter than the pipes of the steam siphon pass through it without obstruction, thus drawing up and ejecting mud, sand, cinders, fruit, grain, chips, coal, etc., that with a common pump would obstruct the valves. Fig. 2270.

Fig. 2270.



Siphon Pump.

Si'phon Re-cord'er. A delicate recording instrument for the receiving end of submarine cables, the invention of Sir William Thomson.

It has a large magnet with a small movable coil of wire (in the line circuit) suspended between its poles; when a current passes the coil moves, and this movement in the magnetic field is communicated to the siphon pen which thereupon writes the message. The letters consist of a codified series of right and left deviations from the right line, due to the movement of the paper by the mechanical feeder.

"*Engineering*" . . .	* xxii. 115, 116.
"*Sc. American Sup.*" .	* 205, * 909, * 4060.
Paper by *Ewing* . . .	* "*Jour. Soc. Tel. Eng.*," v. 185.

Si'phon Slide. A device for the retention of small aquatic animals in a position suitable for experiment and observation.

In a slip of thick plate glass a chamber is excavated that has at each end fine perforations, too small to permit the escape of the animal under view, but sufficient to maintain a flow of water. These openings emerge into tubular mouths, to each of which is attached a tightly-fitting elastic tube; one of these communicates with a reservoir of water, whilst the other acts as an escape conduit.

Fig. 2271.

Siphon Slide.

The position of the slide, when in use, must be slightly above the level of the reservoir, while the escape tube must rest below the same, insuring a siphon action in the apparatus. See Fig. 2271.

Si′phon Tel′e-graph Re-cord′er. See Siphon Recorder.

Si′phon Trap. One in form of siphon to prevent the rising of gases from sewers, etc. See Seal; Sewer-gas Check, *supra*, and Fig. 6618, p. 2617, "*Mech. Dict.*"

Si′ren. 1. An apparatus for detecting the sonorous qualities of various kinds of wood and metals.

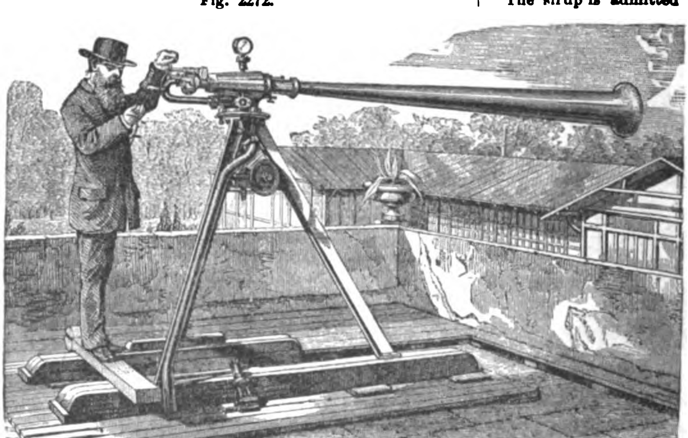
2. An instrument for producing musical tones and for measuring the intonations and vibrations of sound-waves.

For comparison of the Daboll fog trumpet, siren, etc., see "*Smithsonian Report*," 1878, by Prof. Henry, pp. 455–559.

In the grand siren of Lubec a strong system of clock-work keeps in motion a copper disk, pierced with holes at regular intervals. A common air-chamber communicates with a series of tubes that can be accurately adjusted in front of the revolving disk, at any required position. A registry gives the velocity of rotation.

Four of the disks are intended to show the results obtained when the isochronism of the impulses is imperfect from any cause; the fifth shows that impulses coming from different points can unite to form one sound; the sixth serves for experiments on interference; the seventh has eight series of holes, giving the gamut; the eighth has eight series of holes

Fig. 2272.



Siren.

for the harmonics, and the ninth illustrates the phenomena of beats. See also Helmholtz's Double Siren and Oppelt's Siren.

The Centennial Steam Fog Siren or Trumpet and the Austrian fog trumpet are different modifications of instruments intended to denote points of danger to shipping in times of dense fog.

About seventy pounds pressure of steam is employed. As the rotating disk rotates rapidly puffs of steam escape, and as these vibrations quickly succeed each other a sound of great intensity is produced, the pitch of which depends upon the rapidity with which the puffs succeed each other, or upon the velocity of rotation of the disk, precisely as in the acoustic instrument called the siren, used in physical apparatus to illustrate the truth that the pitch of a sound depends upon the number of aerial vibrations produced in a given time. This steam siren has been experimented upon by Professor Tyndall in his recent investigations upon the propagation of sounds through fogs and under other atmospheric conditions, and has proved very far superior to artillery in signaling through fog. See Fig. 2272.

Comparison of the Daboll fog trumpet and siren and other matters in "*Researches in Sound*," "*Smithsonian Report*," 1878, by Prof. Henry, pp. 455–559.

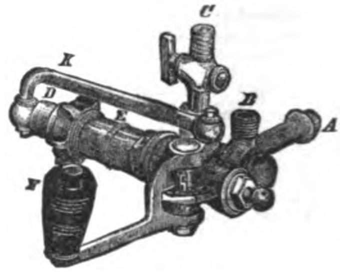
* "*Scientific American Sup.*" . . . . 766.

See Siren, Fig. 5114, p. 2191, "*Mech. Dict.*"
See Fog Trumpet, Fig. 1080, p. 353, *supra*.

Siren . . . . * "*Engineer*," xli. 46.
Buoy, self acting.
Courtenay, Fr. . . * "*Engineering*," xxvii. 510.
Compressed air, *Sautter Lemonnier & Co.*,
Fr. . . . . . . * "*Engineering*," xxx. 366.
Irish, *Wigham* . . . "*Scientific American Sup.*," 2398.

Sir′up Gage. The solid plunger sirup gage, illustrated in the accompanying cut, is a device invented by John Matthews, of New York, for delivering a fixed quantity of sirup and carbonade into bottles at the bottling machine.

Fig. 2273.



Sirup Gage.

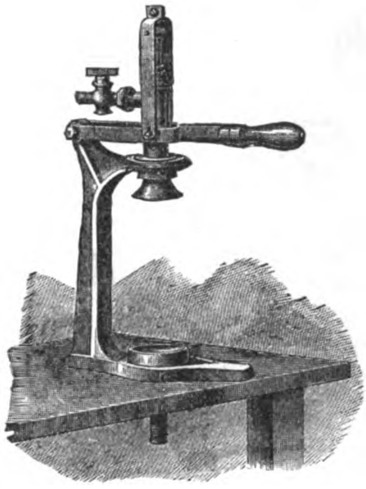
The sirup is admitted to the pump through the inlet *C* and the carbonade enters through the inlet *B*, the mixture passing out to the bottling machine through the outlet *A*. The solid plunger *D* works in the cylinder of the pump *E*, and is operated by means of the handle *F* and the connecting rod *K*. The stroke of the plunger is regulated by means of the pin *H*, which enables the quantity of sirup delivered to the bottle to be accurately gaged. *I* is a guide for the crank which operates the solid plunger.

Sir′up Pump. A device for measuring sirup into soda-water bottles. The pump being secured to the bottling table, the bottles are charged with sirup and passed under the bottling machine. See Fig. 2274.

Sir′up Tank. For soda water.

In the cut (Fig. 2275) is illustrated the portable measuring sub-lift sirup tank invented and introduced by John Matthews, of New York, for use in soda water dispensing apparatus. The glass tank *E* is provided at its lower extremity with a measuring chamber, *S*, and at its upper extremity, with two orifices. Through one of these orifices passes the rod *Y*; the other is intended for filling the tank. The rod *Y* is provided at its lower end with two valves, and at its upper end with a grooved cap, *Z*, into which fits the upper extremity of the lifting bar *V*. Through the rod *Y* runs an opening, *U*, for venting the measuring chamber. *K* is guide for the lifting bar, and *X* is a button on the lower

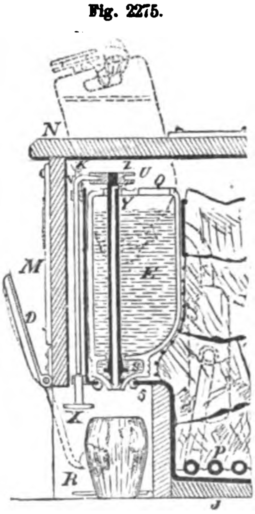
Fig. 2274.



Sirup Pump.

extremity of the bar. The operation of the sirup tank is as follows: When the valve-rod *Y* is at rest, the lower valve on its extremity rests on the lower valve-seat of the measuring chamber. The sirup is now prevented from escaping into the glass, but is admitted from the tank to the measuring chamber. If now the button *X* be raised, either by the hand or by the glass, the valve-rod *Y* will likewise be raised until the upper valve is brought into close contact with the upper valve-seat of the measuring chamber. This will allow the sirup in the measuring chamber to follow into the glass, and will prevent the further admission of sirup into the measuring chamber. The removal of the tank from the apparatus may be effected by raising the guide *K* and turning the lifting bar *V*. The tank can then be taken out as shown by the dotted lines.

Fig. 2275.



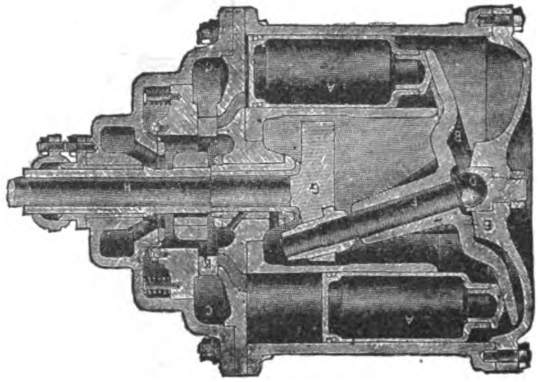
Sirup Tank.

Six-cant'ed File. Has an angle of 120°, and is used for hexagonal nuts, wrenches, etc.

Six-cyl'in-der En'gine. The engine consists of a base-plate carrying a casting containing six cylinders arranged in a circle. The axes of the six cylinders are all parallel to the main shaft, which traverses the middle of the casting. A light hollow piston works in each cylinder, each piston having a conical end that bears against a disk. The disk is mounted on a short shaft, having at one end a spherical bearing, while at the other end enters a brass bush fitted to the crank-arm that is keyed to the main shaft.

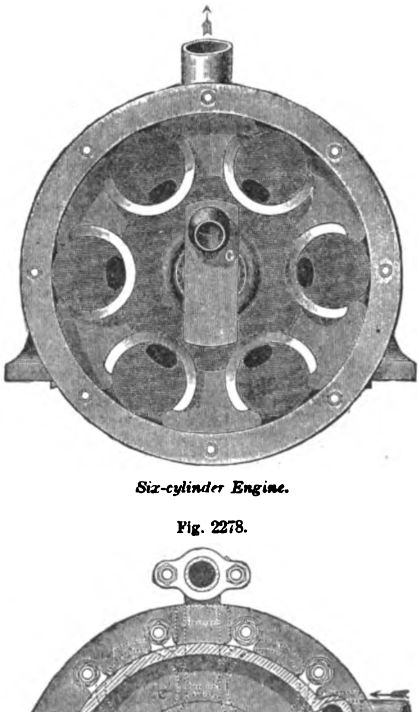
The pistons are single-acting, the pressure of steam in the cylinders tending always to force them against the disk. The shaft makes one revolution for each complete double stroke of each piston, and as each acts during the same revolution, the six going into operation successively at intervals of 60°, it follows that three pistons are constantly acting on the disk. The strain thus thrown upon the crank and shaft is practically uniform, and there being no dead point, no fly-wheel is necessary. It balances itself. See Figs. 2276, 2277, 2278, 2279, which with the description explain themselves.

Fig. 2276.



Six-cylinder Engine.

Fig. 2277.

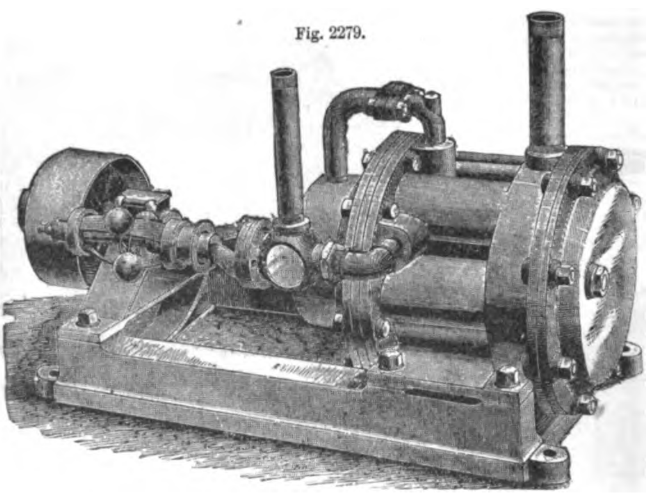


Six-cylinder Engine.

Fig. 2278.

Six-cylinder Engine.

Fig. 2279.



Six-cylinder Engine.

Six-cylinder engine, *West* * "*Engineer*," xlii. 411.
* "*Engineering*," xx. 28.
West, Br. . . . . . * "*Engineering*," xxii. 511.
Applied to Gramm machine . . . . . * "*Engineer*," xlv. 55.
Six-coupled locomotive. * "*Engineer*," xlvi. 185.

* "*Iron Age*" . . . . xxi., Feb. 21, p. 1.
* "*Scientific American Sup.*," . . 923.

See also DISK ENGINE, Fig. 1666, p. 708, "*Mech. Dict.*"

Six'fold Knot. A knot in which one part is wound 6 times around the other before jamming.

Siz'ing. (*Leather.*) A paste made of flour, soap, beeswax, a little linseed oil, and water. It is applied to the grain side with a sponge. It fills the pores and serves to give a smooth finish to the leather.

Sizing cotton goods. *Thompson* . . . . "*Scientific American Sup.*," 1269.
Sizing, history of. . . "*Scientific American Sup.*," 2868.

Skein Screws. A screw with a shallow open thread.

Skein Set'ter. A machine for fitting metallic skeins to wooden axles. See Figs. 148, 151, pp. 61, 62, "*Mech. Dict.*"

Skein Tor'sion Ma-chine'. A machine for twisting silk while under tension. See SILK SOFTENING MACHINE.

Skel'e-ton Bell. An electric call and alarm bell used on railroad trains and other places where such communication is desired from distant points. Such as are peculiarly adapted for railroad trains have a lock attachment preventing any movement of the bell-hammer till it is actuated by the magnets. One variety is made with a continuity attachment causing the bell to continue ringing several seconds after the current on the line wire has ceased, making it useful when a prolonged call is desired.

Skel'e-ton Rol'ler. (*Agriculture.*) An open ribbed roller used in France. The open bars of the drum enable it to answer in a degree the same purpose as the English clod crusher.

Skew'-back. A casting on the end of a truss, to which a tension rod may be attached. It may form a cap, or be shaped to fit the impost.

(*Blast-furnace.*) A ring formed on the inside of the wall of a blast furnace, opposing the descent of stock by diminishing the sectional area at that point.

If sufficient heat gets above the fusion limit of a blast furnace to paste the stock and yet not fuse it, this stock jams on the bosh, forming a ring which if the stock above cannot push it down to the fusion limit, allows this ring to become permanently set and so obstruct the flow of stock.

* "*Iron Age*" . . xxv., March 4, p. 3, Fig. 4.

Skim Net. (*Fishing.*) A large dipping net.

Skin Graft'ing In'stru-ments. (*Surgical.*) The principal special instruments which are used in the transplantation of skin are —

Skin grafting scissors.
Cutisector.
Epilating forceps.
Glass pleximeter.
Scarifying spud.
Milium needle.
Sharp spoon.

Page 11, Part V., *Tiemann's* "*Armamentarium Chirurgicum.*"

Skit'tle Pot. A crucible taking the shape of a skittle, smaller below and bulging towards the top, again contracting at the rim.

Ski'ving. (*Leather.*) The act of removing the rough fleshy portion from the inner surface of a skin by the currier driving his knife obliquely a few inches at a time, and keeping the right hand slightly in advance of the left in the downward motion.

Skiver . . . . * "*Scientific American Sup.*," 101.

Slab'bing Ma-chine'. A tool especially adapted to mill the flats of connecting rods and similar work. It is arranged with bed, tables, and uprights, like planer with a capacity of 25″ × 25″; table 12′ long and operated by a spiral pinion. Spindle to carry cutter 4½″ diameter, 4″ wide, strongly geared, and adjustable to height.

The feed is variable between the extremes, and the table, which is adjustable by hand, has an automatic stop motion to throw out the feed at the end of the stroke. The fast and loose pulleys are 20″ diameter, 3″ face, and should make 114 revolutions per minute.

Slack Bar'rel. One for flour, sugar, cement, fruit, and what not, of a dry character. In contradistinction to *tight* barrel.

Slack Burn'ing Lo'co-mo'tive. See WASTE BURNING LOCOMOTIVE.

Hunt, Br. . . . . "*Iron Age*," xx., Nov. 29, p. 20.

Slack Gas Fur'nace. Casson's new gas and hot blast furnace is applied to puddling furnaces. The coal used — screened slack — is supplied into a hopper and drawn down into the grate. Through the back of the grate it is blown by hot air drawn down from the increased sides of the nearest stack. Hot air is likewise taken in at both the top and bottom of the furnace, and makes its way to the exit of the gas from the gas furnace before it passes over the bridge of the puddling furnace, and the hot air fires the gas. The supply of air is under the control of the puddler and regulates the fierceness of the flame.

The puddling furnace is a double furnace having circular rotating beds that are actuated by mechanical rabbles.

Slag. Blast-furnace slags are usually double silicates of alumina and lime, but vary with the character of the ore, as when the lime is partially replaced by magnesia and oxide of iron, which colors the slag, and in excess is an indication of imperfect working of the furnace.

The glassy slag produced in blast-furnaces is very abundant, and many methods of utilizing it have been proposed. In the Cleveland iron district of England, from three to four millions of tons of slag are made annually. Bricks, paving-stones, slabs, panels, tiles, etc., are made from this material.

About 30 cwt. of slag is made for each ton of pig-iron. The annual accumulation of slag in England is estimated at 80,000,000 tons. Slag is too dark in color to be used for purposes requiring translucency.

At the Cleveland Slag Works, England, in accordance with Mr. Charles Woods's plans, the slag is run from the furnace into two different machines, one of which produces a coarse kind of shingle, and the other a fine sand. For making shingle the liquid slag is run direct from the furnaces onto a circular, horizontal, rotative table composed of thick slabs of iron, kept cool by having water circulated through them. The slowly revolving table carries the slag around to a certain point, when having become solidified, it encounters a stream of water that further cools it, and soon after it comes in contact with a set of scrapers that break it up and clear it off the table, delivering it into wagons placed below that convey it away.

For producing slag sand the slag is run from the furnace into a hollow wheel revolving upon a horizontal axis and fitted with iron buckets inside. A bath of water is maintained inside the wheel at the bottom, and is kept in a state of violent agitation by the revolving action. As the molten slag enters the body of water, it is immediately disintegrated and assumes the form of sand, the water taking up the heat from the molten slag and giving it off in the form of steam.

A constant flow of water is maintained into the machine, and the sand is separated from it and elevated to the top by the bucket plates that are perforated. The slag sand is next dropped into a spout, and thence finds its way into wooden wagons, by which it is conveyed to the slag works for manufacture into brick, etc.

See the following uses and applications: —

1. *Artificial Stone.* — The process of making artificial stone from furnace slag is carried on at the Cleveland Slag Works. It is composed of a wet mixture of —

Pulverized slag	2.5
Ground bricks	2.5
Portland cement	1.0

The mixture is run into molds for building blocks, mantels, cornices, caps, sills, steps, balusters, etc. It sets quickly, and the blocks are ready for use in a week.

2. *Bricks.* — Bricks are made by either of two machines. The slag sand is elevated from the tub, and, after screening to remove coarse pieces, is divided by a revolving measure on the outside and placed at the bottom of the hopper. From another hopper selenitic lime and iron oxide in powder is measured by a similar contrivance, and the two substances unite in the proportion of, sand, 10; lime, 1. The material then passes to a mill where it is incorporated, and thence to the brick molding machine. The production of the machine is 11,000 to 12,000 per day. The bricks, after 4 months' exposure, are said (Kirkaldy) to resist a crushing pressure of 9 tons, and at 3 years of 20 tons. This shows that the chemical combination requires time. The Moss Bay Iron Works (England) also make slag bricks. The slag is ground under edge-stones, then passed through mill stones. The powder is moistened, pressed, and molded into bricks, and hardened in the open air.

3. *Cement.* — The slags, rich in alumina, are preferable for cement, as the aluminate of lime is the principal hydraulic agent in cement.

Mortar is a mixture of slag and 10 per cent. slaked lime.

Cement has an addition of iron oxides. Ransome's cement consists of carbonate of lime, 2: slag sand, 1, burned together. The result gives a cement said to be 30 per cent. stronger than Portland cement.

Concrete is made of the coarse slag at a cost of about one fourth that of brick.

4. *Glass.* — Slags rich in silex are preferable for glass. At the Fenidon glass furnaces, in Northamptonshire, England, the slag is carried in tanks direct from the blast furnace to the glass furnace, there mixed with other materials and worked into bottles. The method pursued is that of Mr. Bashley Britten. The glass furnace is of the Regenerative order, and the tank receives a charge of 500 pounds of molten slag to a due proportion of sand and alkalies. The melted metal runs through a bridge to the working end of the tank, where there are five working holes. Ninety gross of wine and beer bottles are made per day.

5. *Harbor Works and River Walls.* — These can only be economically formed of slag when the works are near the water.

At the Barrow Works the slag is tipped into the sea to make fresh land for the works.

At the Cleveland Works 600,000 tons of slag per annum are used in the continuation of a breakwater and river walls.

6. *Paving Blocks.* — The slag is run into heated molds, and the block is removed and annealed. They are heavy and wear well. Paving blocks and slabs are employed for paving streets, footpaths, stables, coach-house yards, crossings, breweries, curbstones, and channeling.

7. *Pig Beds.* — Slag was formerly granulated and the sand used for pig beds, but this was discontinued for technical reasons.

8. *Road Making.* — Slag was formerly broken up and used for road making in England, and is still largely so used in Silesia. Slag shingle, or coarsely granulated slag is used for road making and paths.

9. *Slag Wool.* — Furnace slag blown while hot into fine threads or filaments has been made at the Clove Furnace, Greenwood Iron Works, Orange Co., N. Y.

The slag is drawn from the furnace into an iron tank carried on a truck. The car is run on a railway to a position opposite one of the apertures in the wool house, which latter is lined inside with thin sheet iron. The slag drops upon a receiver in a small stream, steam is conveyed under the receiver, and as the slag drops it is met by the jet which blows it with great force into the wool house in very thin filaments. The effect of the steam is to detach the slag in small shot which furnishes the basis of the filament. The smaller the shot the finer the filament, so the glass must not be too hot and liquid. By adjusting the heat of the slag and the strength of the steam jet the eventual size of the shot may be reduced to 1-16″ and it is not necessary to separate it from the wool. The lightest wool ascends to the upper story, and is free from the residuary balls. This mineral wool being incombustible and of a fine texture is a good non-conductor of heat, and is employed as a coating for steam boilers, pipes, cylinders, etc. It is called slag wool in England, and silicate cotton in Germany. It is used in Austria for making show cloths, laces, and fancy articles. It is also used in the manufacture of lanterns for electric lights. A patent has been taken out in Germany by Baatsch for the manufacture of prepared slag wool in order to prevent the generation of gases containing sulphur. The wool is placed in a wire netting and rapidly drawn through a dilute solution of water glass (1.2 to 1.3 specific gravity) and emptied on a floor coated with grease. The object is to wet only the surface of the wool without moistening the interior.

10. *Slag for Steam Pipe Insulation.* — Buttgenbach's method: Mix 150 parts of cinder dust, 35 parts by weight of fine coal dust, 250 parts of fire clay, and 300 parts of flue dust, with 10 parts of cow's hair, add 600 parts of water into which 10 to 15 parts of raw sulphuric acid has been poured, and make a stiff dough of the whole. This being applied in layers to the warm pipe hardens rapidly and is succeeded with future layers according to the thickness required. By the action of sulphuric acid gypsum is formed, and the silica rendered free hardens. The mass becomes as hard as porcelain and is still porous.

Slag, granulated for cement, railway ballast, casting bed, foundry molds, "*Iron*" . . .		"*Van Nostrand's Mag.*" xiv. 476.
Slag block apparatus. *Woodward*, Br. . .	*	"*Engineer*," xliv. 5.
Slag-brick machinery. *Wood*, Br.	*	"*Engineering*," xxiv. 246.
Slag, uses of		"*Manuf. & Builder*," ix. 127.
Slag glass		"*Eng. & Min. Jour.*," xxx. 26.
		"*Engineering*," xxii. 274, 283, 321, 349.
Britten		"*Iron Age*," xviii., July 6, p. 24; Aug. 17, p. 11.; Oct. 26, p. 3.
Slag, granulated, Fr. .		"*Iron Age*," xvii., March 23, p. 8.
United States . . .		"*Iron Age*," xvii., April 13, p. 15.
Slag and slag-wool pat.		"*American Man.*," Feb. 27, 1880, p. 13.
Slag paving blocks . .		"*Iron Age*," xviii., Nov. 2, p. 18.
Machine for making .	*	"*Scientific American Sup.*," 1362.
Slag utilization, Iron *Word*, Middleboro' .		"*Scientific American*," xxxix. 345.
		"*Iron Age*," xx., Nov. 22, p. 7.
		"*Scientific American Sup.*," 718.
Slag wool, Greenwood iron works	*	"*Eng. & Min. Jour.*," xxv. 53.
		"*Iron Age*," xix., April 5, p. 7.
Machinery, *Wood*, Br.	*	"*Engineering*," xxiv. 247.
Slag, furnace utilization		"*Min. & Sc. Press*," xxxvii. 151.

Slat Crimp'er. A machine used for sharpening, by compression, the ends of stationary slats to fit and fill mortises in the stiles.

The slats are placed in the vertical guides, and are delivered sharpened, one with each revolution of the shaft.

Slate Roof. An economical system of covering buildings with large slates is as follows: The rafters are placed at a distance apart of 1½″ less than the width of the slates. Down the center of each rafter is nailed a fillet, thus forming a rebate on each side, in which the edges of the slates rest, being secured by putty or by a second fillet 2″ wider than the first nailed over it, so as to cover the edges of the slates and hold them down. Each slate lays about 3″ over the one below it. Only half the number is required in this as compared with the ordinary method of slating, and no boarding or battens are necessary.

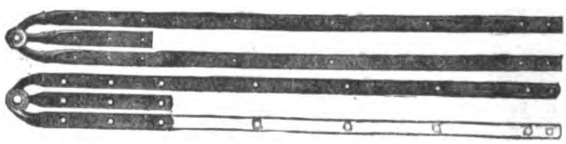
Slate dresser . . . . * "*Am. Man.*," Jan. 3, 1879, p. 12.
Slate quarry . . . . "*Scientific American*," xxxvi. 83.
Slate trim. and punching
machine, *Davis*. . . * "*Scientific American*," xxxv. 34.
Slate washer, *Smith*. . * "*Scientific American*," xliii. 5.

Sla'ting. *Black-board Slating* may be accomplished with the following mixture: 10 ounces pulverized pumice stone, 12 ounces lampblack, 6 ounces pulverized rotten stone, 16 ounces shellac, and 1 gallon alcohol. Mix the first three in enough alcohol to make a thick paste, and dissolve the shellac in the rest of the alcohol. Mix all together. It may be put on brown paper (such as surveyors use), as well as on walls or boards.

Or, dissolve 2 ounces of gum shellac in 1 pint of alcohol, and after it is well dissolved, which will take about two days, add 1 ounce of lampblack and 2 ounces of powdered rotten stone or powdered emery. Apply with a flat brush.

Slat I'ron. The iron shoe or termination of the bow or slat of a carriage top. The shoe is hinged to the stem by a pivot-pin and has an envelope of leather. The illustration represents a three bow pattern made with a sleeve running through the slats to give them free action, and prevent their binding on the nut and turning it off.

Fig. 2180.



Slat Iron.

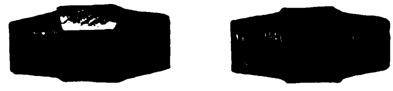
Sleep'er. *Iron Cross-tie.* This tie is semi-elliptical in shape, resting simply on the ballast. The rail is fastened to the cross-tie by a jaw bone chair that is formed in two portions that hook into one another and hold the rail as in a vise. Half of the chair is fastened to the cross-tie by a bolt preferably on the outside of the track while the other half hooks into the first beneath the cross-tie and is immovable. An ordinary eye-headed bolt entering through the hole of the tie adapts itself to the end of this movable arm, and by its successive tightening compensates for any downward wear of the rail.

Iron, *Rock* . . . . . * "*Min. & Sc. Press*," xxxvii. 393.
Railway (of glass).
Siemens . . . . . * "*Scientific American*," xli. 201.
Preserving . . . . . "*Engineering*," xxx. 15.
Iron Railway, *Hilf*, Ger. * "*Engineer*," xlviii. 359.
Macdonnell, Br. . . * "*Engineer*," xlviii. 427.
Hohenegger, Ger. . * "*Engineer*," xlviii. 427.
Hensinger von Waldegg, Ger. . . . . * "*Engineer*," xlviii. 427.
Scheffler, Br. . . . * "*Engineer*," xlviii. 303.
Livesey, Br.. . . . * "*Engineer*," xlviii. 195, 315.
Maclellan, Br. . . . * "*Engineer*," xlviii 265.
Vantherin, Ger. . . * "*Engineer*," xlix. 115.
Potel, Belgium . . . * "*Engineer*," xlix. 241.
Brunon, Fr. . . . . * "*Engineer*," xlix. 241.
Acaster, Br. . . . . * "*Engineer*," xlix. 304.
And permanent way iron.
Kirsch, Belgium . . * "*Engineer*," xlviii. 445.
Wm. Kler, Ger. . . * "*Engineer*," xlviii. 445.
Sleeping car, *Leighton* . "*Railroad Gazette*," xxi. 181.
Kellogg . . . . . * "*Scientific American*," xxxvii. 23.
Sleeping car berth, *Hills* * "*Scientific American*," xli. 307.
British . . . . . "*Iron Age*," xxi., Feb. 21, p. 5.

Sleeve. A short, relatively larger, pipe which receives the ends of two smaller ones and forms a coupling therefor. It may have *bell* or *flanged* ends. See, also, HUB, which has a similar purpose but somewhat different shape.

Sleeve Nut. A double nut with right and left hand threads for attaching the joint ends of rods or tubes.

Fig. 2281.



Sleeve Nut.

Slick'er. (*Leather.*) *Steel.* A rectangular piece of steel about 5″ long. The edge is also a rectangle, and is sharpened upon the rub-stone by grinding it perpendicularly, and then upon each side, producing thus two edges (or rather right angles) by which the leather is scraped instead of being cut. It is used to remove excess of water, oil, etc., from leather. Its applications are various. It has a handle like that of a stock-stone.

Glass or Lignum-vitæ. These are similar in form and dimensions to the steel slicker, but the blades are made either of thick plate-glass or lignum-vitæ. The edges are rounded instead of being rectangular. They are chiefly used to smooth out and polish leather.

Buffing. This slicker has a narrower, longer, and very much thinner blade than the others. Its edge has an acute angular longitudinal groove running along it, thus forming two very keen cutting edges, which are kept in proper condition by the finger-steel. It is used by placing one edge and the stock flat upon the leather, the latter being stretched upon the table, and forcibly pushing it forward, taking off thin shavings from the grain surface. When one edge is dulled the slicker is turned over and the other side used until it loses its edge, when the finger-steel must again be brought into requisition.

Whitening. This instrument has almost the same form and dimensions as the buffing slicker, but instead of a reëntrant angle along the edge, it has a very narrow rectangular one, whose angles are kept sharp by the finger-steel.

Slick'er-sides. (*Mining.*) Smooth, polished surfaces of walls caused by violent trituration.

Slick'ing. (*Leather.*) An operation consisting in scraping the leather, to remove superfluous water or grease, and eradicate the marks left by the stock-stone.

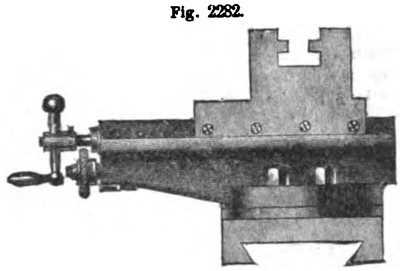
Slide. (*Lumbering.*) A chute for logs over rapids or shoals where such obstructions to floating logs exist in rivers. The slides of the Ottawa river extend at intervals for 200 miles above the city of Ottawa.

On the river Saguenay there is a slide 5,840′ long, with a boom 1,314′; and dams, piers, and bulkhead. The works extend over a distance of about six miles. Slides are constructed on the rivers St. Maurice, Gatineau, Madawaska, Petawawa, and Du Moine. On the rivers mentioned the works are said to comprise: Slides, 12,835′: booms, 67,799′; dams, 17,791′; bulkheads, 346′; bridges, 2,215′; piers, 141.

Slide Cut′-off. (*Steam.*) An independent sliding plate riding on the back of the main valve, of which Meyer's system of valve-gear is a familiar instance.

Slide Rest. This rest has an ordinary cross-feed screw, but by a movement of the clutch, the

Fig. 2282.

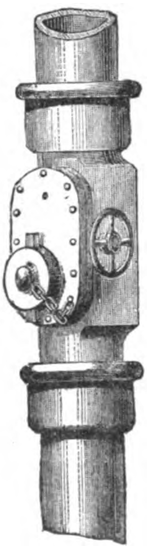


Universal Slide Rest.

screw becomes neutral and transfers its feed through beveled gears, to a screw working at an angle to the first, the upper slide being swiveled, for adjusting to the desired angle, by means of a degree scale.

The upper screw is also controlled by a friction feed enabling the tool to be quickly adjusted by hand without disengaging the clutch on the cross-feed screw, See Fig. 2282.

Fig. 2283.



Slide Valve.

Shaws Co., Engl.
"*Scientific American Sup.*," 583.
Slide rest lathe.
* "*Scientific American*," xl. 404.

Slide Valve. This sliding valve is constructed so as to form part of the conducting pipe, instead of projecting from it as usual, so that the outlet to which the hose is attached can be kept close to the wall.

The sliding valve is worked by a rack and pinion arrangement; the front or cover plate is of gun metal, with the outlet screwed to receive hose, and fitted with gun metal cap and chain, also hand-wheel or spanner or spindle for opening and closing the valve.

* "*Sc. American Sup.*," 803, * 1527.
Allen.
* "*Railroad Gazette*," xxiv. 101.
Ancona.
* "*Railroad Gazette*," viii. 295.
Church, Br.
* "*Engineer*," xlii. 281.
Everitt, Br. . . . . * "*Engineering*," xxx. 27.
Wilson . . . . . * "*Railroad Gazette*," viii. 33.
Aveling & Porter, Br. * "*Engineer*," xlviii. 430.
Balanced, *Wisner* . . . * "*Scientific American*," xxiv. 374.
Taylor-Weatherhogg . * "*Scientific American Sup.*," 319.
Weatherhogg . . . * "*Engineering*," xxi. 168.
Circular, *Webb* . . . . * "*Engineer*," xliv. 69.
Diagrams, appa. for draw. * "*Engineering*," xxi. 388.
Expansion riding valve.
Crohn, Br. . . . . * "*Engineering*," xxv. 151.
Indicator, *Cooper*, Br. . * "*Engineering*," xxii. 393.
Locomotive, *Volga & Don Ry.* . . . . . * "*Engineer*," xlix. 376.
Oiler . . . . . . * "*Railroad Gazette*," xxiii. 583.
Setting apparatus . . * "*Engineer*," xlvi. 377.
* "*Scientific American Sup.*," 193.
Seat, *Walkey* . . . . * "*Railroad Gazette*," xxiv. 390.
Friction of, *Rose* . . . * "*Scientific American*," xxxvi. 264.
Shifting for winding engines . . . . . . * "*Engineering*," xxv. 276.

Sli′ding Door. One running on hangers, sheaves, rollers, or rail; as distinguished from one swinging on hinges.

Sli′ding-door Lock. A lock made especially for fastening sliding doors of cars, for instance. Such locks usually have a hook which engages in a corresponding catch attached to the door-post. The hook may be locked by a bolt operatable by a key.

Slings. (*Boat.*) Ropes with hooks and thimbles whereby to hook the tackles to the ring bolts of the boat in lowering or hoisting.

(*A hoisting device.*) A pair of hooks for clasping a can or cask to be lifted.

Sling Wag′on. A military wagon for carrying a cannon slung beneath the hind axle, which has a large pair of wheels. Plate XLVI., "*Ordnance Report*," 1877.

Russian gun sling, Fig. 27, Appendix L, same report.

Slip Shave. A point or shave made to slip over the nose of the mold-board.

Slip Stop′per. (*Nautical.*) A cable stopper so arranged as to be cast loose suddenly when required.

Slit′-bar Sight. (*Rifle.*) A form of sight having a plate with a vertical slit. See BAR AND SLIT-SIGHT.

Slit′ting Mill. An English term for a gang of thin saws, used in ripping pine balks, known as *deals*, into thin boards. A resawing operation. See RESAWING.

Slit′ting Shear. A machine for slitting sheet metal.

In Bliss's machines, Nos. 104 and 106 of the 1881 catalogue, sheet metal up to 18 gage (Browne & Sharpe) is received in a roll, fed automatically, and the scrap coiled.

Sliv′er-ing Knife. (*Fishing.*) For slicing the flesh from the sides of fish, to be used as bait.

Sliv′er Lap Ma-chine′. A machine designed to unite in one broad sheet or lap a number of slivers or ends of cotton from the carding engine.

The sliver, when stripped from the doffer of the carding engine, passes to a coiler, by which it is deposited with mechanical regularity into a can. A certain number of these cans are placed behind the sliver lap machine, and the sliver is drawn from them through guides to a pair of fluted rollers which press the fibers, and form them into a fleece. They are then wound on a bobbin revolving between two iron revolving plates. The slivers are made to pass over a number of spoons, so arranged that if any of the slivers break the machine immediately stops. When cotton with short staple is used, two calender rollers are placed on each side of the table to assist the sliver in its passage from the can to the guide plate.

Slot Bor′er. A tool used for opening the cut in connection with slotting machines.

Slot-bor′ing Ma-chine′. A machine intended to supersede reciprocating mortising machines in which the wood had first to be bored so as to give clearance for the chisel; this machine combining the two operations in one.

In these machines the workman presses the borer in with his right hand, and moves the wood with the other. The horizontal machines are especially adapted to usual mortising. See ROTARY MORTISING MACHINE, *supra*.

Slot Dril′ling Ma-chine′. Whitworth's self-acting slot-drilling machine has a sliding head-stock carrying the crank motion. The drill-spindle revolves in conical steel bearings. It has a horizontal slide-bed and two tables adjustable vertically and longitudinally.

Double, self-acting.
Daglish, Br. . . . . * "*Engineering*," xxx. 298.
Slotting machine.
Asquith, Br. . . . . * "*Engineering*," xxvii. 257.
Collier, Br. . . . . * "*Engineer*," xliii. 254.
Collier & Co. . . . * "*Scientific Amer.*," xxxviii. 242.
English . . . . . * "*Scientific American*," xxxiv.

Reversible tool atta. for
Garvie, Br. . . . * "*Engineering*," Oct. 15, 1880.
Sellers . . . . . . * *Thurston's* "*Vienna Exp. Rept.*," ii. 218.
Sharpe, Stewart & Co., Br. . . . . . . * "*Engineering*," xxv. 488.

Slub'bing Frame. A machine used in the process of cotton spinning next to the draw-frame, to reduce the thickness of the sliver and impart to it a little twist previous to its passage through the intermediate frame, the roving frame (and where fine counts are spun, the jack frame) which delivers it to the mule.

The slubbing frame exhibited by Dodson and Barlow, at Philadelphia, had 36 spindles, 10″ lift, 8″ space, three lines of rollers, and single boss top rollers.

It was claimed to possess the following advantages: —

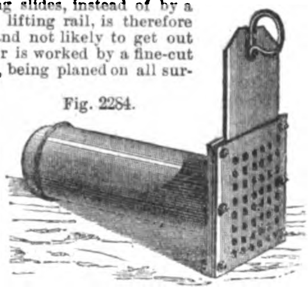
1. The differential motion is completely boxed up, so that no dirt or fly can get among the wheels; there is only one place for lubricating this motion, and the oil cannot work itself out but travels to each bearing which requires lubricating.

2. The swing lever which carries the carrier wheel that drives the bottom shaft, is firmly hung from the beam and has no vibration at whatever speed the spindles may revolve. In the swing there are also loose brackets or slides, which work on a planed surface, and when the wheel becomes so far worn as to be slack in gear with the bottom-shaft wheel, these slides can be loosened, and the wheels can be nicely adjusted by a few turns of a screw.

3. When the frame is doffing, the bottom cone drum is worked up by a screw either from back or front. Both ends of the bottom cone rising simultaneously, it is impossible for the cones to become unparallel.

4. The tapering motion, which is carried on a rail attached to two of the lifting slides, instead of by a bracket fixed to the lifting rail, is therefore much more rigid and not likely to get out of order. The taper is worked by a fine-cut square rack, which, being planed on all surfaces, causes the rack to work very smoothly and consequently a regular taper on the bobbins is obtained.

Fig. 2284.



Sluice.

Sluice. A water way with valve or gate for controlling the flow of water. See "*Mech. Dict.*," p. 2217.

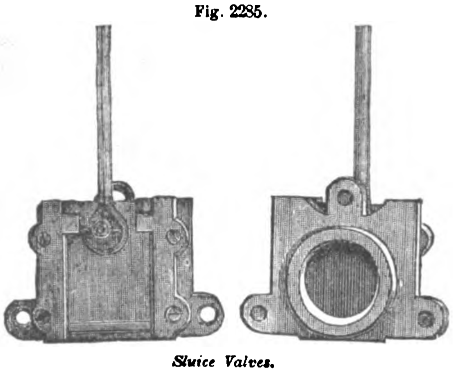
A water way with trap, stop-valve, or screen for the arrest of obstructive substances.

For silver tailings, Nev. * "*Engineering*," xxx. 395, 451.
Ore, *Evans* . . . . . "*Min. & Sc. Press*," xxxvii. 406.
Valve, Equilibrium.
Bagshaw, Br. . . . * "*Engineer*," xliv. 148.

Sluice Fork. A many tined fork for clearing obstructive substances out of sluice ways and water courses.

Slui'ces. (*Mining.*) Boxes joined together, set

Fig. 2285.



Sluice Valves.

with riffle blocks, through which is washed auriferous earth.

Sluice Valve. A sliding valve made so as to be secured to the bulk-head by three bolts instead of by screwed shank and fly-nut. For vessels built in compartments, with gun-metal frame and valve. It passes upward through a brass hinged flap on deck above, so as to open valve without going below. Fig. 2285.

Smash'ing Press. An embossing press.

Smee Bat'ter-y. (*Electricity.*) A single fluid battery having a sheet of roughened platinum between two plates of zinc in sulphuric acid. See "*Mech. Dict.*," p. 2220.

Prescott's "*Electricity*," * 74; Ganot, * 689.
De Moncel, Paris, 1856, 107.
Noad, London, 1859, * 274.
Shaffner, N. Y., 1859, * 93.
Niaudet, American translation, * 54.
Poggendorf's improvement, *Niaudet*, 59.

Smelt'ing Fur'nace. A furnace for reducing ores. See "*Mech. Dict.*," p. 2220, *et seq.*

Boston & Col. Smelting Works . . . . . . * "*Engineering*," xxii. 247, 317.
Kony, India . . . . * "*Scientific American*," xxvi. 151.

Smoke'-burn-ing Fur'nace. M. Ten-Brink's smoke-burning furnace has the heater placed below with its major axis at right angles and horizontal to that of the boiler. One or two furnaces traverse the heater, making with the horizon an angle of 48°. In these furnaces is placed the grate, formed of a table and bars, the latter resting on the table at one extremity and at the other on a support at the end of the furnace. The table has two lateral sides surmounted by a cover so that a close four sided box is formed upon the door and grate extremities. The front piece to which this box is attached is a plate of cast-iron in which several different openings are made. A flue regulated by a hinged cover above the entrance to the furnace admits air in order to insure the complete combustion of disengaged gases.

See also "*Scientific American Sup.*," 962.

Smoke burning furnace. * "*Scientific Amer.*," xxxvii. 232.
Dumery . . . . . * *Laboulaye's* "*Dict.*," iv., "*Fumée*," Fig. 3538.
Smoke preventive . . * "*Scientific American Sup.*," 962.
Smoke burning furnaces,
On, *Hill* . . . . . "*Van Nostrand's Mag.*," xxii. 62.
Smoke-burning furnace. "*Eng. & Min. Jour.*," xxvi. 422.
Clark . . . . . . "*Iron Age*," xxii., Nov. 21, p. 20.
Smoke burning grate.
Jordan . . . . . * "*Scientific American*," xxiv. 403.
Smoke consumer . . . "*Scientific American*," xxxv. 18.
Smoke-consuming furnace "*Scientific American*," xxxix. 138.
Hoyt . . . . . . * "*Scientific American Sup.*," 1120.

Smoke Con-su'mer. The methods proposed for consuming smoke are very numerous.

Papin proposed the downward draft, making the smoke descend through the fire, as in Delasme's base burner, 1685 (Fig. 5911, p. 2410, "*Mech. Dict.*"). In Papin's the draft was obtained by means of a blower; the idea has never fructified into useful form.

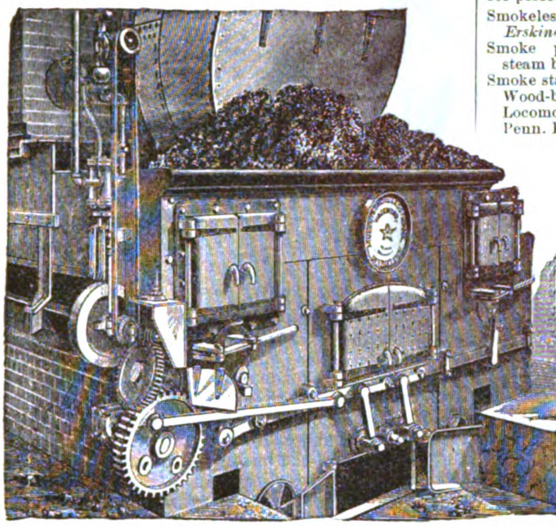
Watt had a wide dead-plate between the furnace doors and grate bars; on this the coal was coked before being pushed back and burnt. This plan is excellent, but requires careful attention. The smoke and gases evolved in combustion of the fresh coal are consumed while passing over the incandescent mass of fuel at the back of the furnace.

A given quantity of air has been introduced above the fire-bars, to insure the combustion of the smoke; this is good in theory, but the regulation is difficult in practice, as, when coal is freshly introduced, a larger quantity of air is required than at other times.

Henderson's mechanical stoker has hoppers above the furnace doors, and the coal is gradually dropped into the furnaces by automatic devices driven by the engine. See STOKER.

Prideaux's has fire doors, in which the air enters through a number of Venetian lattices, and is warmed by contact with metallic plates before reaching the furnace.

Fig. 2286.



Murphy's Smokeless Furnace.

Richardson, C. J. "*The Smoke Nuisance, and Its Remedy by Means of Water.*" With Remarks on Liquid Fuel. London, 1869.

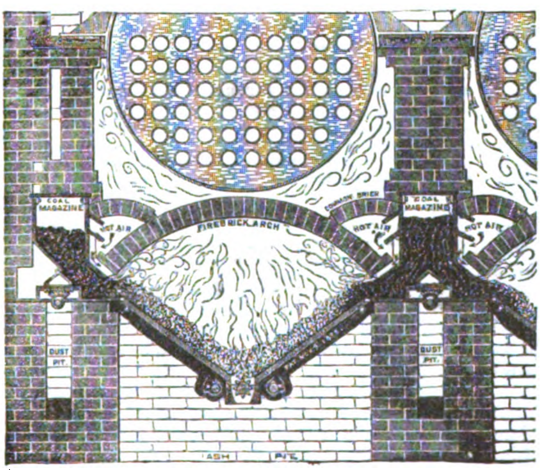
Smoke Con-sump'tion. A new device in smoke consumption on trial in Chicago has special adaptability to all kinds of boilers.

A jet of steam is introduced, creating a vacuum into which the outer air rushes, and the commingled steam and air are delivered into the fire chamber. In this the proportions are one part steam to two hundred parts of atmospheric air. This creates an intense draft, and, it is claimed, the entire consumption of the carbon contained in the soot.

Smoke'less Fur'nace. Murphy's smokeless furnace (see Figs. 2286, 2287) obtains its complete combustion by a natural draft, being fed automatically, and having a steady, uniform feed and therefore an even temperature.

The fuel is put into magazines and pushed very slowly on plates, cooking it before it enters upon the grates. A current of air by natural draft passes over the heated arch above and down at the sides, supplying the mixture of air necessary for perfect combustion.

Fig. 2287.



Murphy's Smokeless Furnace.

Smokeless furnace, *Regan* * "*Scientific American Sup.*," 1368.
Erskine, Br. . . . . . * "*Engineer*," xlvii. 79.
Smoke preventer for steam boilers . . . * "*Scientific American Sup.*," 524.
Smoke stack, *Hewitt* . * "*Railroad Gazette*," xxiii. 459.
Wood-burning, *Finley* * "*Railroad Gazette*," xxiv. 281.
Locomotive, *Turner* * "*Scientific American*," xl. 86.
Penn. Railway . . . * "*Engineering*," xxiv. 123.

Smooth'ing I'ron. Pott's Cold Handle Double-pointed Smoothing Iron has a semi-circular handle that is made of a non-conducting material, so as not to convey the heat from the iron below, and is attachable to the iron by a spring catch that holds it in position while in use, and is readily detached through the pressure by the finger of the knob above when it is desired to transfer it to another iron. See Fig. 2288.

Enterprise Co. * "*Iron Age*," xix., Jan. 4, p. 1.
Sad iron, *Hasenritter* . . . * "*Iron Age*," xvii., Jan. 26, p. 5.
Sad iron and fluting roller. *Kramer* . . * "*Scientific American*," xli. 102.

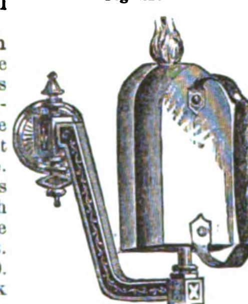
The gas-heating toilet smoothing iron (see Fig. 2289), it is said, can be heated in three minutes on any ordinary gas burner. They are especially adapted for gentlemen to iron

Fig. 2288.

Smoothing Iron.

their silk hats, and for ladies while traveling; also for dress-making and other general uses.

Fig. 2289.

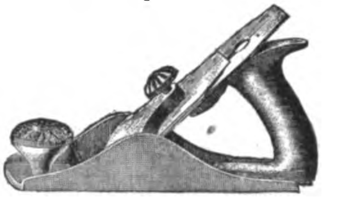


Gas-heating Smoothing Iron.

Smooth Plane. One the bit of which is set at a relatively more obtuse angle than that of a *block* plane. The former is for planing with the grain; the latter across it. See Fig. 2290. See BLOCK PLANE. See also SCRAPER PLANE.

Smut Ma-chine'. A machine for cleaning from wheat the smut, and also dirt and the beard, the latter on the end opposite to the germ. By a certain vigor in the process the bran is also partially removed. The wheat is passed between sharply roughened or pointed iron

Fig. 2290.



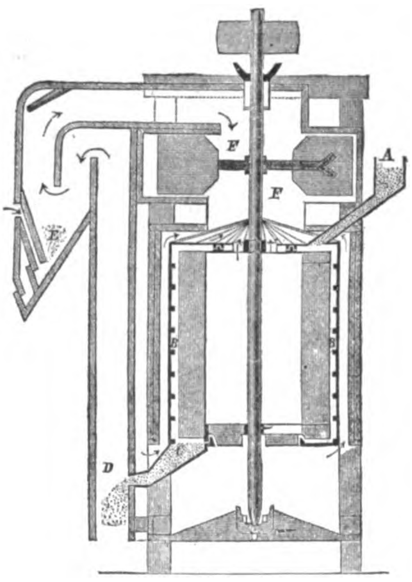
"*Victor*" *Smooth Plane.*

surfaces, as teeth or wire brush, or beaten upon the surface of a cylinder or conical frustum, revolving at high speed within a metallic case perforated with holes or slits, serving the double purpose of permitting the dust to escape and presenting a rough surface.

Howes, Babcock & Co.'s machine for removing smut, pointing, and cleaning grain is shown in Fig. 2291.

The wheat enters at *A*, passes through the cylinder *B B*, comes through *C* to *D*, where it encounters the current of air produced by the exhaust-fan, which conducts the light

Fig. 2291.



Wheat Grading and Purifying Machine.

kernals to *E*, the bran to *F*, and the fan-chamber which leads to the dust and bran chamber. The air moves in the direction indicated by the arrows. The particles of dust, hairs, smut, etc., that pass through the walls of the cylinder *B B*, are carried by the exhaust to *F*. The excellence of the work of this machine is indorsed by Professor Kick in his official report to the Austrian government.

The Eureka smut and separating machine has a separator attachment above the shoe in such manner provided that the dust from the entire machine is all absorbed by the fan.

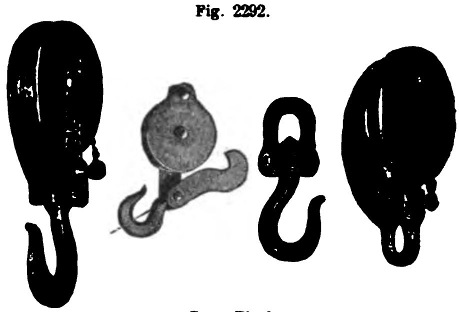
The capacity of No. 2 is 40 to 60 bushels per hour, and like the Nos. 0 and 1 has two separators, one before and one after the scourer. Motion, 625 revolutions per minute. Standard size, pulley 10″ with 5¼″ face.

Snap Ac'tion. (*Fire-arm.*) As distinguished from a lever gun; one which as the hinged barrel closes is fastened by a spring catch.

Snap Block. (*Nautical.*) A block with an opening in the side at which the rope may be laid in the sheave without the trouble of reeving it in. See Fig. 2292.

Snap Ma-chine'. A machine for cutting a

Fig. 2292.



Snap Block.

blanket of dough into snaps. A kind of biscuit; ginger snaps for instance. See CRACKER MACHINE.

Snarl'ing. A mode of producing repoussé work upon any hollow ware of sheet gold, silver, etc., by blows delivered inside. The snarling tool is placed in a vise and the protruding end enters the object and rests against the inside. A blow delivered on the shank of the snarling iron is transferred to the object, and makes a dent which appears as a bulge on the exterior. See SNARLING IRON, p. 2229, "*Mech. Dict.*"

Snatch'ing Rol'lers. (*Printing Machine.*) A pair of rollers driven at a somewhat higher speed than the pair of holding rollers next in the rear of them, in order to *snatch* or break the paper on the lines of the perforations and thus make them into separate sheets.

Sneak Box. The New Jersey sneak box is from 12′ to 14′ in length; the shelving or sideboards on the stern of the boat are used to hold the decoys while the hunter rows to and from the shooting ground. Used by gunners on Barnegat and Little Egg Harbor Bays, New Jersey. The Maryland ducking-sink is used by gunners on the Potomac River and Chesapeake Bay.

Snood. (*Fishing.*) The short line which carries the hook and is attached to the fishing line. A *snell*, *leader*, or *trace*.

Made of catgut, silk, gimp, wire, flax, silk-worm gut, etc.

Snow Flan'ges. (*Railway.*) A bar of iron or steel attached to a car or engine to scrape away snow and ice on the sides of the heads of the rails so as to make room for the flanges of the wheels.

See "*Scientific American,*" xl. 372.

Snow Plow. A plow-shaped apparatus mounted on wheels and propelled by locomotives, used in cutting a way through snow drifts.

Those used in the vast drifts on the Pacific railroad are 13′ high, 10′ wide, and 30′ long. They are mounted on two trucks and weigh 38,000 pounds each. The body of the plow is made of the best lumber, the furrow board of polished ash, running back at an angle of 81° and up, in a half circle of 19″ radius. The apron is of ⅜″ boiler iron and has steel shoes, clamped on the rail by clamps 3′ long. The drifts sometimes become so compacted that they resist the butting action of the plow for a long time, and as high as fifteen locomotives have united their combined power before they could push the plow through the drifts.

Snow plow, *Little* . . * "*Scientific American,*" xxxvi. 226.
Snow plows, railway . * "*Scientific American Sup.*," 731.

Snow Scra'per. 1. (*Railway.*) A plate or bar of iron attached to an engine or car to scrape snow and ice from the rail.

2. An A-shaped plow made of two scantlings and a cross-piece, for cleaning snow off sidewalks. The driver stands on the cross-piece; the horse is hitched to the point of the A.

Snug'ger. A device to impart a smooth and dense exterior and uniform thickness to twine.

Soap. In the preparation of toilet or perfumed soaps, the blocks of rough soap are first cut into thin shavings in a planing machine, and the shavings are then ground with coloring matter, essential oils, and scents, until they form a homogenous paste. The machine for grinding contains granite cylinders, which pass the paste automatically between them, and finally into the upper portion of the hopper, so that the services of only one attendant are required for several machines. After the paste has been ground, it passes to a machine called the *peloteuse*, or mixing mill, which stretches and draws it out and prepares it for being molded and stamped. The *peloteuse* does instantly what at one time required several weeks of scraping, washing, and drying. It is a mortar, in which the soap paste is packed until it is freed of air, and from which it is then forced by increase of pressure, passing through draw plates of any required cross section.

A self-acting cutter divides the stream of soap into blocks of any desired size or weight.

Phosphate of soda is being used in a composition with the common soaps, as especially adapted for use in salt water, as well as fresh water.

(*Glass.*) Binoxide of manganese used to correct the greenish tinge in glass, due to the presence of iron in the sand. Glass made with potash is freer from this coloration but is expensive, hard, and difficult to work.

Binoxide of manganese in excess turns the glass to rose color, purple, and even black, according to the quantity used. It is used in small quantities as a corrective. In the French practice the proportion is 0.5 per cent.

Soap machinery, toilet . * "*Man. & Builder*," ix. 16, 40.
Soap making machinery * "*Scientific American Sup.*," 4107.
Slicing . . . . . * "*Engineer*," l. 280.
Grinding . . . . . * "*Engineer*," l. 280.
Kneading. . . . . * "*Engineer*," l. 280.
Stamping. . . . . * "*Engineer*," l. 280.
Soap works, *Babbit* . . * "*Scientific American*," xli. 385.

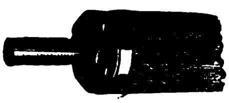
Soap Cut'ter. An apparatus for caking or barring soap in manufacture. See SOAP BARRING AND CUTTING MACHINE, p. 2232, "*Mech. Dict.*," and SOAP CUTTING MACHINE, p. 2233, *Ibid.*

Soap Coil. One fitting the interior of a soap boiling kettle, and through which the steam circulates to boil the ingredients.

Sock'et. A tool used in well boring to recover and lift rods out of the well. They are of different shapes, screwing on to the top of the rod, attaching by gripers, hooks, shoulders, collars, spreaders, etc.

Sock'et Gud'geon. One in which the gudgeon shoulder surrounds the wooden shaft, instead of being let into the shaft. In the illustration (Fig. 2293) it is shown as attached to a conveyor or bolt-reel shaft.

Fig. 2293.



Socket Gudgeon.

Sock'et Pipe. One having an enlarged end to receive the end of another pipe, and contain the lead or other cementing material used in joining the pipes.

Sock'et Wash'er. A washer having a counter-sunk face into which the head of the bolt sinks. See Fig. 2294.

Fig. 2294.

Socket Washer.

So'da Ap'pa-ra'tus. Soda is manufactured principally, now, from common salt.

The manufacture of soda from kelp is comparatively unimportant.

The manufacture from the cryolite of Greenland, is limited practically to that country. Extensive deposits of natural soda, enough to supply the world's demands for centuries, are said to have been discovered in Wyoming territory. Large amounts of the sulphate of sodium are obtained in France and Germany from the mother liquors remaining after the extraction of chloride of potassium.

Jones & Walsh's furnace consists of a large shallow pan, exposed to a free coke fire in which the entire reaction takes place. An axle above the pan having a series of propelling iron shovels agitates the salt. About four fifths of the necessary amount of sulphuric acid is admitted by leaden pipes, and the machinery is set in motion. The evolution of hydrochloric acid is very regular. At the end of fifteen minutes a small quantity is taken out for test, and the rest of the sulphuric acid added.

Camack and Walker admit the chloride of sodium and sulphuric acid at one end of a long horizontal cylindrical rotating furnace, which issues at the outer end in the form of soda.

Hargreaves and Robinson attempt to shorten the process, and effect the formate of sulphate by bringing the gases from the pyrites burners, directly into contact with chloride of sodium at the proper temperature. The finely powdered salt is pressed into small cakes about 1½″ inches thick, and placed in a series of from 8 to 14 cylinders, 15′ in diameter and 12′ high, so united that gas entering at one end of the series must pass through all. The cylinders are kept at a dull red heat for fourteen to twenty days. The current of sulphurous anhydride, air, and superheated steam entering the cylinder in which the reaction is nearest completion, passes on through cylinders containing less and less of sulphate until the mixture of gases and vapor is deprived of all or nearly all sulphurous anhydride when it reaches the last cylinder containing salt scarcely attacked, and issues thence laden with hydrochloric acid to the condensing towers. As the action in one cylinder is completed, it is switched off and emptied and the next is advanced to its place.

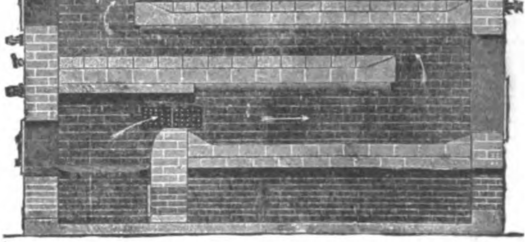
See Prof. Jenkins' report on chemical industries, "*Paris Exposition* (1878) *Reports*," vol. iv., page 82, *et seq.* And Kuhlmann's report on The Chemical Acts, Group III., vol. iv., "*Centennial Exhibition Reports*," page 93.

Soda appa., * Lixiviating.
Shank . . . . . . * "*Scientific American*," xlii. 67.
* Revolving furnace * "*Scientific American*," xlii. 67.
Soda carbonate apparatus
McClosky . . . . * "*Scientific Amer.*," xxxvi. 226.
Soda processes, Fr. . . "*Scientific American Sup.*," 2325.
Soda process, *Solvays* . "*Scientific Amer.*," xxxiv. 403.

So'da Ash Re-claim'er.

Fig. 2295 shows an ash furnace for reclaiming soda-ash liquor after it has been employed to reduce wood to a pulp. The liquor is first placed in a tank of iron over the top of the furnace, and is generally from 7° to 15° in strength. From the tank it descends first into an iron tray that has a slight slant to allow the liquor to gradually drop on to the next pan or tray. The second tray is made of fire-brick plates, 42″ wide; the third tray is made the same way. The liquor is gradually pushed down over these trays until the incinerating hearth is reached. To reclaim liquid soda ash into black ash requires a long flame and high heat, as not only must the water be evaporated out of the liquor, but

Fig. 2295.



Soda Ash Reclaimer.

the particles of wood must be burned. This requires soft or bituminous coal, waste wood or saw-dust; by discharging hot air on top of the fire the gas is ignited, and the flame is extended to the top pan or tray.

So′da-wa′ter Ap′pa-ra′tus. The principle of making aërated waters by the American system is by charging a cylinder of water with carbon gas, under pressure evolved by the mixing of sulphuric acid and whiting or marble dust. As used in England and her colonies, and on the Continent, the gas is made in a leaden generator, and by its own force issues into a gasometer, where it remains until it is pumped, with the water to be bottled, into the condenser, and is here mixed together by an agitator.

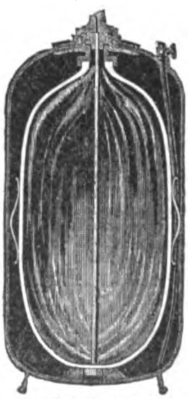
One of the first attempts to make artificial waters was made by Thurniessen in 1560, and from then to the present time the machinery for the manufacture has gradually been perfected. The system at present in use in the United Kingdom and on the Continent, is identical. It is what is called the "continuous direct action process." The principle of this is as follows: The carbonic acid gas is made in a leaden vessel, the carbonate being placed in, generally mixed with water, the acid, which is contained in a continuous vessel, being poured on by a simple arrangement in just sufficient quantities to generate the gas, no more being used than is absolutely required for the purpose, the waste product when exhausted being easily drawn off and a fresh charge inserted.

Various materials are employed as carbonates, these varying, of course, with circumstances, depending entirely on their handiness and cost, whiting, marble dust, carbonates of soda and magnesia, and very many other substances being used. The marble is supposed to effervesce less violently than less compact forms of carbonate of lime.

See "*Mech. Dict.*," pp. 2236, 2237.

So′da-wa′ter Foun′tain. Fig. 2296 shows a seamless fountain with glass reservoir inside a copper one, which withstands a pressure of 500 lbs. There is no pressure on the glass, as it is balanced by the gas between the two shells.

Fig. 2296



Seamless Soda-water Fountain.

So′da-wa′ter Foun′tain Cock. The coupling to which the pipe is attached passes into a square, hollow box, and by means of a thumb-screw is made tight; avoids all twisting and breaking of pipes, and requires no wrench.

Sod Plow. Avery's plow turns the sod either to right or left, and lays it so as to put ordinary grass out of sight.

So′fa Bed. A sofa whose seat is hinged to open out, the under side of the seat and the exposed part of the sofa, when unfolded, forming a mattrass.

Soft-board′ing. (*Leather.*) Boarding or bruising the leather on the flesh-side; it renders the skin very pliant.

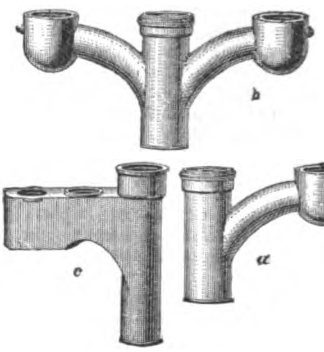
Soft Cen′ter Steel. A composition of iron and steel. A mold is divided into two or more sections by sheet or plate iron partitions. The metals are poured into their respective chambers, and the partitions, fused by the heat, weld the mass together. Used for safes, plows, etc.

The character of the center, that is, whether it shall be "hard" or "soft," of steel or iron, depends largely upon the use to which it is to be put. Where the use demands hardness on the outside for protection against wearing or abrasion, and at the same time considerable toughness in the center, as in plows, the center is soft or of iron. For ease of welding and toughness with rigidity, hard center or steel center is used. — *Iron Age.*

Soft Paste. (*Ceramics.*) A name applied to the material of porcelain, which is semi-hard only. It is of fine clay, with proportions of silex and other substances. A name applied either to the Worcester paste of England or to the *vieux Sèvres*. See PORCELAIN.

Soil Branch. A sewer pipe, making lateral connection with the hopper of a water-closet.

Fig. 2297.



Soil Branches.

a. Single soil branch. *b.* Double soil branch. *c.* Hospital soil branch.

Soil Pipe. A sewer pipe serving a water-closet.

Soil-pipe ventilator, *Boyle*, Br., * "*Engineering*," xxix. 127.

Soil Pul′ver-i-zer. An implement for triturating the earth in preparing for seeding.

See HARROW; DISK HARROW; CLOD CRUSHER; ROLLER, etc.

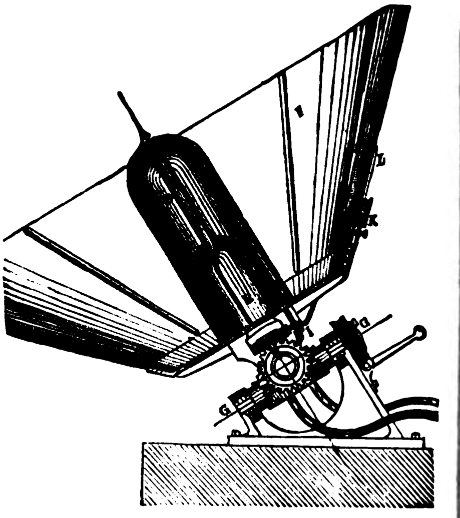
So′laire. An apparatus for using directly the heat of the sun's rays. The resolution of this difficult problem has been attempted from the time of Hero of Alexandria, B. C. 100, by Baptista Porta, Martini, Kircher, Bélidor, Oliver Evans, Ericsson.

The question is considered at some length in *Laboulaye's "Dictionnaire des Arts et Manufactures,"* tome iii., article "*Solaire,*" where Mouchot's apparatus is described and represented.

So′lar Boil′er. An apparatus intended to utilize the heat of the sun's rays.

Fig. 2298 shows Prof. Mouchot's solar boiler. *A* is a glass bell; *B* is a boiler with a double envelope; *D* is a steam-pipe; *E* is a feed-pipe; *F* is a conical silvered mirror; *G G* is a spindle around which a motion is given to the machine from east to west; *H* is the gearing regulating the inclination of the apparatus on the spindle *G G*, according to the seasons; *I* is a safety-valve; *K* is a pressure-gage, and *L* is a water-gage. The mirror has the form of a truncated cone, with parallel bases, and the generating line makes an angle of 45° with the axis of the cone. The incident rays striking parallel to the axis, are reflected normally to this axis, and give a heat area of maximum intensity for a given opening of mirror. The reflectors are formed of 12 silvered sectors, carried by an iron frame in the grooves of which they slide. The diameter of opening is 112.3″ at the top and 39.3″ at the bottom, giving an effective mirror area of about 45 square feet. The bottom of the mirror is formed of a cast-iron disk to add weight to the apparatus. In the center of this disk is placed the boiler, the height of which is equal to that of the mirror. It is of copper blackened on the outside, and is formed of two concentric bell-shaped envelopes connected at their base by a wrought-iron ring. The larger envelope is 31.5″ high, and the smaller, 19.68″; their respective diameters are 11.02″ and 8.66″. The water is introduced between these two envelopes, so that it forms a cylinder 1.18″ thick. The amount of water does not exceed 4.4 gallons, and about one third of the annular space is left as a steam-chamber. The inner envelope remains empty; it is furnished on one side with a copper pipe leading from the steam-chamber,

Fig. 2298.



Solar Boiler

and connected with the motor by a flexible tube. At the foot of the boiler is placed the feed-water tube. The glass envelope or bell is 15.75″ in diameter, and 33.46″ high, the thickness of the glass being .2″ thick. A space of nearly 2″ is thus left between the sides of the glass and the copper envelope.

The apparatus is mounted on an inclined axis, the angle of which can be made to change to correspond with the motion of the sun, and a rotating movement of 15° per hour can also be given to it. To effect this double object, the apparatus is carried on trunnions resting on a shaft perpendicular to their axis, and this shaft forms, from north to south with the horizon, an angle corresponding to the latitude of the place. Two movements result from this arrangement which permit the apparatus to follow the course of the sun, since by a half revolution it turns from sunrise to sunset, whilst by an annual rotation of 46° at most on the trunnions, it is brought opposite the sun in all positions. This double movement is effected by means of worm gearing, the first being repeated at half-hour intervals, the second every eight days.

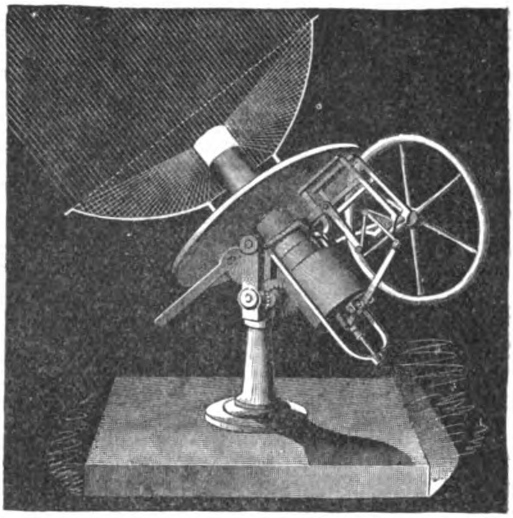
Experiments made with this apparatus at Tours showed that in 40 minutes 44 lbs. of water were raised from a temperature of 68° to 252°, and thence to a pressure of 5 atmospheres. In less than 15 minutes, 33 lbs. of water of 212° were raised to 307°. Finally, in favorable weather, 11 lbs. of water have been evaporated per hour. The steam generated was employed for driving a pump.

The inventor of this apparatus points out various uses for which it may be employed, especially in warm climates, as, for example, for the distillation of water, either on shipboard or in rainless countries, for the manufacture of ice, in connection with the Carré apparatus for the distillation of alcohol, etc., and in the manufacture of sugar.

So′lar Ca-lor′ic En′gine. Fig. 2299 represents Captain Ericsson's new engine for the utilization of solar heat in the production of motive power. It is calculated that the heat radiated by the sun during nine hours per day, for all the latitudes comprised between the equator and the 45th parallel, corresponds per minute and per square foot of normal surface to the direction of the rays to 3.5 thermo units of 772 foot pounds. Hence, a surface of 100 square feet would give a power of 270,000 foot pounds, or from 8 to 9 horse-power. The engine illustrated is on the caloric system, and has run at 420 revolutions per minute with the sun near the zenith and during fine weather.

Solar caloric engine.
Ericsson . . . . . * "*Scientific American*," xli. 67.
Solar engine, *Ericsson* . * "*Scientific American Sup.*," 1104.
Mouchot . . . . . "*Eng. & Min. Jour.*," xxx. 26.
Solar heat, applications of.
Simonin . . . . . "*Iron Age*," xviii., Sept. 14, p. 7; Sept. 21, p. 6.

Fig. 2299.



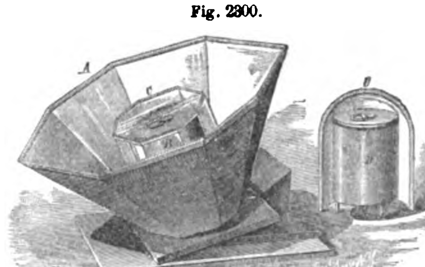
Solar Caloric Engine.

Appa., *Hittell & Dietzler* * "*Scientific Amer.*," xxxvii. 18.
Engine . . . . . . * "*Man. & Builder*," xii. 254.
Sun engine, *Mouchot*. * "*Engineer*," xlvii. 39.
Paris . . . . . . * "*Scientific American Sup.*," 2655.

So′lar Cook′ing Ap′pa-ra′tus. A device for utilizing the heat of the sun's rays for culinary purposes.

Fig. 2300 shows Adams's solar cooking apparatus used at Bombay. It consists of a conical reflector, *A*, made of wood and lined with common silvered sheet glass. Inside there is placed a copper cylindrical vessel, *B*, covered by a glass cover, *C*. The cooking vessel is raised about 4″ from the bottom, and the glass cover is 5″ longer than the vessel, and

Fig. 2300.



Solar Cooking Apparatus.

2″ wider, which leaves an interval of 4″ of hot air under the boiler and 1″ all round and at the top. The wedge under the apparatus is to keep it inclined, so that the rays of the sun may fall perpendicularly on the boiler. Glass being diathermanous to the direct or reflected rays of the sun, and non-diahtermanous to obscure heat, the rays penetrate the glass, and, striking on the vessel, become transformed into obscure heat, when they are retained by the glass. The glass cover over the boiler is made octagonal, because, in that form common window glass can be used. The position of the apparatus requires to be changed about every half hour, to face the sun in its apparent course from east to west. The rations of seven soldiers, consisting of meat and vegetables, are thoroughly cooked by it in two hours, in January, the coldest month of the year in Bombay, and the men declare the food to be cooked much better than in the ordinary manner. Several people in Bombay and in the Deccan have tried it, and always with success. If the steam be retained the dish is a stew or a boil; if it be allowed to escape the food is baked. The reflector is 2′ 4″ in diameter. The intensity of the heat is increased by increasing the diameter of the reflector.

So'lar Lamp. 1. Another name for the argand lamp. It has a tubular wick and central duct that admit air to the interior of the flame. See ARGAND LAMP, p. 142, "*Mech. Dict.*"

2. One of the fourth class of electrical lights. In all electric candles the carbons are placed parallel to one another, and as the waste of the two must be equal, they are fed by alternate currents. Some of them have an automatic arrangement for lighting and relighting. The candles without columbin are to be referred to the voltaic-arc class; Jablochkoff's candles possess the characters both of the arc and of incandescence.

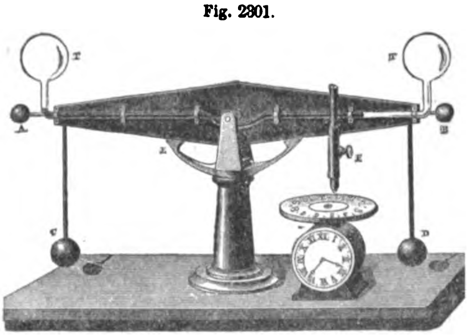
The Clerc and Bureau lamps are allied to the candle by the nearly parallel arrangement of their two carbons, and to the incandescence class by the nature of their light, produced as it is by a piece of chalk raised to a very high temperature, and made incandescent by the passage of the current across the voltaic arc established between the two carbons, and which grazes its surface. In the case of the candles, as in that of the *lampe-soleil*, a certain number of apparatus can be placed in one circuit; hence we might regard them as a fourth class of electric light apparatus by division (polyphote regulators).

So'lar Pho-to-graph'ic In'stru-ment. An instrument for photographing the surface of the sun.

So'lar Ra-di-a'tion Reg'is-ter. An apparatus to automatically register the period the sun shines.

In Fig. 2301 the two bulbs of the thermometer *T T'* are covered with lampblack. The bulb *T* to the left is alone exposed to the open air, all the rest being inclosed in a box. When the sun shines the air contained in the bulb *T* dilates, and the mercury in the differential thermometer is driven into the tube, thus destroying the equilibrium of the balance. The beam then inclines, and the point of the pencil, which is fixed to the support *F*, rests on a paper circle fastened to a copper disk. This disk keeps constantly revolving on its axis, carrying with it a paper dial. When the sun is

Fig. 2301.



Solar Radiation Register.

no longer shining the balance resumes its equilibrium, the pencil ceases to touch the paper, and the tracings made by it are thus broken.

To complete the description of this ingenious apparatus we will add that the metallic balls *A B* are provided with screws, and serve to place the beam in equilibrium. The rods *C D* are made of metal, and are designed to prevent oscillation.

Sol'der. A fusible metal used to join two less fusible metallic bodies.

Jewelers will find the annexed list of silver solders of considerable practical value. Hard solder: Pure silver 16 parts, copper 3½ parts, spelter ½ part. Medium: Fine silver 15 parts, copper 4 parts, spelter 1 part. Easy solder: Fine silver 14 parts, copper 4½ parts, spelter 1½ parts. Common hard solder: Fine silver 12½ parts, copper 6 parts, spelter 1½ parts. Common easy solder: Fine silver 11½ parts, copper 6½ parts, spelter 2 parts. The fusing points of these solders are as follows: No. 1, 1,866° Fah.; No. 2, 1,843°; No. 3, 1,818°; No. 4, 1,826°; and No. 5, 1,802°.

See "*Mech. Dict.*," p. 2239.

A few solders, the metal to which they are applied, and their appropriate fluxes, are tabulated below.

Name.	Composition.
Soft, coarse	Tin, 1; lead, 2.
Fine	Tin, 2; lead, 1.
Fusible	Tin, 2; lead, 1; bis., 1.
Pewterer's	Tin, 3; lead, 4; bis., 2.
Spelter, soft	Copper, 1; zinc, 1.
Hard	Copper, 2; zinc, 1.
Silver, fine	Silver, 66.6; copper, 23.4; zinc, 10.
Common	Silver, 66.6; copper, 30.; zinc, 3.4.
For brass and iron	Silver, 1; brass, 1.
More fusible	Silver, 1; brass, 1; zinc, 1
Gold, for 18 carat gold	Gold, 18 carats fine, 66.6; silver, 16.7; copper, 16.7.
More fusible	Same as above with a trace of zinc.
Platinum	Fine gold.

Material to be soldered.	Solder.	Flux.
Tin	Soft, coarse, or fine.	Rosin or zinc, chl.
Lead	Soft, coarse, or fine.	Rosin.
Brass, copper, iron, and zinc.	Soft, coarse, or fine.	Zinc, chl.
Pewter	Pewterer's or fusible.	Rosin or zinc, chl.
Brass	Spelter, soft.	Borax.
Copper and iron	Spelter, soft or hard.	Borax.
Brass, copper, iron, steel	Any silver.	Borax.
Gold	Gold.	Borax.
Platinum	Fine gold.	Borax.

To solder German silver, pour out some spirits of salt in an earthenware dish, and add a piece of zinc. Then scrape clean the edges to be soldered, and paint over with the spirit of salt. Apply a piece of pewter solder to the point and melt with the blow-pipe.

Comp. . . . . . "*Iron Age*," xxi., March 21, p. 7.

Sol'der Cut'ter. (*Sheet-metal Working.*) A machine for chipping solder into pieces convenient for use in soldering.

A fly-wheel operated by hand carries cutting blades. The operator feeds the bars of solder down an incline, and they are sheared between a bead on the frame and those on the wheel.

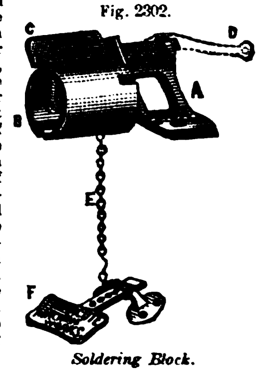
Sol'der-cut'ting Dies. Dies used in cutting out bars of solder in a press, eight in a block.

Sol'der-ing Fur'nace. A new form is adapted to burning coal oil, and is being extensively introduced as a heater for tinners' coppers, taking the place of the charcoal furnace.

Sol'der-ing Block. Used in soldering cans.

Fig. 2302 consists of an inclined frame, *A*; lever and "knife," *C*; expanding cylinder, *B*; chain, *E*; treadle and fulcrum, *F*, etc. A slot in the frame allows the use of different cylinders, from 1 lb. to 1 gallon, and their adjustment up and down, without changing the knife. A slot in the lever allows the knife to be set out for varying lengths of cylinders. Adjustments are also provided in the length of the chain, leverage of treadle, position of cylinder around its center, and "set" of the knife. The latter has a groove to prevent "tinning." The chain passes through the bench and hooks in at *D*. The action of the foot then raises the knife and the spring does the holding down.

Fig. 2302.



Soldering Block.

Sol'der-ing Frame. (*Sheet-metal Working.*) A clamp for holding the parts of a can in apposition while soldering.

Sol'der-ing I'ron. One recently invented has a platinum receptacle in which heat is instantaneously generated with air and petroleum vapor, or air and coal gas.

The Gem soldering iron is adapted to fit on an ordinary gas burner, with the copper up. The handle and tool are hollow, allowing the gas to escape through the point, where it may be ignited and the copper will be speedily heated.

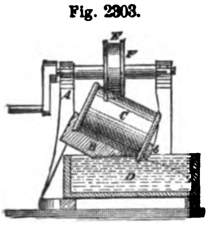
Soldering iron, gas heated * "*Scientific American Sup.*," 4106.
Soldering mach., *Howe* * "*Scientific American*," xxxv. 115.
Soldering tool, *Painter* . * "*Scientific American*," xlii. 178.

Sol'der-ing Ma-chine'. (*Sheet-metal Working.*) Howe's machine is for soldering the tops and bottoms of round cans. The cans roll along in an inclined trench, the edge passing along a shallow groove in which is melted solder. Page 108 of Bliss's catalogue (1881).

For soldering tin cans.

Fig. 2303 shows a machine especially suited for soldering the end seams of cans. *A* represents the frame of the machine, to which is attached a track, *B*, along which the cans are to be rolled. The track is flanged along its side edges to keep the cans *C* in place upon it, and has a side inclination to cause the ends of said cans to rest upon the lower side flange *b'* as they are rolled along said track. The track *B* is slotted in the lower side of its middle part, along the flange *b'* to allow the end seam of the cans to project through into a solder bath *D*, placed beneath it in the frame, and in which the solder is kept melted by a furnace. The bath *D* is of such a length that the cans may make at least one entire revolution with their end seams in the solder. The track *B* is made with an upward incline at one end, down which the cans are rolled in passing from the machine. The cans *C* are rolled along the track *B* by an endless band *E*, which passes around the pulleys pivoted to the frame, and to one of which motion may be given by hand or other convenient power.

Fig. 2303.



Soldering Machine.

Sol'der-ing Pot. For making joints in line wire.

When the upright handle is moved back, it allows a wire to be slipped down the slots, the joint being inside of the pot, which is partly filled with melted solder. The wire is pressed down on each side until it finds a secure lodgment in the bottom of the slots. The clamp is shoved forward so as to hold the wire in place, the arms of the clamp at the same time covering the slots and preventing the solder from running out. The pot is then tipped forward so as to cover the joint with solder, thus making a neat and well protected joint.

Fig. 2304.

Soldering Pot.

Sol'der-ing Tongs. A pair of flat nosed tongs used in brazing the joints of band saws. The saw is held in a scarfing frame, a film of solder placed between the scarfed edges which are lapped together, and then the heated tongs clamped upon them to melt the solder. See BAND-SAW HOLDER.

Sol'der Mold. A mold for running solder into any shape desired.

Sole. A recent inventor proposes to make boots with stone soles. A suitable quantity of clean quartz sand is mixed with a water-proof glue, and spread on a thin leather sole which is employed as a foundation. These quartz soles are said to be flexible and almost indestructible, while they enable the wearer to walk safely over slippery roads.

Sole Cut'ting Ma-chine'. The one shown in Fig. 2305 is adapted for cutting outsoles, insoles, heeling, counters, shanks, etc., and can be used with dies having handles or without. It has a circular revolving block; the die is fastened in a chuck over the block, and can be moved about as desired. The block is worn evenly by the constant revolving motion; the wear is taken up by raising the screw under the machine.

Fig. 2305.

Sole Cutting Machine.

Sole Form'ing Ma-chine'. One for rounding up shoe soles. A rounding up machine can shape 100 pairs of soles per hour.

The rounding is all done by one revolution of the knife, which at the same operation gives to the edge of the sole any desired bevel, and will work to patterns of any size or style, the changes being handily made.

Sole Leath'er Rol'ler. A machine for pressing leather stock into firmness, by passing between spring rollers. See Fig. 5309, p. 2244, "*Mech. Dict.*"

Sole Leath'er Strip'per. Adjustable blades or skivers for stripping the rough side of the leather.

Sole Mold'ing Ma-chine'. For shaping the cut sole to the shape of the last.

Sole Riv'et-ing Ma-chine'. The McKay riveting machine automatically cuts a rivet of the proper length, drives it, and clinches the point on the inside of the shoe. It clinches the rivet on a rotating horn, and thus makes the clinching certain. With the clinching rivet and the perfect length of the nail a thin insole can be used with safety. The rivets are corrugated so that they do not work up into the foot in wearing.

Sole Tile. A flat or bellying tile, according to requirements, for the bottom of sewers, muffles, or other objects in which the whole circumference is not in one piece.

Sol'id Plate Saw. A circular saw made of a single plate, as distinguished from a *segment* saw.

So'le-noid. An electro-dynamic spiral, having the conjunctive wire returned along its axis, neutralizing that component of the effect of the current that is due to the length of the spiral, and reducing the whole effect to that of a series of equal and parallel circular currents.

Sol'u-ble Glass. An alkaline silicate that is soluble in water, but remains unaffected by ordinary atmospheric changes.

The silicates of soda and potash differ from the other silicates grouped under the general name of glass in being soluble in water; hence they are known as soluble glass, liquid quartz, etc. While ordinary glass has been known from very ancient times, these peculiar compounds are quite new to us, having been accidentally discovered by the late Professor Fuchs, of Munich, in the year 1818, while experimenting with a view to the preparation of pure silica.

When soluble glass is applied to surfaces of plaster and limestone a chemical reaction takes place, resulting in the formation of silicate of lime. A vitreous surface is thus produced impervious to moisture and unaffected by atmospheric agents. Soluble glass is also used as a vehicle for mineral colors in a kind of fresco painting, known as stereochromy. The famous frescoes by Kaulbach, in the museum at Berlin, were done in this way. It is also entering into the preparation of paints for ordinary use.

One method of making artificial stone is by moistening fine sand with a solution of silicate of soda, pressing the mixture into molds, drying it and exposing it to a high temperature. The silicate fuses and cements the grains of sand together into a mass resembling sandstone. Any desired color is imparted by the admixture of metallic oxides previous to molding. Thousands of tons of the silicate are consumed for this purpose in England. Another important application of soluble glass is in calico-printing, where it is now extensively used as a mordant. It is even more in demand in soap-making, for which it has advantages over resin on account of its alkaline character. It also enters into the composition of fire-proof cements for stoves and iron-work, and especially for putting up iron fronts for buildings.

Soluble glass, uses of . "*Scientific American Sup.*," 1417.

Son'do-graph. A recording sounding apparatus, which see, specifically; an invention of Lieutenant Pinheiro, of the Brazilian navy, to give a continuous delineation of the bottom of the sea along the line on which it is operated.

See "*Telegraphic Journal*," vi. 426.

Soude a Dart. (*Surgical.*) A cannulated lithic instrument, having a flexible sound projected through it and out near the apex to collide with the stone. See Fig. 153, Part III., *Tiemann's "Armamentarium."*

Sound. Elliott's sound, modified by H. Leonard, is a new adaptation of a long surgical instrument, usually of metal, and partaking of the nature of a probe. It is used especially in making explorations in the bladder in search of stone. It is inserted through the urethra, and a peculiar click is heard when it comes in contact with a stone.

Simpson's sound (No. 8) graduated, and his (No. 9) telescope, for convenience in carrying, are also new modifications of the same instrument. To which may be added Dr. Helmutt's instrument for *supra pubis* puncture. Skene's uterine sound, *sonde de anal, sonde de belloc, sonde de Brisée, sonde à conducteur, sonde de saforest,* and *sonde* or pinchers of Hunter.

Sound Con-cen'tra-tor and Pro-ject'or. Hopkins' acoustic apparatus is a portable and adjustable whispering-gallery, having many useful applications. An air-tight drum or reflector, one head of which is rigid and the other elastic, is mounted on pivots in a swiveled support, and is provided with a flexible tube having a mouth-piece and stop-cock at its free end. Two wires are stretched across the face of the reflector at right angles to each other, and support at their intersection a small plane mirror, the office of which is to determine the position of the reflector in relation to the direction of the sound.

A small ear-trumpet is used in connection with the reflector, to increase the effect by gathering a portion of the sound that might escape the unaided ear. The reflector is adjusted by looking through the ear-trumpet toward the small plane mirror, and moving the sound-reflector until the source of sound is seen in the mirror. The reflector is then focused by exhausting the air from behind the flexible head until the required degree of concavity is reached, indicated by the ease with which sounds may be heard in the ear-trumpet. The air is withdrawn from the reflector by applying the mouth to the mouth-piece.

Sound'er. Sir William Thomson's apparatus for deep-sea sounding while the ship is in motion. See SOUNDING APPARATUS; FLYING SOUNDER.

Sound'er. (*Electricity.*) An alarm or call, made by closing an electric circuit.

The system of telephoning by means of beat of drum, long practiced in Africa, and called by the Cameroons *elliembic*, proceeds upon the principle of signaling by varying the beats according to a code. It perhaps would be too much to call it an alphabet code, and travelers who have noticed it do not seem to have been curious as to the nature of the system. The sound under favorable circumstances may be heard 2 or 3 miles.

The Mani-mani wooden portable signal drum known as the *clincufo* was shown at the Centennial in the Egyptian section, but the great drum *manyunjee* is a hollowed trunk of wood mounted on feet. It has sides of uneven thickness which give a different note aiding in giving variability to the signal. A similar drum from the Fijis is in the National Museum at Washington. See: —

Schweinfurth's "Africa," * ii. 24, 118.
Williams's "Fiji," * 129.
"Atlantic Monthly," * xxxix. 649.
Cameron's "Across Africa," * 231.
Duncan's "Western Africa," * 275.
Livingston's "Zambesi," * 98.
"Scientific American Supplement," 2737.

Sounder, India wires	. * "*Scientific American*,"	xl. 408.
Theiler	. * "*Telegraphic Journal*,"	vii. 63.
Simon & Son (gas)	. * "*Telegraphic Journal*,"	vii. 206.
Otto (gas)	. * "*Telegraphic Journal*,"	vii. 173.
Deep-sea, *Thomson*	. "*Min. & Sc. Press*,"	xxxv. 179.

Sound'-house. A marine alarm station from which audible alarms or signals are given in foggy weather. The apparatus are usually fog horns or sirens.

Sound'ing. Devices for sounding and gaging in surveys of the upper Mississippi; including stadia, water-gages, sounding stakes on sand-bars and trees, etc. See "*Report of Chief of Engineers, U. S. Army*," 1880, * ii. 1518.

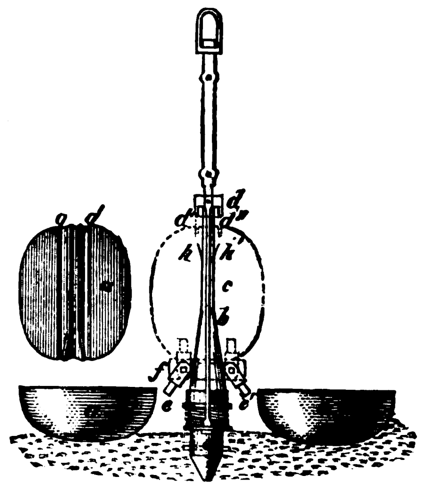
See BATHOMETER in "*Mech. Dict.*"

Sound'ing Ap'pa-ra'tus. A device for bringing up specimens of sea bottom.

In Admiral Sands' device a box is screwed into the bottom of the sounding lead and is secured thereto by a key. It has a conical point and is surrounded by a flanged sleeve pressed downward by a weak spiral spring. On striking bottom the point penetrates the ground and the flange on the collar forces it upward, exposing an aperture through which the mud, sand, or other material enters. When the lead is drawn up the spring reacts, closing the opening so as to prevent the specimen being washed out.

Admiral Sands has also invented an improved self-detaching sounding apparatus to be used in connection with the

Fig. 2306.



Self-detaching Sounding Apparatus.

specimen cup. The sinker is composed of two semi-ellipsoidal pieces a a', having central grooves unitedly forming a tube through which the stem b, attached to the sounding line by a swivel, passes. A rod, c, carrying a collar, d, having downwardly projecting prongs, passes through the stem longitudinally and is attached to the sleeve of the specimen box e. When a sounding is made the two pieces a a' are fitted on the rod, being held by the prongs d' d'' and pens e e' on the cross piece, f, entering the grooves g g'. When bottom is reached the upward movement of the sleeve on e raises the rod c, lifting out the prongs d' d'' on the collar d, and the pieces a a' are thrown off by springs h h' on each side of the stem b.

In an instrument invented by Sir William Thomson for taking flying soundings while a ship is in motion, the essential idea is to measure the depth by the pressure of the water at that depth, which is effected by lowering a pressure gage with the lead line. Of the two forms of gage the first and that chiefly in use consists of a narrow glass tube closed at one end and open at the other. When it is lowered into the sea the water entering the open end of the tube compresses the air column, diminishing its length in proportion as the water pressure increases, according to Boyles' well-known law. The height to which the water rises in the gage tube marks the limit to which the air has been compressed. The indicating mark is shown in various ways,—generally by lining the tube with a colored preparation that is removed as far as the water by pressure is driven up in the tube. The tube is of so narrow a bore that there can be no splashing of the liquid in it during the sounding process. The glass tube is guarded from shocks by a perforated metallic covering. The gage is provided at each end with a mounting containing a valve that opens inward under a definite amount of force As the tube descends into the sea, the lower valve is forced open, and the water enters the tube. When the hauling in is commenced, the lower valve shuts and holds the water that has entered it. On the other hand the pressure of the sea acting upon the upper valve causes it to open, allowing the air within the tube gradually to escape, obviating the danger of bursting from unequal pressure.

In order to ascertain the depth to which the tube has been sunk, a scale is provided, graduated in fathoms up to 100.

See Field's "*History Atlantic Telegraph*," Lieutenant-commanding Otway H. Berryman. See p. 2248, "*Mech. Dict.*"

See *Siemens*	* "*Scientific American Sup.*," 368.
Thomson	* "*Scientific American Sup.*," 1632.
Leocentre	* "*Scientific American Sup.*," 3305.
Fo'	* "*Scientific Amer.*," xxxvi. 182.
Rousset	* "*Scientific American*," xliii. 310.
de Luna e Cunha . .	"*Scientific American*," xlii. 32.
Sir William Thomson .	* "*Engineering*," xxiv. 329.
Sounding, deep-sea . .	"*Scientific American Sup.*," 728.
Soundings instrument.	
Sir William Thomson	"*Telegraphic Journal*," v. 285.

Sound'ing Board. The sounding-board of pianos is made of spruce, which, with its alternate soft and hard grain, is recognized and used as the best material for the purpose. The beauty and volume of tone in an instrument depend materially upon the sounding-board, and mainly from its quality to react against the molecular vibration of its most delicate inner fibers. This latter process puts the air column surrounding the sounding-board into that vibration that to the ear is perceptible as "tone." The pressure of these several particles of the sounding board against each other, more or less determine not only the power of tone, but its susceptibility, and the singing quality also depends greatly upon it.

Sound'ing Lead. The sounding lead of M. Leocentre, has a helical winged screw at the apex which rotates as the lead descends. On the axis of the helix is a bevel-wheel which transmits motion to a system of gearing, and the hands of two dials registering tenths of meters and meters respectively. The helix ceases to move when the lead touches bottom, and is loose on its axis as it is drawn up.

* "*Sc. American Supplement*," 3805.

Sound'ings Ther-mom'e-ter. The electrical balance thermometer, invented by C. W. Siemens of London, is intended to ascertain the temperature of the ocean at any depth, and is based on the principle that, as the electrical resistance of any metal conductor depends on the dimensions and temperature of the latter, we have only to find the law of the increase or decrease of its resistance for high or low temperatures to be able to determine the resistance from the temperature, or the temperature from the resistance. The deep-sea thermometer, constructed by him on the above principle, consists of a "resistance-thermometer," to which the sounding-line is attached, and of a battery, electrical bridge, and "balance-thermometer," to be used on board the vessel for determining the temperature indicated by the resistance-thermometer at any point of its descent or upon its reaching the bottom. The law of increase and decrease being known, a table is made up, by means of which to correct the deviations of the galvanometer into parts of a degree of temperature.

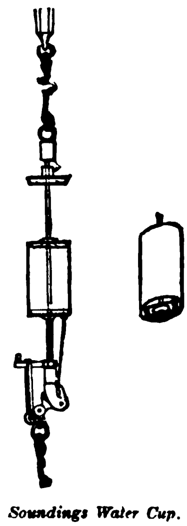
Trowbridge's deep-sea thermometer, "*Coast Survey Report*," 1858.

Six's self-registering thermometer, modified by Miller-Casella, is made in London.

Sound'ings Wa'ter Cup. A cup to bring water from the depths sounded.

An apparatus, designed to bring up one pint of water, consists of the following parts: A stem or spindle 0.5″ in diameter and 20″ in length, terminates at its lower end in a ring for the attachment of the sounding-lead, and at its upper end, in a slotted head, in which is pivoted the detaching trigger. This trigger is 3.5″ in length. It is pivoted at one end in the slotted head, and terminates at the other in a hook, curved upward, in which is placed one end of a rubber spring, as shown in the drawing. Near its middle the trigger carries a swivel for the attachment of the sounding-line; two curved lugs project from its lower side, and work, one on either side of the head of the spindle, so that when either is closed against it, by raising or depressing the free end of the trigger, the other will be open. For convenience of reference, the lug farthest from the free end of the trigger is designated the *rear* and the other the *front* lug. Below the slotted head, at a distance of 3″ from the pivot of the trigger, the spindle carries an arm 3″ in length, projecting in the plane of the trigger, and on the same side of the spindle with it. This also ends in a hook curved downward, over which passes the lower end of the rubber spring before mentioned. This arm slides on the spindle and is furnished with a set-screw, so that its distance from the trigger may be increased at pleasure. At a distance of 8.4″ below this arm the spindle carries a fixed disk 2.6″ in diameter, below this at a distance 4.5″, another disk 3″ in diameter. Passing freely over the former, and closing water-tight upon the latter, is a sliding cylinder 5.4″ in length. This cylinder is open at both ends, the upper end being furnished with a cross-bar and collar, working smoothly on the spindle, to guide the cylinder in sliding up and down. Attached to this cross-bar is a wire sling, ending in a loop, and of such a length that when this loop is placed over either of the lugs of the trigger, the lower end of the cylinder will come flush with the lower surface of the upper disk, as shown in the left-hand figure.

Fig. 2307.



Soundings Water Cup.

A spiral spring, coiled around the spindle between the projecting arm and the collar of the cylinder, tends to force the latter firmly down on the lower disk.

See "*Coast Survey Report*," by Lieutenant Collins, Appendix, No. 14.

The method of securing the specimens with the apparatus, shown in Fig. 2307, is as follows: —

A lead of sufficient weight (10 to 50 lbs., depending upon the depth of water and strength of current) is bent on close to the lower ring of the spindle, and a line, marked to fathoms, to the swivel on the trigger. If, now, the bottom-specimen is desired, the instrument is prepared by sliding up the cylinder and placing the loop of the sling over the *rear* lug of the trigger. A rubber spring is then stretched over the hooks of the trigger and projecting arm, this spring being of such a strength as to yield to the weight of the lead when the apparatus is suspended by the sounding-line, thus allowing the rear lug to close against the head of the spindle, preventing the cylinder from sliding down and closing on the lower disk.

Thus prepared, the apparatus is lowered into the water. On reaching the bottom, the weight of the lead being taken off, the rubber spring draws the hooked end of the trigger downwards, thus allowing the wire sling to disengage itself from the rear lug. The cylinder, forced down by the spiral spring, closes over the disks, and thus the specimen from the stratum in which it rested is secured and drawn to the surface.

For the intermediate specimens the apparatus is prepared by placing the loop of the sling over the *front* lug of the trigger, and supplying a rubber spring of sufficient strength to hold the free end of the trigger down when the instrument is suspended by the sounding-line, thus keeping the lug closed The line is then made fast to the rail of the boat or vessel, at such a place as will allow the mark indicating the number of fathoms from which the specimen is desired to be at the surface when the line has run out taut.

The instrument is then put overboard and allowed to descend freely. As it reaches the desired depth the line is tautened, the rubber spring yields to the shock of the arrested motion, and the cylinder closes instantly, as before.

Sour Beer Core. This term is applied to a dry-sand core in which sour beer or ale has been used for the purpose of increasing the adhesiveness and strength of the sand when dried.

Sour Kraut Cut'ter. A machine for cutting cabbage for kraut. A stationary hopper, has a sliding board with a double edge knife which runs with alternate action, cutting each way. Adjustable screws regulate the thickness of the cut. A follower is used to feed the vegetables to the knife, and is also useful as a partition in cutting small quantities. The cutter is worked by a crank, with its accompanying gearing.

Spade. A variety of spades are used by whalemen.

Boat spade, to disable the whale by cutting its flukes.
Cutting spade, to peel the blubber from the carcass of the dead whale.
Half-round spade, to cut the "blanket" piece to allow the blubber hook to enter.
Head spade, to cut off the head of the whale.
Mincing spade, to cut the blubber small for trying out.
Throat spade, to cut off the head of the whale.
Wide spade, to cut the blubber in the rough, before mincing.

Spade Gun. Invented by Buskett of St. Louis. A detachable spade may be fitted to a socket in the butt-plate and form an efficient implement in intrenching. When not in use it is carried in a recess in the stock.

See . . . . "*Scientific American Supplement*," 1938.
Spade gun, *Buskett* . "*Scientific American Sup.*," 1938.

Span'drel. An inner frame or border for a picture. A *mat.*

Spal'ling Ham'mer. An axe-shaped or chisel-edged hammer for rough dressing stone.

Span'ish Fox. (*Nautical.*) A seizing made by hand-twisting several yarns together and rubbing with hard tarred canvas.

Spank'er Gaff. (*Nautical.*) The gaff of the fore-and-aft sail, which is also called the driver; the aftermost sail of a ship or barque.

The *spanker boom* is the lower spar of the same sail.

Span'ner. A hoseman's wrench. The Skinner spanner has two equal arms, of which the rigid one has a pushing point slightly curved, while the pivoted arm has a drag hook on its end.

Spare An'chor. (*Nautical.*) An additional anchor, the size of the bower.

Spar'ger. A three nozzle self-acting revolving instrument for sprinkling paper, clothes, etc.

Spark Ar-rest'er. A wire or perforated screen to arrest the sparks that ascend smoke-stacks of locomotives, furnaces, etc.

Spark arrester, *Smith* . * "*Scientific American*," xxxvi. 70.
Davis . . . . . . * "*Railroad Gazette*," xxiv. 97.
Graham, Br. . . . * "*Engineer*," l. 41.
Stamp . . . . . . "*Man. & Builder*," viii. 9.
Garrett, Br. . . . . * "*Engineering*," xxx. 539.

Spark Net'ting. A wire cloth over the opening of a locomotive smoke stack, to arrest sparks.

Spawn'ing Screen. A device used in pisciculture to collect the spawn of fish. For list of United States patents, see FISH CULTURE.

Speak'ing E-lec'tric Tel'e-graph. See TELEPHONE.

Speak'ing Tube Whis'tle. A modification of an intonating modulating steam whistle.

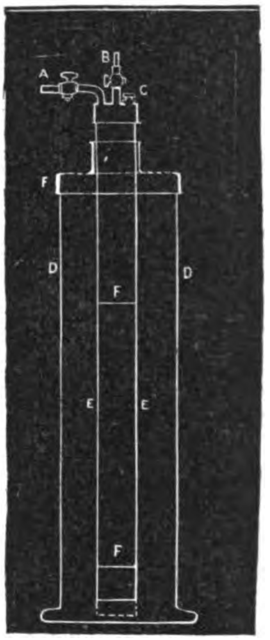
Spears. (*Fishing.*) Fish spears are barbed for securing the fish that are pierced thereby. They were used in very early days. Job speaks of them, as also do early Greek writers. They are of various makes adapted to the fish intended to be caught.

Spear Head. Spear heads are multiform both in shape and in the material of which they are made. They were generally made of stone or quartz by the aborigines of this country; although there was a notable exception with the (at least) partially civilized people who once resided in the neighborhood of the ancient copper mines of Lakes Superior and Huron. They possessed the means of tempering copper, that was lost with them, and notwithstanding all the researches of modern times, has never yet been rediscovered.

Spe-cif'ic Grav'i-ty Ap'pa-ra'tus. Fig. 2308 shows an apparatus for taking the specific gravity of coal and other gases by efflux through a fine opening in a thin plate of metal by Bunsen's method.

The apparatus consists of a glass jar, *D D*, having a perforated top with a collar or sleeve, through which passes a glass tube, *E E*, about 1″ diameter, open at the bottom, but closed at the top by a metallic cap having the connection and cock by which the gas is admitted at *A*; a thumb screw and place for thermometer, *C*, with the pillar cock *B*, on top

Fig. 2308.



Specific Gravity Apparatus.

of which is the exit opening through the thin metal plate. The glass jar *D D* being filled with water to the proper height, the tube *E* can be filled with gas or air at pleasure, thus forming a simple instrument, and one easily operated. Another form, equally simple, and very accurate, is Dr. Letheby's method; the apparatus consists of a glass globe about 6″ diameter, having engraved upon it its exact weight when full of air at mean temperature and pressure (a counterpoise weight being provided exactly equal to the weight of the globe when the air is exhausted): this globe is fitted with two cocks, one of which is attached to a gas pillar; to the other is attached a glass tube ½″ diameter and 7″ long, to which is suspended a thermometer, the end of the glass tube being fitted with a jet for burning the gas.

Goodwin's stop watch for density test of gas, "*American Gas-light Journal*," * July 3, 1876, p. 7.
Goodwin's minute clock, * *Ibid.*, p. 7.
Letheby's specific gravity apparatus for gas, * *Ibid.*, p. 7.

Goodwin's density and specific gravity apparatus, * *Ibid.*, p. 6.
Taylor . . . . * "*Scientific American*," xxxvii. 360.

Spe-cif'ic Grav'i-ty Bal'ance. The instrument employed in the office of the Constructor of Ordnance (U. S. A.) in the determination of the specific gravity of metals for cannon, is simply a form of the hydrostatic balance. It is shown in Plate I., accompanying Appendix I., *c*, to the "*Report of the Chief of Ordnance, U. S. Army*," 1877, and described on p. 394.

The Troemmer instrument for obtaining the specific gravities of large grained powder is a mercury densimeter and is described on p. 396 of above volume, and accompanying Plate II.

Description of the Du Pont, de Nemorirs & Co.'s machine, "*Ordnance Report*," 1879, Appendix I., Plate VII., and pp. 113-115.

Mohr's balance is for taking the specific gravity of liquids by a method which requires no calculation and but a small quantity of the liquid. The apparatus is shown in Fig. 5352, p. 2257, "*Mech. Dict.*"

Spe-cif'ic Grav'i-ty Bot'tle. A slight blown glass bottle of known capacity for obtaining the specific gravity of liquids by weighing measured quantities.

Spe-cif'ic Grav'i-ty Ma-chine'. A new densimeter submitted to the Academy of Sciences, Paris, by M. Gosselin, is very simple in construction and operation. A wooden rule is suspended by a wire attached to some convenient point other than the central point. To the long arm a weight is attached sufficient to balance the body to be examined hung at the end of the other. The latter is immersed in water, and the weight on the longer arm is moved until the rule is again horizontal. A scale on this arm shows at once the density of the body at the point occupied by the weight.

Spe-cif'ic Grav'i-ty Scales. For determining the specific gravity of metals and other substances.

One form is adjusted to accurate balance with its counterpoise and loop removed from the beam, but with double baskets in position, and a vessel supplied with water. In determining specific gravities, the mineral or other solid to be tested is placed in the basket and the pan holder or counterpoise is adjusted to the position, established at a convenient distance from the fulcrum, and marking the extreme working length of the lever arm. One or more of the pans are placed upon the holder to counterbalance the weight of the mineral and a sufficient quantity of the granulated copper is placed in the pan to cause the beam to assume a horizontal position or to stand in perfect equilibrium. The mineral is then removed from the upper basket and placed in the lower basket where it is submerged in the water contained in the vessel. The counterpoise with its load of pans and granular material is then moved along the beam toward the fulcrum to a position where it just counterbalances the submerged mineral. This position corresponds with the specific gravity of the mineral, and the amount being indicated by the graduated scale, can be read off direct, thus giving at a glance the correct specific gravity without regard to the weight or quantity of the mineral or other substance under test.

Spec'ta-cles. Protective spectacles are made of various forms and material to protect the eyes of engineers, firemen, furnace tenders, masons, etc.

The use of such protection from snow has long since been recognized by the Esquimaux and other uncivilized and semi-civilized people.

"In order to avoid the terrible glare of the Arctic snow, we find the Esquimaux have invented snow spectacles. These consist of a piece of wood cut out in the shape of a spectacle; where the glass should be in ordinary spectacles we find two very fine slits. This apparatus I should think would be admirably adapted to drivers of railway engines, who have to encounter snow, wet, and hail, as the engine rushes through storms at express pace. The eye itself is entirely protected, while it gets a fair lookout through the slit in the wood. The ingenuity displayed by these hardy Esquimaux is very interesting and instructive." — *Frank Buckland in* "*Land and Water.*"

Spectacle lens, annular, *Rowell*, * "*Scientific Amer.*, xl. 293.

Spec-trol'o-gy. The science of chemical analysis, by means of the lines of spectra, as modified by the volatilization of different elements.

Spec-trom'e-ter. For measuring the intensity of light.

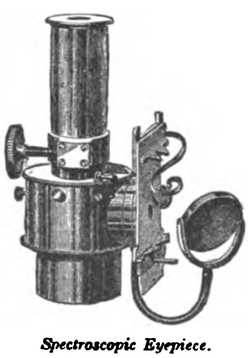
Prof. J. W. Draper describes in the July, 1879, issue of *Silliman's Journal* a new instrument, which he calls a "spectrometer," and which he proposes to employ to determine the intensity of a light, on the general principle that a light becomes invisible when it is in the presence of another light about sixty-four times more brilliant. He brings the spectrum of the light to be measured into the presence of an extraneous light of known illuminating power, and varies its distance from the instrument until its light is just sufficiently powerful to extinguish the spectrum. The suggestion is novel and valuable, and our readers are referred to the original communication for details. We remark incidentally that, in the use of this instrument, Prof. Draper found that the generally-accepted belief that the yellow is the brightest of the colored spectrum spaces is not true of the prismatic spectrum, and that the luminous intensity diminishes from that in both directions, above and below; that the "extinguishing flame" first extinguished the violet, then the other more refrangible colors in their descending order, and that the red was the last to persist. The red, he found, was invariably perceptible long after the yellow had disappeared. On diminishing the illumination, the red region of the spectrum first comes into view, the other colors following in the order of their refrangibility. He believes this apparent contradiction to be due to the action of the prism, "which narrows, and, as it were, condenses the colored spaces more and more as we pass toward the red, increasing the intensity of the light as it does that of the heat."

Spec'tro-scope. Christie's half prism spectroscopes have ordinary prisms that have been cut in half by a plane perpendicular to the base. In summing up the advantages of the half prisms: Suppose two slightly divergent rays of monochromatic light to pass through an ordinary prism, the angle of separation will not be changed so that the rays emerge at the same angle to each other which they had at entrance. But if two such rays fall perpendicularly upon a face of the half prism, the deviation of one ray in traversing the glass will be much greater than that of the other, and they will consequently emerge at a much wider angle. It is therefore claimed that the half prism is equivalent to a magnifier with cylindrical lenses.

Spectroscope, *Mouton*, Fr. "*Scientific American*," xxxvii. 40.
Ricco . . . . . . * "*Scientific Amer.*," xxxvi. 184.
Thollon, Fr. . . . . "*Scientific American*," xli. 25.
Application of . . . "*Scientific American*," xxxv. 16.
Compound, *Thollon* . * "*Manuf. & Builder*," xii. 12.
In solar work . . . * "*Scientific Amer.*," xxxix. 242.
Measuring appa. for.
Reynolds . . . . * "*Scientific American Sup.*," 1946.
Uses of . . . . . "*Scientific Amer.*," xxxiv. 257.

Spec'tro-scop-ic Eye'piece. (*Optics.*) An adaptation of the spectroscope to the microscope for the examination of minute substances. It consists of a compound direct prism, fitted over a Huyghenain eye-piece, a slit and a supplementary stage upon which an object can be placed for comparison with another which is laid upon the stage of the microscope.

Fig. 2309.



Spectroscopic Eyepiece.

This piece of apparatus fits into the draw-tube of the microscope in place of the ordinary eye-piece, and by it accurate observations are made on the positions of the various absorption bands in the spectra of various fluids, crystals, minerals, etc.

Spec'trum. The several colored and other rays of which light is composed, separated by the refraction of a prism or otherwise, and exhibited, either as spread out on a screen or in direct vision.

Spec'trum Scale. (*Optics.*) A slice of a crystal of quartz of a given thickness, cut parallel to its axis, placed between two Nicol's prisms, and giving a series of black bands. It is used as a standard for recording the position of the absorption bands in objects examined under the micro-spectroscope.

Spec'u-lum. The Storer vaginal speculum is so arranged that by a simple spring attachment at the side of the cusco bivalve, the blades may at once be disjointed, swung around back to back, and there fixed by a turn of the nut upon the screw traversing the handles, with the effect of giving a retractor equal in working facilities to that of Sims.

Neugebauer's speculum consists of four blades, with short, flat handles, all of which fit into each other compactly. Each blade resembles in shape that of Sims, differing but slightly in the curve and in not having its end rounded up. The main peculiarity of the instrument consists in the different blades being so proportioned to each other that any two consecutive sizes may be combined to form a tube; the lateral edges of the smaller are then inclosed within those of the larger.

The larger of the two selected is introduced posteriorly, as Sims' would be; the other enters beneath the pubic arch. The point of the latter, which at the outset is in the hollow of the opposite blade, gradually emerges as the blade is pushed forward.

It requires a little practice to enable one to perform this manipulation without inflicting some pain upon the patient. The result is a perfect tube through which the cervix may be readily inspected. The four blades form three complete specula of different sizes.

Amongst other specula not yet noted are those of Dr. E. B. Turnipseed, Sims' solid and wire instruments, Dr. E. W. Jenks', and Nott's instruments.

Speculum polisher, *Grubbs*, Br., * "*Engineer*," xlii. 160.

Speed. A leg or beam to which a drilling apparatus is attached. The word may not, in this connection, have a very extensive application, but is applied to the beams supporting the drilling tubes in submarine rock-drilling, as at the Rapide aux Galoups, St. Lawrence River.

The comparative speed of various saws and other machine tools are given as follows: —

Velocity of circular saws at periphery	6,000′ to 9,000′ per minute.
Rate of feed for circular saws	15′ to 60′ per minute.
Velocity of band-saws . . .	3,500′ per minute.
Velocity of gang-saws, 20″ stroke	120 strokes per minute.
Velocity of scroll-saws . . .	600 to 800 strokes per minute.
Velocity of planing machine cutters at periphery . . .	4,000′ to 6,000′ per minute.
Velocity of molding machine cutters	3,500′ to 4,000′ per minute.
Velocity of squaring-up machine cutters	7,000′ to 8,000′ per minute.
Velocity of wood-carving drills	5,000 revolutions per minute.

Speed In'di-ca'tor. An instrument for registering the speed at which an engine or machine may at any given time be traveling. Some of them are purely automatic in their construction, while others are in conjunction with their mechanical device operated by hand.

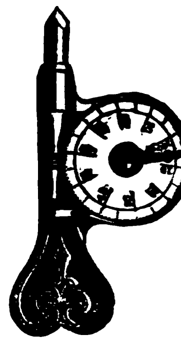
The Harding & Willis Indicator is designed to reveal by a glance at the needle, and without counting or using a watch, the speed at which the engine or machine is working. The small pulley is driven by a quarter-inch band from a second pulley placed on the shaft whose speed is to be indicated. The pulley drives a small shaft on which is fixed inside the casing a small fan with radial vanes. Alongside this fan is placed another one very delicately mounted on a small steel spindle that carries, but outside the fan-box, the indicating needle which works on the dial in the usual way.

The spiral spring always tends to bring the needle to the zero of the instrument, which is, of course, the lowest speed it is intended to indicate. When the fan is caused to revolve it has a tendency, on account of the air inclosed in the casing, to carry round in the same direction the other fan, together with the index-needle, and that against the resistance of the spiral spring. The greater the rate of the revolution to the greater extent is it possible for this fan to overcome the tension of the spring, so that the farther round will the needle be carried. The needle and fan are brought to rest as soon as the pressure on the fan vanes is balanced by the resistance of the spiral spring, the needle then indicating the increased velocity. The dial is indexed for each revolution per minute from 25 to 50, and by means of the eye the divisions may be subdivided to a quarter revolution.

The Union Boston Indicator (see Fig. 2310) is used to register the speed of any revolving shaft, pulley, or mandril.

To ascertain the number of revolutions of the shaft in a given time the point of the indicator is placed in the center of the shaft, and for each hundred revolutions the dial revolves once. Less than one hundred will be indicated by the pointer, which requires to be placed at the 100 before starting.

Fig. 2310.



Speed Indicator.

By a device on the face of the dial a person may feel with the end of the thumb how often it revolves without looking at it, thus enabling the operator to keep correct time.

The Westinghouse Railroad-speed Indicator is an apparatus for ascertaining and recording the speed of a train at any given instant, and by means of automatically constructed diagrams showing the fluctuations of the velocity caused by the applications of the brake.

The principle of construction consists in controlling the escape of water under pressure by means of a small valve loaded by the action of centrifugal force, the arrangement being such that the higher the speed at which the apparatus is driven, the greater will be the pressure exerted by certain revolving weights upon the escape valve, and the higher, therefore, the pressure maintained within the chamber with which this valve communicates, the chamber receiving a constant supply of water from the pumps.

A pressure-gage affixed to the chamber containing the water affords information as to the speed that is attained. The registrations are made on a paper drum similar to that used at meteorological stations to record the velocity of the wind. The heights of the recording lines on the diagram represent pressures on the accumulator of the speed indicator, and these pressures are proportioned to the squares of the speed.

There is a differential speed indicator adopted by all the ironclads of the French channel squadron.

Speed indica., *Butler*, Br. * "*Engineer*," xliii. 293.
Portable . . . . . * "*American Miller*," iv. 28.
Hobson, Br. . . . . "*Iron Age*," xix., April 12, p. 1.
Moss . . . . . * "*Scientific American Sup.*," 85.
Weir . . . . . * "*Scientific American Sup.*," 89.
Train, *Westinghouse* . * "*Engineering*," xxii. 203.
Ship's, *Normanville*, Br. . . . . . . * "*Engineer*," xlvi. 198.

Speed Meas'ure. Brown's measure (Fig. 2311), has a mercury reservoir and a radial communicating pipe. As the device is revolved by the machinery, the mercury, obeying the centrifugal force, passing up into the tube descends in the axial graduated tube, its sinking being the measure of the speed of rotation.

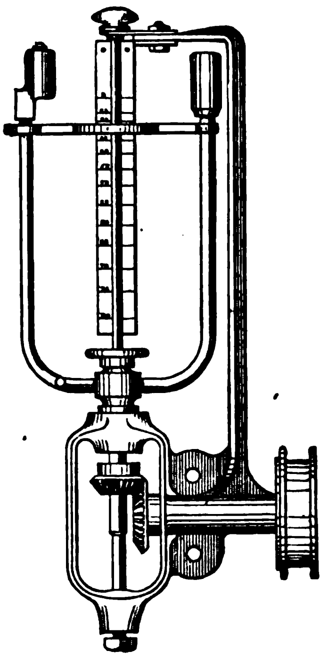
Speed Meas'ur-er. The speed measurer for trains, used at the brake trials at Cassel, Germany, in 1877, consisted mainly of (1) contact instruments, (2) reading instruments, and (3) reading-off instruments.

The contact instruments were fixed by the side of the rails at 33⅓ meters apart along each trial ground, and were all in electric communication with the reading instrument, which, with the reading-off instrument, was fixed in a room of the Buntershausen station.

The apparatus is described in

Speed measurer for trains, Ger., * "*Engineer*," xliv. 235.

Fig. 2311.



Speed Measure.

Speed Re-cord'er. Miller's speed recorder is an indicator of the speed of trains, their stops and delays (necessary and unnecessary), registering the same for reference. See under STEAM GAGE, *infra*

See, also, "*Scientific American Supplement*," 1457.

Theiler, Br.	* "*Engineering*," xxiv. 155.
Westinghouse	* "*Engineer*," xliii. 10.

Speed Reg'u-la'tor. Hübner's governor or speed regulator for railway horse powers is intended for regulating such powers in small factories, etc.

The rim or circle is fastened on the power behind the belt wheel, leaving the shaft in the center. The hub has arms attached, with weighted balls, friction blocks, and a stud with a small coiled brass spring, adjustable with a thumb-screw at the end to regulate the amount of speed needed. As the velocity of speed throws the balls out the friction blocks are pressed against the rim, and act as a brake, but as soon as machinery is applied and takes the power, the balls drop back and relieve the breaking.

See, also, "*Scientific American*," xlii. 245.

Speed regulator for light machinery, * "*Engineer*," xlix. 606.

Speed'y-cut Boot. See HORSE BOOT.

Spel'ter-Sol'der Al-loy'. A good solder for copper and iron is composed of three parts zinc and four parts copper.

A softer solder that is used for ordinary brass work is composed of equal parts of zinc and copper.

A very hard but fusible solder is composed of two parts zinc and one part copper. This solder is so hard and brittle that it can be easily crumbled in a mortar when cold.

The two first solders are first alloyed and cast into ingots. The ingots are allowed to cool in the mold, and then reheated nearly to redness upon a charcoal fire, and are broken up on the anvil, or in a mortar, into a finely granulated state, for use.

Spelter furnace . * "*Scientific American*," xxxix. 402.

Spen'ce's Met'al. A metallic compound consisting of a metallic sulphide mixed with sulphur.

Used for pipe-joints, calking metallic joints, etc.

Announced in a paper read by Dr. Cole before the Society of Arts. Reported in "*Engineering*," 1880, and repeated in "*Van Nostrand's Mag.*," xxii. 371.

Sperge. A charge of distiller's wash. *Muspratt.*

Sphe're-om'e-ter. A sphere-measurer, adapted to measure the radius of a sphere, invented by the French optician De La Roue, to measure the radii of lenses.

This instrument is valuable to opticians, for if they know the radii of the spherical surfaces of a lens, and also the refracting power of the glass of which the lens is composed, they can estimate the general action of the lens on rays of light that fall upon it, and thus arrive at a knowledge of the focal length of the lens.

Sphere Turn'ing Lathe. A lathe for turning spheres; mechanically adapted to the production of a perfect lens.

Its principle is based on the fact that the section of a true sphere at any part is always a circle.

Sphyg'mo-graph. An instrument for indicating the movement of the pulse.

The nature of the circulatory system and even the functions of the arteries and the veins and the nature of the blood were long enigmas.

Praxagoras of Cnidus (300 B. C.) wrote on the pulse, showing that it is a measurer of the force of disease, and discussed the difference between arteries and veins.

Theophilus of Alexandria ("*De Corporis Humani Fabricu*") wrote on the pulse and attributed it to the contraction of the heart.

Erosistratus of Alexandria described the action of the heart, but supposed that the arteries carried air and the veins blood. He noticed the lacteals, but did not understand their function.

Servetus of Geneva (burned 1553), observed the smaller circulation of the blood, that from the head through the lungs and return.

Rialdo Colombo ("*De Re Anatomica*," 1559), successor of Vesalius, at Padua, described the pulmonary circulation.

Fabrizio of Padua (*Acquapendente*), 1562, noticed that the venal valves all opened towards the heart. Harvey was one of his pupils.

Galileo (fl. 1610) invented an instrument for rendering the arterial pulsations visible. Placing one end of a light mirror upon the artery leading to the thumb and the other upon a fixed object, he caused the image of a sunbeam reflected from the mirror upon an opposite wall to vibrate in unison with the pulse. A remarkable similarity exists between this and Sir Wm. Thomson's galvanometer. No apology is needed for naming them together.

The idea was revived by Wenham (Engl.) ("*English Mechanic*," xxiv. 20) who proposed to use a small mirror laid on the pulse and reflecting upon a wall or screen.

Aselli of Milan ("*De Venus Lacteis*," 1627), discovered the function of the lacteals which pour the chyle into the blood.

Santorio of Padua ("*Commentarius in Primum fera Primi Libris Canonis Avicennæ;*" Venet, folio, 1626), invented an instrument for measuring the force of the pulse.

Andrea Cæsalpin ("*Exercitatio Anatomica de Cordis et Sanguinis Motu*," 1628) seems prior to his published work to have understood the greater or systematic circulation. A monument has been erected to him in Rome as "the discoverer of the circulation of the blood," and a table attributing the discovery to him has been attached to the portals of the University of Pisa, where he once taught.

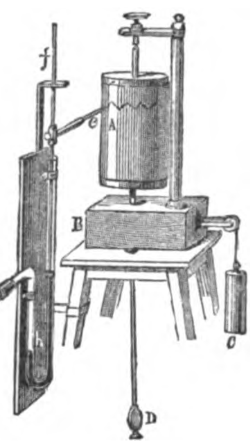
Harvey, in 1616, made the discovery of the nature of the arterial and venal circulations and the double circulation. The doctrine was first publicly discussed and combated as Harvey's, in Europe as well as in England. Within a century of the death of Harvey, the father of modern physiology, Haller, revived the whole controversy, and gave a verdict in favor of the English physician. Holding that the true discoverer of any truth is he who draws it from its sources "at his own risk and by his own meditations, and establishes it by arguments so forcible that they convince those who are longing for the truth," Haller decided that "not to Cesalpinus, on account of a few utterances of obscure meaning, but to Harvey, the laborious author of numerous experiments and the expounder of all the arguments which, in his time, could be advanced, belongs the immortal glory of the discovery of the circulation of the blood."

An apparatus for measuring the force due to the arterial circulation in a living animal, was made by an English physiologist, Stales, during the past century.

He was followed by Ludwig, the present professor of physiology at Leipsic, who contrived a registering instrument, Fig. 2312, to record the variations of pressure of the blood circulating in the arteries.

A tube was applied to the artery of the animal and the varying force of the blood, acting upon a column of mercury, caused a float to rise and fall and a pencil attached thereto traced upon a turning cylinder each oscillation of the manometer.

Fig. 2312.



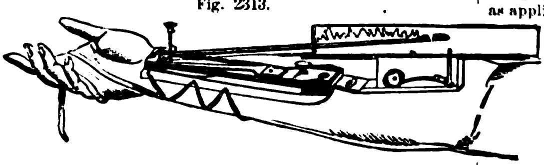
Ludwig's Register of Arterial Pulsations.

This is said to be the first registering instrument constructed for the uses of physiology.

The *sphygmoscope* proper (σφυγμός, the pulse, μέτρον, to measure) that is, the instrument applied to the pulse, was invented by Professor Vierardt, of Tübingen. It was not a *sphygmometer*, or *sphygmograph*, for it neither counted nor recorded the pulsations, but its indicator oscillated in the fashion of a pendulum and afforded a means of counting by the eye instead of by the strokes of the pulse against the finger-ends.

The *sphygmograph* first attained definite shape in the invention of M. Marey. A view of the apparatus detached is shown in Fig. 5380, p. 2365, "*Mech. Dict.*," but its operation will be more readily understood from viewing it in position, Fig. 2313.

Fig. 2313.



Marey's Sphygmograph.

It may as well be mentioned here that instruments which graphically indicate the beating of the heart are applied to the chest, and entitled CARDIOGRAPHS.

Marey's sphygmograph employs a spring pad to rest upon the pulse and the degree of pressure is obtained by means of a regulating screw. This spring device is so light that it follows faithfully the movements which are communicated to it by the exterior pulse, due to the swelling and collapsing blood vessel beneath the skin. These movements are so slight that it becomes necessary to amplify them, and this is done by translating the motion of the spring to a very light wooden lever near the axis of its movement. The outer end of the lever carries a scriber which records on a moving strip of paper, movements many times greater than those received from the artery. Extreme lightness of the lever and the union of the lever with the spring, the movements of which it records in much greater amplitude, are the necessary conditions for a good trace.

The sphygmograph reveals many delicate shades of difference in the pulse, showing the suddenness or slowness of the impulse, its strength or weakness, its length or brevity. The degree of abruptness is indicated by the angle of the line of trace departing from the base or horizontal line. The strength is shown by the amplitude of the excursions of the pencil; the duration, which is tantamount to the rate of repetition, is shown by the position occupied by each beat upon the length of the trace.

The ribbon is moved by clock-work.

The same rules govern as in the instruments for graphically representing articulate sounds, as mentioned under PHONAUTOGRAPH, p. 1678, "*Mech. Dict.*," and illustrated under TELEPHONE, *Logographic curves*, Fig. 6257, pp. 2514, 2515, *Ibid.*

The sphygmograph of Marey was followed by several devices for the same purpose, notably by that of Holden, described in his work "*On the Sphygmograph*," Philadelphia, 1874. He there credits Vierordt with the suggestion of the instrument, and refers to Professor Burdon Sanderson's improvements on Marey.

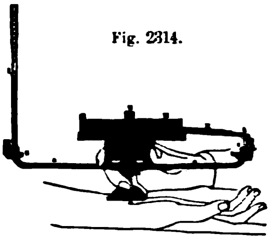
Holden's sphygmograph differs from Marey's (1) in the form of the pulse-spring, which is made to partially embrace the artery instead of merely resting upon it; (2) in conveying a to-and-fro lateral instead of a vertical motion to the tracing pencil; (3) and in a watch-spring device for registering the pressure upon the artery.

See also Dr. Sanderson's "*On the Sphygmograph*," an English work.

The sphygmograph of Dr. Keyt, of Cincinnati, Ohio, illustrated and described in the "*New York Medical Journal*" (xxiii. pp. 25 *et seq.*, plate opp. p. 30), and shown in Fig. 2314, has points of resemblance to the Marey instrument, but still more numerous novel features.

The base or receptacle *a* is made of thin brass, semi-circular above, but with a free, oblong edge below, over which is stretched an elastic rubber membrane which, when in use, lies upon the pulse and partakes of its movements. In the neck of the chamber *a* is a tube, *b*, which has a three-way stop-cock and two lateral branches, *c c*, leading to the two extremities of the instrument. From one of these rises a graduated glass tube in which the liquid affected by the beating of the pulse against the membrane rises and falls in a degree proportioned to the force of the arterial impulse and at a rate, of course, coincident therewith.

Fig. 2314.



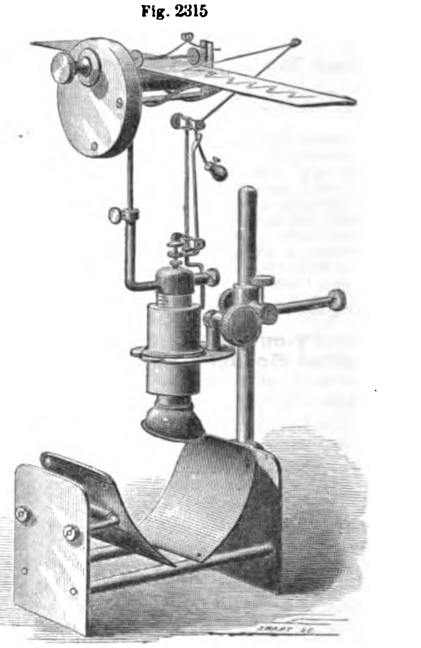
Keyt's Sphygmograph.

At the end of the other tube, *c*, is a small cup, *g*, in which is a disk resting on the fluid in the tube, and from the disk rises a stem, *j*, supporting a lever, *k*, on whose free end is the pencil which makes the trace upon the smoked glass slide which is traversed by clock-work.

The instrument weighs 8 oz. when filled with the liquid, and is 12″ long, 4″ high. The graduated tube folds down to place the instrument in its case. It is usually held by the hand of the observer, as in the illustration, which shows it as applied to the radial artery. Much fuller details of construction are given in the "*New York Medical Journal*," above cited, and republished in * "*Scientific American Sup.*," 117, 118.

Pond's sphygmograph, shown in Fig. 2315, is an improvement upon the *Sphygmoscope*, shown in Fig. 5381, "*Mech. Dict.*" The instrument is capable of adaptation as a sphygmograph, cardiagraph, myograph, or pneumograph, but in the figure is shown as

Fig. 2315



Pond's Sphygmograph.

adapted to the pulse of the forearm, which should lie in the cradle below. The tube, with an elastic membrane at its lower end, rests upon the pulse, and the pulsations, acting upon the membrane, are transferred to the liquid contents of the tube raising the piston; these motions are transferred to the stylus, which makes traces upon the smoked glass plate, which is traversed at right angles to the line of motion of the style. The combination of the two motions gives the graphic representation.

By the sphygmograph we may read the pulse as follows: —

The *amplitude* of the pulse is shown by the height of the undulations.

The *regularity* of the pulse is shown by the rhythmic succession and equal stages and development of the undulations.

The *frequency* of the pulse is shown by the rapidity of succession of the undulations.

The *quickness* of the pulse is shown by the suddenness of the ascent of the undulations.

The *compressibility* of the pulse is shown by the degree of elevation at which is displayed the maximum amplitude of the undulations.

The *tension* of the pulse is shown by the mark of compressibility in connection with the rate and manner of descent of the undulations.

The *dicrotous* of the pulse is shown by the distinct break in the line of fall, or, as frequently seen, a second rise from the line of fall, or bottom of the undulations.

Minor sphygmographic curves are at times shown by the lesser interruptions in the fall of the undulations.

It is suggested that an enlarged shadow of the undulations might be projected on a screen in a clinical theater; or photographed upon a prepared surface moved as in the THERMOGRAPH or BAROGRAPH, Fig. 6350, p. 2546; Fig. 569, p. 234, "*Mech. Dict.*"

See following United States patents: —

203,548 *A. T. Keyt*, sphygmometer, May 14, 1878.
167,785 *W. R. Pond*, sphygmoscope, Sept. 14, 1875.
161,821 *W. R. Pond*, sphygmoscope, April 6, 1875.
205,412 *E. A. Pond*, sphygmograph, June 25, 1878.
183,205 *E. A. Pond*, sphygmograph, October 10, 1876.
232,105 *W. H. H. Barton*, sphygmophone, Sept. 14, 1880.

Sphyg-mom'e-ter. An instrument for measuring the force, rate and other characteristics of the pulse. The subject is considered under SPHYGMOGRAPH, which see. See also PULSOMETER, page 1825, "*Mech. Dict.*," and article in —

"*Manufacturer and Builder*" . . . . xii. 208.

Sphyg'mo-phone. For rendering audible the sounds of the pulse beats.

In Dr. Richardson's sphygmophone, a microphone is added to a Pond sphygmograph. A thin plate of platinum is mounted on a slip of talc which is placed in the sphygmograph as if for a tracing of the pulse. One terminal from a Leclanché cell is connected to the slip of platinum on the talc, and the second terminal to a terminal of the telephone. The other terminal of the telephone is connected to the metallic rod of the sphygmograph which supports the talc.

The instrument is placed on the pulse in the ordinary way, and the needle thrown back till a good pulsating movement is secured. The needle is then thrown over to touch the platinum strip, which it traverses with each pulse movement and completes the connection of the telephone with the battery: this passing over the metallic plate causes a distinct series of sounds corresponding with the movements of the pulse. The sounds heard are three in number: one long sound and two short, corresponding to the systolic push, the arterial recoil, and the valvular check.

The sphygmophone of Dr. Stein, of Frankfort, consists of a piece of watch-spring, five centimeters long, which is soldered to a small brass frame, and is provided at its free end with a gutta-percha knob which is placed against the pulse or chest. The knob carries a platinum contact plate, opposite to which is a platinum contact point, and these two contacts are connected in circuit with two Bunsen cells and a telephone. The movements of the pulse (for instance) establish contact between the point and plate, and so make and break the circuit. The result is that the natural rythm is heard aloud in the telephone.

See notices in —

"*Manufacturer and Builder*" . . xi. 96.
"*Eng. and Mining Journal*" . . xxviii. 128.
"*Telegraphic Journal*" . . . . vii. 120.
"*Iron Age*" . . . . xxiv., July 3, p. 15.

Sphyg'mo-scope. An instrument for rendering visible the beats of the pulse.

Such was made by Galileo, by means of a mirror and beam of light; see SPHYGMOGRAPH, where also is mentioned the device of Prof. Varardt, of Tübingen.

See also Pond's Sphygmoscope, Fig. 5381, page 2265, "*Mech. Dict.*" This instrument has since been made a recording instrument, and is further illustrated under SPHYGMOGRAPH, present volume.

Spic'u-lar. A dentist's long curved-nose forceps, for removing small fragments of bone, etc.

Spi'der Hoop. (*Nautical.*) A brass hinged hoop made to clasp around the mast of a vessel, with attachments for the fastening of the futtock-shrouds.

Spie'gel. (*Metallurgy.*) *Spiegeleisen*, "mirror-iron." A crystalline variety of white cast-iron containing from 2 to 10 per cent. of manganese, and a large amount of combined carbon. It is excessively hard and lustrous, and is used chiefly in the Bessemer and Siemens-Martin processes. See below.

Spie'gel-ei-sen. Manganiferous cast-iron. See FERRO-MANGANESE, SPIEGEL, and SPIEGEL IRON. See also *Comptes Rendus*, April 5, 1874.

Micro-structure of . . * "*Scientific American Sup.*," 2668, 2738, 2761.

Spie'gel I'ron. Mirror iron.

In German "Spiegeleisen," which means "mirror iron," is thus called because its fracture shows flat shining surfaces, reflecting light like pieces of mirrors. It is of all iron the richest in carbon, and also the most brittle and hardest, — no steel tool will make an impression on it. It is very fusible, and it is principally used at present in the manufacture of Bessemer steel. In this process most of the impurities are removed from the melted mass by forcibly blowing air through it, which burns them out, but also too much of the carbon, so that at the last stage of the process the iron is reduced to a condition of being almost equivalent to wrought iron, and cannot be poured, the temperature, high as it is, being insufficient to keep wrought iron in the liquid state. Melted spiegel iron is then introduced, which at once combines with the mass under the evolution of a large flame; the iron becomes then at once as liquid as water, and is poured in the molds to make ingots. Spiegel iron is also used to make safes burglar-proof: as an interior filling for this purpose it is cast between sheet-iron lining. It also possesses the curious property of being less magnetic than any other kinds of iron; it is less attracted by the magnet than other kind of iron, and strongly resists efforts to magnetize it, which is contrary to the property possessed by wrought iron, which takes magnetism easily but also loses it easily; while steel takes it with some resistance, but when once it is magnetized it holds it. We have a spiegel iron in this country; it is made from the New Jersey Franklinite ore, and was at first called Franklinite iron. It has commenced to be universally used in place of the spiegel iron, thus far imported from Germany, and will probably supersede it, if it has not already done so.

Spike. The following table shows the amount of spikes to a mile of railroad: —

Size measured under Head.	Average Number per Keg of 150 lbs.	Ties 2′ between centers, 4 Spikes per Tie, makes per Mile:	Rail used, Weight per Yard.
5½ × 9-16	280	5,670 pounds = 38 kegs	45 to 70
5 × 9-16	300	5,170 pounds = 35 kegs	40 to 56
5 × ½	340	4,660 pounds = 31 kegs	35 to 40
4½ × ½	400	3,960 pounds = 27 kegs	30 to 35
4 × ½	450	3,520 pounds = 24 kegs	28 to 85
4½ × 7-16	510	3.110 pounds = 21 kegs	25 to 30
4 × 7-16	540	2.940 pounds = 20 kegs	
3½ × 7-16	675	2.350 pounds = 16 kegs	20 to 25
4 × 3/8	760	2,060 pounds = 14 kegs	
3½ × 3/8	890	1,780 pounds = 12 kegs	16 to 20
3 × 3/8	930	1,710 pounds = 11½ kegs	

Spike Ex-tract'or. An iron lever with a fulcrum hook beneath to clasp the rail and a claw hook at its lower extremity to lift the spike by the head.

Spike extractor . . . . . * "*Engineer*," xliv. 413.
Devine . . . . * "*Engineer*," xli. 42.

Spil'liard. (*Fishing.*) A floating trawl line.

Spin'ner. (*Fishing.*) A trawling spoon-bait which revolves as it tows abaft the boat.

A flanged attachment in connection with a fish-hook to cause a lively motion of the hook and bait.

(*Wool Manufacture.*) Avery's continuous wool-spinner resembles the original Hargreave spinning machine. The roving is fed from the spool by a revolving drum driven from the pulley-shaft, and is delivered to peculiarly-constructed wheels, which seize it at the proper moment and release it again as the spinning occurs, and the required draught is thus given. The drum and the cage-wheel with which it acts revolve at the same speed. The roving, as delivered, hangs down loosely until sufficiently twisted, when the next motion delivers a new supply and takes up that already twisted.

Spin'ning. (*Fine Art Metal-working.*) A mode of forming silver and other ductile metal into shapes. A disk of metal is placed in the clamp in the lathe, and while revolving is pressed by a burnisher which spreads the metal, giving the disk a cup-like form, for instance. Other pieces are worked in a similar way, and form parts such as cover, body, foot, of a pitcher or what not. Fig. 5412, "*Mech. Dict.*"; * "*Scientific American*," xxxvi. 290, Fig. 9.

Spin'ning, Tex'tile Ma-chin'er-y, Fab'rics, Sew'ing, Knit'ting, etc. See under the following heads: —

Aino cloth.
Algerine.
Alpaca.
Alpaga.
Alpine.
Anacostra
Armure.
Arras.
Australian crape.
Baize.
Balling machine.
Bandekin.
Banding machine.
Banding ring.
Barége.
Basket.
Batavia weave.
Beaming machine.
Beetling machine.
Biaretz.
Bleachery
Block.
Blocker.
Blocking machine.
Bobbin winder.
Bolivar.
Bombazine.
Bourdalisandre.
Braiding machine.
Brilliantine.
Brim pouncing machine.
Brim stretcher.
Brocade.
Brushing machine.
Buckram.
Burlaps.
Burring machine.
Button making.
Calender rolls.
Calico.
Calico printing.
Calico rolls.
Cambric.
Camel's hair.
Cam loom.
Cannel.
Card and combing machine.
Card guider.
Cardigan jacket machine.
Carding machine.
Carpet loom.
Carpet machinery.
Carpet matching and measuring machine.
Carpet winder.
Cashmere.
Cashmere de bege.
Chain loom.
Chain tappet loom.
Challis.
Chambery gauze.
Chinchilla.
Chintz.
Circassienne.
Circular knitting machine.
Circular ribbing machine.
Cloth cutting machine.
Cloth dressing machine.
Cloth drying machine.
Cloth finishing machine.
Cloth folding machine.
Cloth measuring machine.
Cloth press.
Cloth pressing machine.
Cloth shear.
Cloth shearing machine.
Cloth stretching machine.
Cloth teasling machine.
Cloth winding and measuring machine.
Cocoon winder.
Combing machine.
Cone.
Cop reel.
Cop winding machine.
Cord making machine.
Cordwain.
Corset loom.
Cotton.
Cotton cylinder.
Cotton machinery.
Cotton opener.
Cotton process.
Cotton spinning.
Cramoisy
Crape of Spain.
Cretonne.
Crown pouncing machine.
Cuff frame.
Cypresse.
Damask.
Darner.
Darning machine.
Debaige.
Degumming machine.
Delaine.
Diagonal.
Diaper.
Dimity.
Dobby machine.
Doubling winding machine.
Drag.
Drap d'Alma.
Drap d'Alpes.
Drap de Nationelle.
Drap d'Été.
Drawing-frame and ribbon-lap machine.
Drugget.
Drying chamber.
Drying machine.
Duck.
Dunging vat.
Dyeing
Dye vat.
Embossing machine.
Embroidering machine.
Épingline.
Épinglé.
Excelsior.
Fabric.
Faller.
Faller machine.
Fancy board loom.
Feather plush.
Felt.
Felting machine
Felt mat.
Finishing press.
Fireproofing cloth.
Flat-rib knitting machine.
Flax baking machine.
Flax comb.
Flax loom.
Flax machinery.
Flax silk.
Flax spinner.
Flock.
Forming machine.
Foulard drying apparatus.
Foulard machine.
Frieze.
Fulling mill.
Fur blowing machine.
Fur hat machinery.
Fustian.
Gas cloth.
Gauze.
Gingham.
Gingham loom.
Girth stretcher.
Glove making.
Glove sewing machine.
Grenadine.
Grisaille.
Hair cloth.
Hand loom.
Hank dyeing machine.
Hardening machine.
Harness.
Hatchel.
Hat.
Hat block.
Hat blocking machine.
Hat finishing lathe.
Hat forming machine.
Hat lining sewing machine.
Hat machinery.
Hat press.
Hat shaping machinery.
Hat stretcher.
Hat sweat.
Headstock.
Heddle.
Hemmer.
Hemp.
Hemp softening machine.
Henrietta cloth.
Hernani.
High loom.
Hosiery seaming machine.
Imperial silk serge.
Indigo mill.
Ingrain.
Intermediate spinning frame.
Ironing machine.
Jacquard loom.
Jean.
Jupon.
Jute.
Jute machinery.
Kalameil.
Kerseymere.
Knitting machine.
Knot.
Lap doubling machine.
Lap machine.
Leather cloth.
Linen machinery.
Linsey-woolsey.
Lint.
Llanos.
Loom.
Loom stopper alarm.
Machine twist.
Luster.
Mandarining machine.
Manteau.
Matelasse.
Melange.
Merino.
Merino tulle.
Mexican cloth.
Mohair.
Mohair glacé.
Moire.
Moulleton.
Mousseline.
Mousseline de bege.
Mozambique.
Mule.
Muslin.
Nankeen.
Nosing motion.
Oiler.
Opener.
Opening machine.
Opener lapper.
Opus consutum.
Overpick loom.
Palamporé.
Paramatta cloth.
Pattern chain.
Plaiter.
Plaiting machine.
Pongee.
Porcupine.
Positive motion loom.
Pouncing machine.
Presser foot.
Printing.
Print-washing machine.
Ply.
Punjam.
Ramie.
Ramie fiber machine.
Rayne, cloth of.
Rep.
Retting.
Rib-fabric knitting machine.
Rib-top machine.
Ring and traveler throstle frame.
Rolling machine.
Rope.
Roving frame.
Roving reel.
Ruffler.
Sail Sewing machine.
Salampore.
Sample cutter.
Sarsnet.
Satin.
Satine.
Satinet.
Satinet loom.
Satin weave.
Scouring.
Scutcher.
Seaming machine.
Selvage.
Sendal.
Serge.
Serge armure.
Sewing machine.
Sewing machine, dress protector for.
Sewing machine shuttle
Sewing machine treadle.
Sewing silk.

Shaping machine.
Shaving machine.
Shawl loom.
Shearing machine.
Shirt frame.
Shirt knitting machine.
Shoddy machine.
Shuttle race.
Sicilienne.
Siclatome.
Silk.
Silk degumming machine.
Silk dyeing machine.
Silk loom.
Silk machinery.
Silk reel.
Silk softening machine.
Silk spinner.
Silk spooling machine.
Silk spooling and measuring machine.
Silk stretching machine.
Silk thread.
Silk-washing machine.
Silk waste.
Silk winder.
Silk-worm nursery.
Sindon.
Singeing machine.
Skein-torsion machine.
Sleeve frame.
Sleeve machine.
Sliver guide.
Sliver lap machine.
Slubbing frame.
Slubbing machine.
Snugger.
Spinner.
Spinning.
Spinning head.
Spinning machine.
Spinning mule.
Spinning ring
Spinning roller.
Spool holder.
Spooling machine.
Spool printing machine.
Spool winding machine.
Stamper.
Steam chamber.
Stiffening machine.
Stop motion.
Straw braid.
Straw hat.
Sweat-lining sewing machine.
Sweat rolling machine.
Sweat sewing machine.
Taffeta.
Taffetas.
Taffetas armure.
Take-up.
Take-up motion.
Tamise.
Tamise rep.
Tapestry carpet.
Tars, cloth of.
Teasel.
Teaseling machine.
Tentering machine.
Textile fabrics.
Thread dressing machine.
Thread waxing machine.
Throstle frame.
Tin-box loom.
Tip stretcher.
Tissue.
Tissue paper.
Tissue Silk.
Toile-de-Saxe.
Tom-tom.
Top.
Tuck creaser.
Tuck marker.
Tulle.
Turenne cloth.
Turning-off machine.
Turquoise.
Twilled armure.
Tying-in machine.
Valencia.
Velours.
Velentine.
Velvet.
Vigogne.
Vode.
Warping machine
Warp-tying machine.
Washing roller.
Waste picker.
Wax thread sewing machine.
Weaving.
Weighting.
Whipper.
Whirling apparatus.
Wool burring machine.
Wool carding machine.
Wool combing machine.
Wool extract.
Wool hat machine.
Wool oiler.
Wool scouring machine.
Wool washing machine.
Worsted.
Yarn flocking machine.
Yarn printing machine.
Yarn reel.
Yarn tester.
Yarn washing rollers.
Yarn winder.

See *Band's "American Cotton Spinner's Guide."*
Leroux's "Practical Treatise on Worsteds and Carded Yarns."

Spin'ning Head. A twisting and drawing head, resembling in some respects that described on p. 2273, Fig. 5408, "*Mech. Dict.*," is described in *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," vol. iv., article "*Broche de la Filature*," edition 1877.

For twisting and drawing heads see the following patents: —

Ballard, 62,921, March 19, 1867.
Chappell, 115,435, May 30, 1871.
Chabot, 89,290, April 27, 1869.
Crowell, 28,161, May 8, 1860.
Germain, 69,205, September 24, 1867.
Goulding, 32,059, April 16, 1861
Hoard, 58,101, September 18, 1866.
Houghtaling, 78,968, June 16, 1868.
House, 99,674, February 8, 1870.
Jenks, 132,582, October 29, 1872.
Kennedy et al., 21,538, September 14, 1858.
Lawrence et al., 108,709, October 25, 1870.
Martin, 177,861, May 23, 1876.
Motting, 128,418, June 25, 1872.
Nutting, 125,686, April 16, 1872.
Parmelee, 56,258, July 10, 1866.
Plummer, 31,031, January 1, 1861.
Potter, 62,498, February 26, 1867.
Roberts, 89,170, April 20, 1869.
Silver, 9,301, November 9, 1852.
Skinner, 135,015, January 21, 1873.
Spineux, 69,944, October 15, 1867.
Sargent, 11,812, October 17, 1854.
Sheffield, 137,083, March 18, 1873.
Victory, 11,106 (hemp), January 13, 1854.
Victory, 28,220, May 8, 1860.
Wilcox, 3,075, May 8, 1843.
Wilson, 37,538, January 27, 1863.
Wright, 5,964, December 12, 1848.

Spin'ning Ma-chine'. The Byewater spinning machine is remarkable as a continuous spinner in contradistinction to the intermittent work of the mule.

The condenser bobbin containing the sliver, as in the mule, is placed upon the top of the machine, and revolving, delivers its contents to and upon the tops of a number of small porcupines, arranged upon a slowly revolving shaft. The porcupines, on receiving the roving, comb and draw the fibers of the wool into parallel lines, delivering it in an attenuated form to another part of the machine, composed of two very small rollers fitted in a disk.

These rollers, one of which is fluted and the other covered with rubber, constitute a pair of draft rollers, as in the ordinary mule, but are so small in size as to serve only for the reception of one thread. The draft motion of these rollers is obtained by the action of a pair of small toothed wheels, that are covered from sight in the disk. From the great amount of twist imparted to the thread in this movement, and in which the proper degree of attenuation is obtained, a much shorter fiber can be spun with less risk of breakages than in the long stretch of the mule.

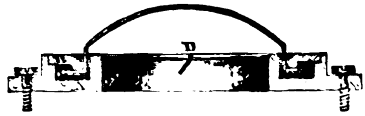
There has already been spun on this machine a material, the waste of silk noils (that is, the noils of the noils), that has hitherto been used only for upholstery purposes, etc., and which in the mule could not be spun into thread at all. The thread on its delivery from the rollers carried in the disk, is passed on to the spindle, and wound upon tubes in the form of a pin or cone, having received its complemental amount of twine.

Any quantity of twist can be put in between the rollers and the spindle, as the latter can be driven up to 7,000 or 8,000 revolutions per minute. The thread is wound upon the spool by the needle flyer. In order to build a proper cop from the yarn the traverse race differs from that found in roving frames, throstle spinning frames, etc., in having an additional movement. Besides the ordinary ascending and descending movements of the traverse, there is progressive ascent made every journey, equivalent to the growth of the yarn cone from the deposit upon it of every layer of yarn.

See CARDING MACHINE, pp. 167, 168, *supra*.

Spin'ning Ring. In Booth's steel-top spinning rings with steel flanges inserted in the base, the traveler draws perpendicularly, so that when the lower steel flange becomes worn the flange can be reversed and become a perfect ring again.

Fig. 2316.



Potter Spinning Ring.

The Potter ring is another modification of the spinning ring. See Fig. 2316.

Spin'ning Rol'ler. Leigh's anti-friction top roller has two bosses, which are covered with cloth and leather, and made from a solid piece of iron. The bosses are loose running on a dead spindle. There is, therefore, no appreciable wear of either hook-saddle, cap-bar, or roller. Each boss can go its own speed, independently of its fellow boss, and therefore delivers out faithfully its proper length. The leather keeps smooth, saves waste, and the bearings being internal, the roller seldom requires oiling. It saves the squares of the under roller to the extent of the variation of the bosses in diameter.

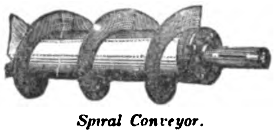
Spi'ral Au'ger. The American form of auger-bit, raising and delivering its chips on the principle of the Archimedean screw. A modification of the spiral auger is also used in well-boring.

Spi'ral Bat'ter-y. (*Electricity.*) One in which the elements consist of plates laid together with something to maintain their distance and then rolled together spiral.

Niaudet . . . . * "*Amer. Trans.*," p. 17.

Spi'ral Con-vey'or. A forwarding device for removing grain to higher levels, when used within a tube or trough in which it works, on the principle of the Archimedean screw.

Fig. 2317.



Spiral Conveyor.

Spi'ral El-lip'-tic Seat'-spring. A spring made of a thin band of steel and wound on a spiral coil, the transverse section of which is elliptical.

Spi'ral Grooved Guide. The spiral grooved guide is a wrought-iron tube, from 8′ to 12′ long, the size of the hole intended to be bored, set with diamonds at intervals, to prevent it from wearing, and provided its full length with spiral grooves, to allow egress for the water and sediment on the way up to the top of the bore-hole.

It is used in boring long holes, and is of especial value in boring for shafts and tunnels; as, by its exactly fitting the hole bored, it prevents the drill from diverging from the direction in which it started, making the hole perfectly straight.

Spi'ral Pump. A pump that raises its water by a spiral flange or screw, on the principle of the Archimedean screw.

Spi'ral Punch. A punch so formed as to cut its way through the metal with a shearing action, which it is alleged does not tend to injure the metal like the ordinary punch.

Spi'ral Seat'-spring. A light spiral spring made of wire for upholstering car-seats

Spi'ral Spring. A spring made of a metal rod or bar coiled in the form of the thread of a screw, so that it can be compressed or extended in the direction of the axis around which it is coiled.

See —

Compound spiral spring.	Nest spring.
Cluster spring.	Paragon spiral spring.
Dinsmore spiral spring.	Quadruple-coil spiral spring.
Double-coil nest spring.	Round-bar spiral spring.
Edge-rolled spiral spring.	Rubber-center spiral spring.
Equal-bar nest Spring.	Spiral elliptic seat-spring.
Flat-bar spiral spring.	Spiral seat-spring.
Group spring.	Spool-shaped spiral spring.
Half-round-bar spiral spring.	Square-bar spiral spring.
Hibbard spring.	Triple-coil nest spring.
Keg-shaped spiral spring.	Wool-packed spiral spring.

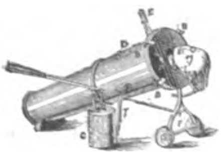
Spi'ral Tube Boil'er. One having a spirally convoluted tube passing across the flame space. See Fig. 5636, Plate LXI., opp. p. 2326, "*Mech. Dict.*"

Spi'ro-phore. A breath-carrier. An apparatus for inflating the lungs in case of suspended animation. *Woillez*, "*Technologiste*," xl. 179.

An apparatus for restoring asphyxiated persons, especially such as have been in danger of drowning, and new-born infants.

It consists of a conical cylinder of sheet-iron closed at one end and open at the other. The case is large enough to receive the body to be treated, which is let down into it as far as the head, that remaining outside. A tightly fitting diaphragm closes the aperture about the neck. A strong air pump containing more than four and a half gallons of air, outside the case, communicates with it by a thick tube. It is worked by a lever, the descent of which produces aspiration of the air confined about the body. The raising of the lever again restores the abstracted air to the case. A transparent piece of glass on the upper part of the cylinder enables one to see the chest and abdomen of the patient, and a movable rod sliding in a vertical tube is made to rest on the sternum.

Fig. 2318.



Spirophore.

When a body is inclosed as described, and the lever quickly lowered, a vacuum is produced around the body and immediately the external air penetrates into the chest, the walls of which are seen to rise as in normal life. The ribs separate, the sternum is pushed up 0.393″ at least (indicated by the movable rod that rests on it). Further, the epigastrium, and even the abdomen below, present an inspiratory projection, which shows that the enlargement of the chest is effected during the artificial inspiration, not only by the raising of the ribs and the sternum but also by the descent of the diaphragm. All returns to the former position when the lever is raised again. These complete respiratory movements may be repeated fifteen to eighteen times in a minute as in a living man.

By means of a tube fixed into the windpipe of the body and communicating with a graduated reservoir of air, over a vessel of water, M. Woillez has measured the quantity of air that thus penetrates into the chest at each pressure of the lever. He finds that this is on an average $1\frac{3}{4}$ pints; whereas the physiological average is only 7–10 pints. More than 22 gallons of air can be made to traverse the lungs of the asphyxiated person in ten minutes.

Splay. (*Architecture.*) The beveled expansion or recess in the wall of a building, as in the abutments in ancient architecture and the approaches to doors, windows, and fire-places necessarily beveled in the heavy walls of those days.

Splice. (*Nautical.*) The joint by which two ropes are united. See "*Mech. Dict.*"

Rails and splices on Penn. R. R. See report by *F. Slataper*, "*Centennial Exhibition Reports*," * vol. vi., Group XVIII. p. 66.

Splice Joint. The connecting joints between rails on railways. The number of splice joints per mile, 2 bars and 4 bolts and nuts to each joint, is, rails 20′ long, 528 joints; rails 24′ long, 440 joints; rails 26′ long, 406 joints; rails 28′ long, 378 joints; rails 30′ long, 352 joints.

Spli'cing Clamp. A hinged clamp with apertures of various diameters to correspond with size of the material intended attached.

Splin'ing Ma-chine'. (*Metal Working.*) A machine for cutting key-seats and grooves.

Splint.

Wood's hammock splint.*
Ahl's adaptable porous splints.
See *Dr. J. H Thompson's* report on Group XXIV. in vol. vii., page 58, "*Centennial Exhibition Reports.*"
Guillery, Hippolyte, Brussels, Belgium.
Perforated zinc plates adapted in shape to the fractured limb.
See also "*Scientific American Sup.*," 788.

Cable, *Stillman* . . . * "*Scientific American Sup.*," 1597.
Paraffin, *Macewen*, Engl. "*Scientific American Sup.*," 2310.
Fracture, *Croskery* . . * "*Scientific American Sup.*," 873.
Split pulley . . . . . * "*Engineer*," xlix. 71.
Plaster of Paris, paper by
Croft . . . . . . "*Scientific American Sup.*," 2121.

Splint-cut'ting Ma-chine'. A machine for cutting small slats or splints.

Ransome, of Chelsea, England, has a reciprocating cutting machine for lucifer-match splints, etc.

Split'ting. (*Leather.*) Reducing the sides of leather to a uniform thickness, by passing them through the splitting-machine. The latter can be adjusted to split the sides to any required thickness. It is mainly employed in the preparation of thin and light leathers.

Split'ting Chis'el. (*Stone-working.*) A tool chiefly used on the softer stratified stones, and sometimes on fine architectural carvings in granite.

Split'ting For'ceps. (*Dental.*) For the division of teeth which require to be split before extraction.

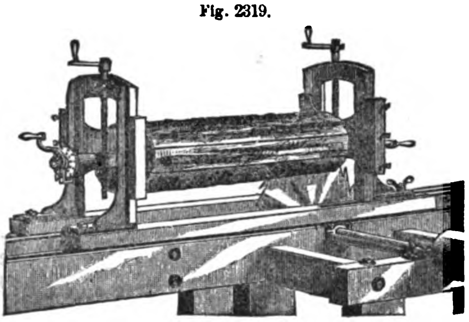
Split'ting Knife. (*Fishing.*) For ripping and halving fish before salting.

Split'ting Ma-chine'. A machine for resawing thick boards.

Split'ting Saw. A saw table with elevating set screw, adjustable clamps, splitting gage, and self-oiling saw arbors.

A machine for splitting round logs into bolts; as a substitute for riving or sawing through and through in parallel

Fig. 2319.



Splitting Saw.

planes. The center sawing machine is used in getting out stuff for axe and pick handles, heavy spokes, etc., and work in which the run of the grain of the wood is of consideration in the fashioning of the article. It has a sliding carriage, furnished with center head-blocks, on which the log is placed, and is provided with a dial-plate and stops by which the log can be spaced into stuff of the desired size. The saw cuts invariably towards the center. Also called a *center saw*.

Split Wheel. A split gear or other wheel so contrived that flanges on the one side of the one part fit upon and are bolted to the side of the other part, to allow of applying to and removing from the shaft such wheels in less space than is required when they are fastened by bolting two flanges together at the sides of the wheel. One part of the wheel may also be dovetailed into the other, to sustain the expanding action of the key, better than in the other way.

Spoke. (*Wheelwright.*) One of the radial arms that connect the hub with rim of the wheel.

Spoke-in-sert'ing Ma-chine'. A spoke-setting machine, for inserting the spokes by mechanical pressure instead of driving.

Spoke-fa'cing and True'ing Ma-chine'. (*Wheelwrighting.*) A machine designed for facing common and patent spokes, and finishing the miter joint on them.

It has a large cast-iron disk, in which are placed three cutting knives. The disk is revolved, and the spoke, being placed in position on the table, is brought into contact with the cutters, finishing it to the desired surface or angle. The table is light and moved on parallel ways, placed at right angles to the face of the disk, and has a spring that returns it from the disk when the cut is completed. It is furnished with necessary stops and guides.

The pulley or disk-shaft, 10 × 5, should make 1440 revolutions.

Spoke Lathe. A machine for turning spokes, gun-stocks, lasts, handles, etc.

Spoke Point'er. A knife held in a cone devised to dress up the tenons of the spoke ready for hub and rim. (See Fig 2320)

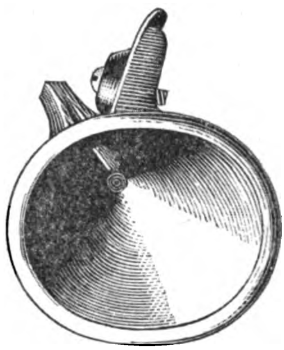
Spoke Pol'ish-ing Ma-chine'. Gleason's spoke polishing machine takes a sand-belt from 6″ to 12″ wide. Its driving pulleys, tight and loose, are 7″ diameter, with 5″ face. It makes 900 to 1,000 turns per minute.

Spoke Set'ting Ma-chine'. Morgan's spoke setting machine has an adjustable frame that is supported on springs so as to be moved vertically as desired by the bolts and crank-nuts. The hub is placed on a central bolt, and is rigidly secured by a crank-nut.

Above the main frame is the guide or set ring on which the posts are placed while being set and driven into the hub.

After the hub is fastened in place, the adjustable frame is screwed down until the center line of the hub is on a level with the circle. The hub is then dotted above the leveling straight-edge, and the bolts are screwed down until the desired dish or set of the bolts is obtained. This is necessary, as all hubs are made with straight front and sloping back mortises, throwing the outer ends of the spokes forward at the same inclination. It then only remains to rest the spokes upon the guide-ring and drive them into the hub.

Fig. 2320.



Spoke Pointer.

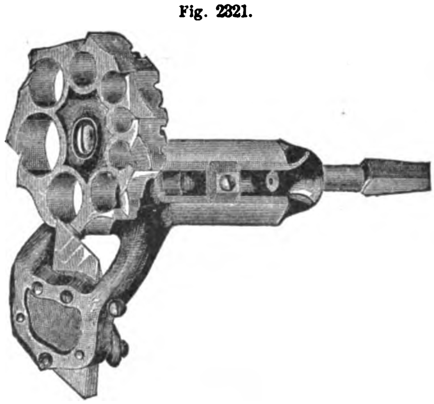
Spoke setting machine, *Morgan* . * "*Sc. Amer.*," xxxiv. 348.

Spoke Shave. A modification of the plane with a handle at each end. The French make a double spoke-shave, with one blade concave, the other convex.

Spoke Ten'on-ing Ma-chine'. A machine provided with a hollow auger, that, rotating around the ends of the spokes, forms the tenons.

In Dole and Deming's spoke tenoning machine, Fig. 2321, the hub is held in a self-centering chuck that admits of rotating the wheel to present the spokes to the hollow auger, the spokes when in position being firmly held on the spoke rest, in line with the auger. Each and every tenon is cut

Fig. 2321.



Spoke Tenoning Auger.

with shoulders uniform in width and in the same plane. With a slight transformation it is changed into a boring machine, for boring the felloes for the spokes and dowel pins. The No. 1 machine is provided with the star hollow auger, capable of cutting tenons from 7-16″ up to 1″. The No. 1 machine is not furnished with legs, being generally clamped in the vise or on the bench.

Spoke Throat'ing Ma-chine'. A machine intended for dressing and shaping the throat (which is reduced a short distance from the hub to add to its flexibility).

Spoke Turn'ing Lathe. Gleason's spoke turning lathe is a modification of the Blanchard. ("*Mech. Dict.*," p. 2282.) It is used for turning handles as well as spokes.

The uprights forming part of the rocking frame are fastened to the rock shaft by set screws. The adjustable upright is movable on the shaft with wrought iron cross bars above, to take in any desired length of model. The center for holding the model in the said upright and the center for holding the spoke admit of being adjusted to any position, so as to turn spokes from the same model of different lengths.

The center is worked by an eccentric lever and is capable of holding the largest spokes. The running shaft extends outside to the left of the machine, and pulleys for driving the model and feed run loosely thereon. The pulley that drives the cutting wheel above has a hollow mandril, running in bearings one on each side. The hollow mandril is fitted with two feathers which fit into slots that run the whole length of the main shaft. The bearings are part of the carriage, that extends down on the opposite side to receive the hollow mandril carrying the pulley that drives the cutter wheel.

Spoke Trim'mer. A tool for trimming the ends of spokes, chair rounds, etc., before using the hollow auger.

Spoke Wheel. A metallic light flanged track wheel for mine cars and other light service.

Sponge Brush. Sponge brushes are of various kinds, in which the sponge tied or wired to a handle is a substitute for bristles.

Sponge Di-la'tor. (*Surgical.*) A dilator in which the absorptive power of sponge is made the means of expansion. *Emmett's*, Fig. 110, Part V., *Tiemann's* "*Armamentarium.*"

Sponge For'ceps. (*Surgical.*) An instrument specially adapted to hold a sponge, and place it in situ. It is usually a long staff with a spring or sliding clasp on the end. Page 81, Part III., *Tiemann's* "*Armamentarium.*"

Sponge, Me-tal'lic. M. Laboulaye treats of the "industry created" by M. Chenot, which, at the time of writing, had not "arrived at a complete success, for the full adoption of the process would completely revolutionize the metallurgic industry; but the results obtained (1877) were extremely important."

For the study of the process he selects the most complex to which the method can be applied, that of the production of cast steel.

The treatment comprises four principal operations: —

1. The reduction of the mineral into the state of sponge.
2. The cementation of the sponge.
3. The compression.
4. The fusion.

1. The reduction takes place on wasted and broken mineral, in a prismatic furnace about 40′ high, furnished with exterior belt of furnace from the mouth 22′ downward. The mineral introduced at the top is subjected to a gradually increasing heat, undergoing a reduction similar to what takes place in the shaft of the blast-furnace. On arrival at the bottom of the belt furnace it is scarcely cherry-red, the iron is completely reduced, but the heat is insufficient to melt it, or even to make it pasty. It forms a porous mass like the spongy platinum whence it takes its name.

Continuing its descent, the sponge cools slowly, and at its discharge at the lower end of the furnace is near the ordinary temperature, in default of which cooling it would rapidly reoxidize, owing to its eminently pyrophone tendency. The discharge from the furnace is made at certain intervals by means of certain devices whose function is to prevent a current of air from passing through the furnace.

2. The sponge, passing to the cementation stage, is plunged in a bath of resin, tar, or some fatty matter, the bath being heated if necessary to maintain its contents liquid, in order that the sponge may be saturated. It is calcined at a heat only sufficient to remove excess of the carbonaceous matter which is collected, and a loup of metal is obtained with a certain quantity of carbon uniformly diffused through it. A second cementation may be necessary to arrive at exact results.

3. The sponge is then broken and afterwards subjected to heavy pressure in order to make it more compact and to reduce the surface exposed to the action of the oxygen of the air.

4. The compacted sponge is broken up, put into crucibles, and treated as usual for cast steel. There is, however, this difference, that in pouring the metal there is a quantity of scoriæ consisting of earthy matter which the previous operations have not removed. The slag, which is very fluid, swims on the metal, is coagulated by a little sand and clay, and readily removed with a ladle

Blair's process is described in, —

"*Scientific American Sup.*"	1991, 1992.
"*Scientific American*"	xxxix. 68.
"*Mining & Scientific Press*"	xxxvii. 2.
"*Engineer*"	xlv. 226, 308.

The United States and European patents on sponge processes are very numerous.

Sponge Pro'cess. (*Metallurgy.*) A process for making wrought iron and steel direct from the ore without the use of the blast furnace.

The reduction by the blomary or German hearth is at a greater heat than that of the sponge process. The temperature in each is below that of melting; in the blomary the iron is obtained in an agglutinated mass, as a *loup* ready for the shingler; but the *sponge* obtained by the other process contains the iron in a metallic state besides the earthy ingredients of the ore. The *sponge* is then worked to a *loup* in a reverberatory, gas, or blomary furnace, to consolidate the metal and remove the earthy matter, and then is hammered to a *bloom*.

The reduction of the ore in the sponge process takes place in a cylinder or cupola furnace, the fuel with which it is mixed being preferably charcoal. The iron is cooled before removal from the reducing current, to prevent oxidation, which takes place rapidly on the spongy mass.

The sponge is then puddled in a reverberatory.

Or it has been added to a bath of pig-iron, as wrought iron is added in the Martin process to make steel by relatively lowering the carbon of the iron.

Chenot, Yates, Benton, Gurlt, and others have devised sponge processes. The method adopted by Blair, of Pittsburg, is a modification of the Chenot.

A cylinder 40′ high and 36″ diameter has at 6′ of its upper end an interior cylinder 28″ diameter, leaving an annular space 4″ wide. The upper half of the cylinder is kept at a red heat by gas burning on the outside, and the charcoal and ore in small pieces are charged at the upper end of the annular space. The carbonic oxide from the reduction burns in the inside cylinder, and the charger is then heated to redness between the two fires. As the charge sinks it occupies the whole interior capacity of the large cylinder, the lower half of which is cooled by a water-jacket. The sponge and remaining portion of the fuel are withdrawn in a cool condition from the lower point of the cylinder.

The sponge is separated from the charcoal, compacted into balls by hydraulic pressure, which are then worked into a bath of metal in a Siemens or other furnace.

Sponge is also made in a Danks rotary puddling furnace; the ore is roasted, added with fuel to the furnace, which is rotated while a reducing flame on the regenerative principle is applied.

In 1876 Blair discovered during some experiments, that by the addition of a small quantity of alkali to the carbonaceous matter mixed with the ore, the action of reduction was quickened to a remarkable extent, and ore which took thirty hours to reduce without alkali could be perfectly done in six hours with it. Subsequent investigation showed that lime in a fallen state answered as well as any other alkali, and on account of its cheapness was most suitable for the purpose. The quantity of lime required being only about five per cent. the extra cost was quite insignificant when placed against the great saving in time. When, however, Mr. Blair came to work the existing furnaces under the new condition of quickened reduction, he found the arrangement could not in any way be altered to suit it. Perhaps a brief description of these furnaces will make the matter more easily understood.

Each reducing furnace consisted of a group of three vertical retorts, each retort being 3′ internal diameter and about 28′ high, surrounded by an outer casing of brickwork, leaving a combustion chamber between the inside of the brickwork and the outside of the retorts. The retorts and outside brickwork stood upon a cast-iron entablature, supported on columns 12′ from the ground; below the entablature, and forming a continuation of each retort, were wrought-iron cylinders, each surrounded with a water jacket for more quickly cooling the iron sponge, and having at the lower extremity a sliding sleeve for discharging it. In the top of each retort a cast-iron pipe or thimble, 2′ diameter and about 6′ long, was inserted, leaving an annulus of 6″ between it and the inside of the retort.

The retorts were heated externally by gas jets, the air for combustion being supplied through apertures immediately above each jet. When the retorts were thoroughly heated and all in working order, the gas generated from the ore under reduction ascended up the inside of the pipe inserted in the top of the retort, and, on meeting with the air, flamed and so heated the pipe. The ore and carbonaceous matter were fed into the retort down the 6″ annulus between the retort and pipe, and, forming a narrow column heated on both sides, were thoroughly heated up before reaching the wide retort below. Thus the ore, on entering the wide retort or reducing zone, was all of one uniform heat, both in the center and on the outside, and hence uniform reduction was the result. This initial heating, as it is called, must be done if the ore is to be thoroughly and uniformly reduced. It was this part of the furnaces which would not suit the quickened action of reduction taking place in the body of the retort below; the ore could not be heated up as quickly as the reduction took place, and hence the two did not work in harmony.

After several alterations, Mr. Blair abandoned the system of external heating, and decided to adopt that of passing a stream of hot carbonic oxide through the mass of ore and carbonaceous matter. He has since made some improvements in the first-named furnace, where the initial heating of the ore is performed as quickly as is possible to be done by transmitted heat, and which is much quicker than the inserted pipe. The new form of reducing furnace adopted by Mr. Blair has several important features. The following is a description of it: —

A vertical retort made of fire-bricks, with an external wrought-iron casing, stands upon a cast-iron entablature supported on columns. The retort is continued below the entablature by a wrought-iron cylinder with water jacket, or as the writer proposes, instead of one wrought-iron cylinder and water jacket, four small ones are suspended, and thus split up the hot sponge into small columns, by this means effecting the cooling much more quickly. At the lower extremity of each water jacket is a conical mouthpiece and valve, so that the iron sponge can be discharged periodically into any receptacle placed under.

The lower part of the retort, where the gas is admitted, is larger than the upper portion. This is done so as to form an overhang immediately above the aperture where the gas is admitted, thus forming a chamber round the mass of ore, etc., and allowing the gas to permeate it uniformly. At the top of the retort is an outlet for the escape of the gas after passing through the ore, which is connected by a horizontal pipe to a vertical one descending to the ground, and there connected to the chimney flue. In the horizontal pipe above named a steam jet is inserted, so as to form a vacuum in the top part of the retort, to induce a regular current of gas through the ore, etc. The retort is fed by an ordinary bell-hopper.

The carbonic oxide is generated in a gas-producer placed a few feet from the reducing furnace, and connected to it by a flue of sufficient capacity. The gas-producer is circular in section, formed of wrought iron plates, lined internally with fire-bricks, and standing on an entablature, which, in turn, is supported at the requisite height by columns of brickwork. Below the entablature, and suspended from it, is a wrought-iron continuation, tapering to a conical discharging valve for allowing the ashes to be from time to time removed.

Apertures for admitting air for combustion in the gas-producer are placed in its circumference, fitted with slide covers to regulate the admission of air.

Mr. Blair uses the Ponsard producer in preference to the ordinary Siemens one, as the admission of air is more easily regulated. The object of using a carbonic oxide gas is primarily to supply heat to the ore, etc., to be reduced. What reduction is effected by the gas is a secondary matter; and in this point the process differs from other attempts where carbonic oxide has been used solely for reducing the ore. It will be seen that in using the steam jet to induce a stronger current of gas through the ore under reduction, the temperature in the gas producer will be increased, and the gas in time become hotter than required, the result being that the mass against which the gas impinges in the reducing furnace, being almost entirely metallic, would become welded together, and so interfere with the regular working of the furnace. To obviate this, a very simple and ingenious arrangement has been made by Mr. Blair, by which the temperature of the gas can be kept at almost one uniform heat. The gas, after passing through the reducing furnace, is still almost entirely carbonic oxide, and on passing by the steam jet becomes mixed with steam; in order to condense it a water spray is introduced at the top of the descending flue to the chimney. A little above the air apertures in the gas producer are two pipes connecting it and the descending flue, so that some of the gas which has already passed through the reducing furnace can be again sent through the gas producer and used over again, and at the same time cool down its temperature. By regulating the slide covers of the air apertures in the gas-producer and the damper in the flue to the chimney, an equal quantity of air and gas can be supplied to the producer. It is found, in practice, the two can be so regulated that an almost uniform temperature can be maintained in the reducing furnace, and a saving effected in fuel; in fact, by the cooling action of the return gas, any temperature can be obtained. The reducing furnace just described will reduce about 200 tons of ore to a metallic state weekly, the dimensions of the retort being 6′ diameter in the upper, and 6′ 6″ in the lower part, by 16′ in height. The height of the whole structure is 36′, and the cost about $3,500.

The fuel used in the gas-producer is coke; and if the iron sponge made is intended for steel-making, the coke should not contain more than .75 of sulphur — the less the better — otherwise the iron sponge will be affected by it. But where pure ore can be had, and coke from washed coal not containing more than the above-named amount of sulphur, this form of reducing furnace is undoubtedly the best for producing iron sponge in large quantities, and the whole of it thoroughly metallic.

The question of the subsequent use of iron sponge is an important one. Where the ore is rich and pure, iron sponge made from it can be at once made into tool steel, the quality of which cannot be equaled by that made from the best brands of Swedish bars. Probably in the case of ore which is not so rich, but still suitable for steel-making, the best way of utilizing the sponge made from it is to melt it in a cupola furnace into pig metal, and while in a molten state pour it into a Siemens-Martin furnace, and in this way convert it into steel. The pig metal obtained in this manner will contain about 1.5 carbon and practically no silicon, the greatest amount of the latter yet found by analysis being 0.25, and the lowest 0 19. If this metal is poured while molten into an open hearth furnace as proposed, there ought to be no serious difficulty in getting six heats from each furnace in twenty-four hours, in place of the two or three heats now obtained. Iron sponge melts readily in a cupola furnace, and the risk of oxidation is less than when it is thrown into a bath of pig iron in an open hearth furnace. The same remarks apply to the manufacture of wrought iron. From the nature of the particles of iron in iron sponge, being so minute, it cannot be balled up in an ordinary balling furnace without considerable oxidation; on the other hand, if melted in a cupola furnace, and the resulting metal, containing so little carbon and silicon, be taken in a molten state from the cupola to the puddling furnace, very little rabbling brings it to nature.

The molten metal can be made almost as cheaply as pig iron; in fact, there is no reason why it should not be made as cheaply.

Sponge Pla-ti′num. The production of spongy platinum, says the "*Metallarbeiter*," is a task more easy in appearance than in reality. The principal requirement of spongy platinum is that it should be spongy, but this obvious requirement is very frequently overlooked, and hard and useless masses of platinum are produced through overheating the sponge and running together the finer particles. Into a concentrated solution of muriate of ammonia drop a similar solution of platinum chloride; a yellow precipitate is formed, which is washed three or four times with hot water to free it from the sal ammoniac. This precipitate, when properly cleaned, and while still moist, is dropped on a very thin platinum wire stretched several times across a small ring of copper, and is then allowed to dry thoroughly. After drying, it is slightly heated over a spirit lamp, contact with the flame of which is to be avoided. As above remarked, only very careful heating over the spirit lamp will give satisfactory results.

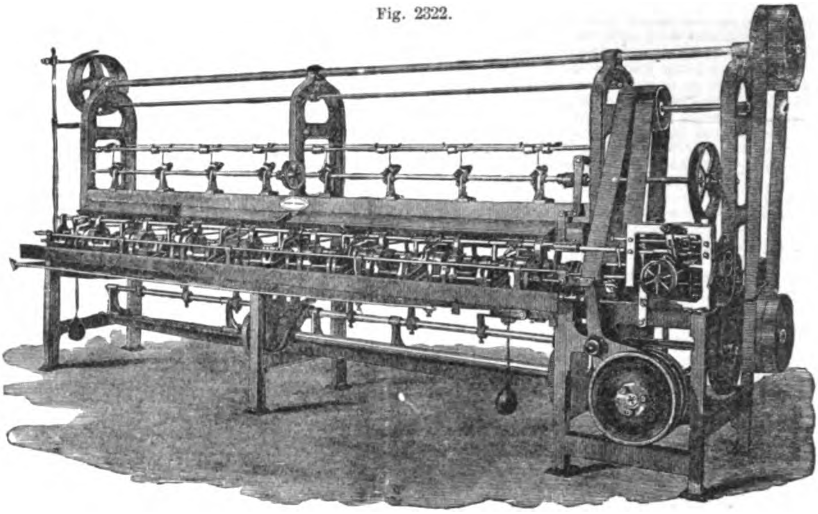
Sponge process, *Blair* . "*Iron Age*," xxi., April 11, p. 16.
"*Scientific American Sup.*," 1991.

Spool Hold′er. A case for holding spools of different numbers of thread placed on the thread-holder of a sewing machine. The spools are placed on pivots and the case revolves so that any spool can be drawn from at will.

Spool′ing Ma-chine′. A machine for winding silk on to 100, 200 yards, or one-ounce spools, for domestic and manufacturing purposes. See also SILK SPOOLING MACHINE.

Fig. 2322 gives a front view of a spooling machine composed of two parts, the portion on the left consisting of eight little duplicate machines arranged in a row, and that on the right, of the apparatus which operates the winding machines. Each of these little machines winds a spool of thread. Back of these is a trough, containing empty spools, and back of this is a shelf which is intended to hold the bobbins of thread. From these bobbins threads are passed through a tension apparatus above them, and carried each to its little machine. The machines are held rigidly together by longitudinal rods, and there are three longitudinal shafts or rods passing through the whole set from the machinery at the right-hand end: the upper one, which we will call the guide-rod, moving back and forth and giving side motion to the thread; the main shaft below and behind, with cog-wheel attachments at each machine for revolving the spools; and a rod in front which carries a steel finger for

Fig. 2322.



Spooling Machine.

moving the thread, as will be explained presently. The spools are held horizontally and longitudinally in position just back of the front finger-rod by clamping-pins like axles, which pass into the holes at the ends and revolve with the spools very rapidly. Just back of each spool is a swinging curved hopper, its upper end reaching almost to the spool-trough previously mentioned, and its lower end open and curving up just under the position of the revolving spool. All that the attendant has to do is to keep the hoppers filled with empty spools, remove the full spools from the lower troughs as they accumulate, and see that the thread is regularly supplied by the bobbins behind.

A thread-guide is fastened on the upper sliding or guide-rod at each machine. The thread passes down from the tension apparatus over this guide to the spool. As the spool revolves, the longitudinal motion of the guide-rod back and forth moves the thread to and fro over the spool, which winds it up layer by layer.

A measuring-gage is attached to the machine, and just as two hundred yards are wound, the spool ceases to revolve; a little chisel moves up and nicks its edge; the sliding-rod in front with its steel finger moves longitudinally and draws the thread over; a hook passes up and pulls it down tightly into the nick; another chisel cuts it off, and the spool drops down into the receptacle provided for it in front. The swinging hopper then flies up with an empty spool in its curved lower end, which is taken up by the axle-clamp and starts into revolution. At the same time the thread, the cut end of which has been held down by the apparatus for the purpose, is pulled over and started on the new spool, and the operation proceeds as before.

The part of a spool on which the thread is wound always has a variable length, increasing as the winding proceeds outward from the center. Provision must therefore be made to give this variable motion to the guide-rod carrying the thread-guides. This is effected in its feed at the right end by giving a variable motion to the stops changing its direction. There are attached to this guide-rod two segmental nuts which are made to come alternately into contact with a revolving shaft having reverse screws contiguous to each other, one screw working in each half nut, causing the nuts to travel first in one direction and then in the other. These nuts connect with an arm with a forked end, which works on a fulcrum and operates over a pair of stops or jaws, pressing on to them and moving above them for one motion, and below them for the other, two heavy springs operating to produce the pressure and change the motion, alternately forcing it down and up, the alternate action of the nuts changing each time in accordance with this motion. By means of a cam and an arrangement of toggle-joint the pair of jaws opens gradually as the thread winds, keeping at a certain distance to correspond to each particular layer, thereby regulating exactly the sliding movement of the guide-rod. When the winding is finished and ready for another spool, the jaws are suddenly closed to their smallest dimensions and the operation is repeated.

Spool cotton works.
Willimantic . . . . * "*Scientific American*," xli. 351.
Spooling machine, cotton.
Cobb . . . . . . * "*Scientific American*," xxxix. 98.

Spool Print'ing Ma-chine'.

The spools are agitated by reciprocating rods, and guided through a conduit into a race, from which the forward one is discharged by a flexibly-driven plunger into one of duplicate receivers, in which it is held by a reciprocating holder. During this movement the duplicate printing-dies, having been inked while at rest, move forward, are tipped into horizontal position by cams, and, moving against the spool, print its opposite ends in different colors, and, retreating, are raised into vertical position to be inked, while the rear spool-holder, rising, liberates its spool, and the receiver, making half a revolution, discharges the rear spool by its contact with a discharge arm, and moves into position to receive another spool, when the former operation is repeated, and the printed spool carried to the rear and the new one received are again printed, the former receiving a new impression in a contrasting color.

Spool'-shaped Spi'ral Spring. One narrower at the waist than at the ends. The opposite of *keg-shaped*.

Spoon. (*Surgical.*) See CURETTE; SCOOP.

(*Fishing.*) An object of glass, metal, mother of pearl, bone, or what-not, armed with a hook and towed abaft a boat, so as to shine while in motion and resemble a small fish. Trawling or trolling.

Spray Con-den'ser. (*Steam.*) The condenser, Fig. 2323, consists of two chambers, one over the other; the exhaust steam from the engine is admitted to the upper chamber, and is there condensed by contact with the injection water, which is brought in at the top, and made to fall on a perforated plate, which produces a rain-like spray. The condensed steam and injection water is drained away by alternately creating and destroying a vacuum in the lower chamber. This is accomplished by first opening a valve, and admitting a small quantity of steam at a very low pressure (1 or 2 lbs. per square inch), and then opening a valve to admit cold water; these two valves are actuated by tappets geared up to a shaft to produce seven strokes per minute. A steady vacuum of about 28″ is obtained with about half the water used in the ordinary jet condenser, and the condenser will draw its own water from any depth up to 27′. Salt, muddy, or even sandy water may be used, if pure water cannot be obtained.

Spray'ing Ma-chine'. A machine invented by Daughtry to irrigate growing cotton plants with wet poison to destroy the cotton caterpillar.

See *Comstock's* "*Report upon Cotton Insects*," 1879, p. 242.

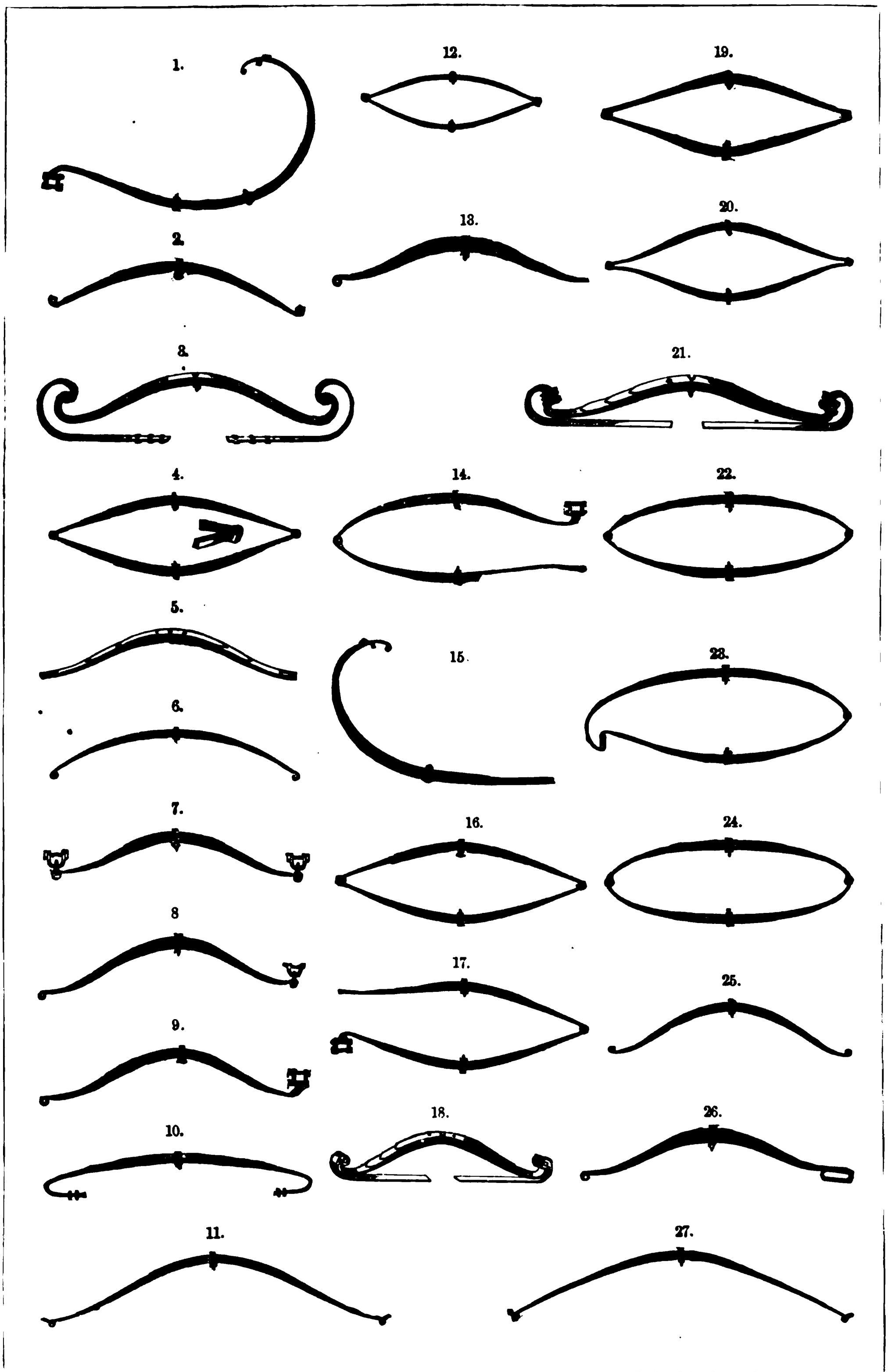
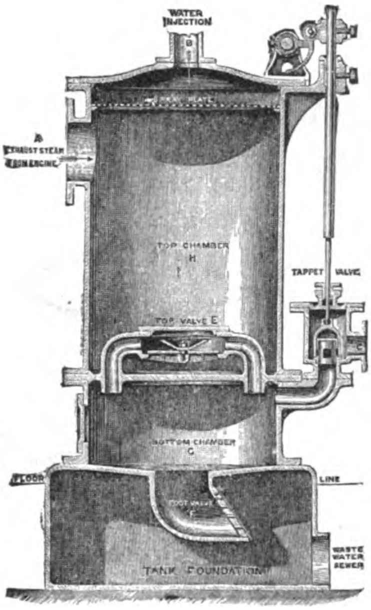


PLATE XLV. SPRINGS. See page 847.

Fig. 2323.



Spray Condenser.

Willie's atomizer, *Ibid.*, * p. 243.
Johnson's sprayer, *Ibid.*, * p. 245.
See also SPRINKLER; FOUNTAIN PUMP.

Spray In'stru-ment. The set of atomizers represented in the cut are arranged for spraying

Fig. 2324.

Sprayers.

the throat. The set consists of three straight tubes of strong glass, seven inches in length, tapering at the distal end to a point with only a small perforation. On the right side of this extremity a second little funnel-like tube is strongly cemented. This is for holding the few drops of the medicament to be used, and may be filled from the bottle or with a pipette.

In one instrument the point of the medicine-tube is exactly in front of the air-tube; this is for throwing the spray directly into the throat. In the other two a variation in the direction of the tube gives a corresponding direction to the spray, so that it may be thrown upward with one instrument and downward with the other.

A common Davidson syringe or rubber air-bulb may be attached to the proximal end of the long tube for forcing the air through.

Both tubes, for an inch from the distal end, are flattened on their under surface, and roughened, and serve the purpose of a tongue-depressor.

Spray Noz'zle. For spraying a stream instead of delivering it solid.

The nozzle shown in Fig. 2325 enables the pipeman to approach and enter a burning building; and with it the excessive use of water, and unnecessary damage to goods, may be avoided. It consists substantially of a common nozzle, having a number of small levers pivoted around it near the outer end. These levers extend about 2″ beyond the end of the nozzle, and are inclosed in a neat cup or guard, *A*, completely protecting them from injury. They are bent inwards at a slightly acute angle, resembling the figure 7. The part corresponding to the short leg of the figure is wedge-shape, the thin edge being nearest the aperture of the nozzle. The other ends of these levers (below which they are pivoted) are connected with the collar, *C*, in such a manner that when the collar is revolved one-eighth of a revolution to the right, the wedge-shaped parts of half the levers are projected into the stream, dividing it up into a number of triangular streams. By turning the collar *C*, one-eighth of a revolution further, the remaining four levers are projected into the stream, dividing it up into double the number of streams. These streams, after leaving the nozzle a few feet, become a dense mass of flying spray, covering a large surface, and extinguishing the fire with wonderful rapidity.

Fig. 2325.

Spray Nozzle.

The illustration shows very clearly the solid stream, half spread, and full spread. Any intermediate degree of spread can be given to the stream, according as the pipeman is near to or remote from the fire.

Spread'er. An attachment to the end of a branch-pipe to make it discharge a sheet instead of a jet or solid stream.

Spring. Plate XLV. gives a variety of vehicle springs.

1. C spring.
2. Dray spring.
3. Half scroll spring, button head.
4. Berlin head elliptic.
5. Bolster spring.
6. True sweep side spring.
7. Platform cross spring.
8. Scroll head side spring, hole out of center
9. Scroll head cross spring, hole in center.
10. Spar spring.
11. Double sweep Concord spring.
12. Seat spring.
13. Straight-end truck spring.
14. Coach platform spring.
15. Cradle spring.
16. Full elliptic button head.
17. Coach platform spring.
18. Half scroll spring, button head.
19. Philadelphia elliptic button head.
20. Yankee-end elliptic.
21. Half scroll spring, with loops.
22. Full elliptic.
23. Full scroll spring.
24. French elliptic French head.
25. Coach platform cross spring.
26. Loop-end truck spring.
27. Single sweep Concord spring.

See under the following heads: —

Back-lash spring.	C-spring.
Back spring.	Door spring.
Bolster spring.	Double-coil spring.
Bow spring.	Draw spring.
Buggy spring.	Edge-rolled spring.
Carriage spring.	Elliptic spring.
Car-seat spring.	Equal-bar nest spring.
Car spring.	Flat bar spiral spring.
Combination spring.	Graduated spring.
Compound spring.	Group spring.
Cluster spring.	Gum spring.

Spring testing, *de Bonneville* . . . . * "*Van Nostr. Mag.*," xviii. 519.
Springs, uses and Manuf. *de Bonneville* . . . * "*Van Nostrand's Mag.*," xviii. 391, 523.
Spring motors . . . . * "*Scientific American Sup.*," 723.
Spring motor . . . . "*Scientific American Sup.*," 791.
Shoemaker. *Maestein.*
Frahm et al. *Howell.*
Doubler. *Lathrop.*
Bacon.
Spring motors for sewing machines . . . . . * "*Scientific American Sup.*," 2256.
Spring motors (2) . . * "*Scientific American Sup.*," 757.
Schumacher. *Jones.*

Spring Band. (*Vehicles.*) An iron strap which clasps the plates of an elliptic spring.

Spring Bar Clip. A clip for fastening the spring-bar to the spring.

Spring Beam. A transverse timber which rests on top of the body-springs of a six-wheeled car-truck. There are two such beams to each truck, on which the bolster-bridges which support the bolster rest. — *Forney.*

Spring Block. 1. A seat secured to the axle to give a larger longitudinal support to the spring.

2. A distance-piece used in some forms of springs.

Spring Buf'fer. A spring device to receive the shock between colliding or impinging objects.

Spring Cap. A socket against which the top of a spring works.

Spring Case. A box inclosing a spring, as in some forms of car-springs shown on pp. 482, 483, "*Mech. Dict.*"

Spring Catch. A Y-shaped spring-piece, the bifurcated parts having their ends turned outward and back, used in raising pipe from drive wells.

Spring Com-pres'sor. (*Optics.*) A means for compressing or squeezing an object whilst under examination with the microscope. The glasses under which it is placed are pushed together by a spring and kept apart by a screw. It is made of convenient size for lying on the stage of a microscope.

Spring Coup'lings. The shackle joining the transverse and lateral springs in side-bar and platform springs in buggies.

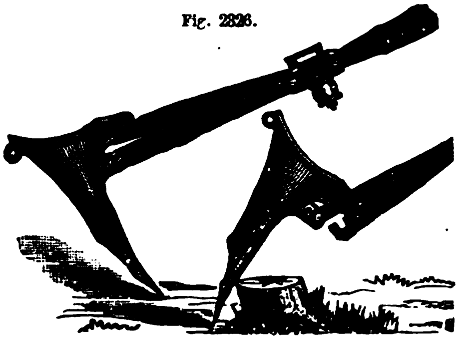
Spring Hang'er. A loop or clevis which sustains a spring beneath an object.

Spring Hinge. One in which a spring automatically closes the door when opened.

Spring Hoe. In the Farmer's Friend Drill, shown in Fig. 2326, the hoe is attached to the drill in the usual way, but is arranged so that the fastening forms a hinge, and when the hoe strikes any fixed obstruction it flies back and passes over it, when the expansion of a rubber spring that is compressed in the operation brings it back to its proper position.

Spring Hook. (*Fishing.*) A supplementary hook, which, when a fish catches the barbed hook, springing down, secures the fish from getting free.

Fig. 2326.



Spring Hoe.

See Fig. 2000, p. 872, "*Mech. Dict.*"; and for list of U. S. Patents, see p. 275, "*Report U. S. Fish Commission,*" Part I., 1873.

Spring Net. One closed by trigger and spring. Used in catching birds. A flap net. Another kind is used in catching rabbits.

Spring Plank. (*Railway.*) A transverse timber beneath a truck bolster.

Spring Sad'dle. A clevis which holds an elliptic spring, as in some car-trucks where a spring rests upon the journal box.

Spring Seat. The support for the lower part of a spring, shaped according to circumstances.

Spring Shack'le. The couplings used in joining the transverse and longitudinal springs in the platform spring system for buggies.

Spring Sha'ping Ma-chine'. A device to supersede the method of pinching heated spring leaves or plates into form by means of tongs, consists of a solid and flexible former, supported on a bed-plate, and a system of cams, drop lever, and screw for shaping.

"*Scientific American*" . . . . xxxvi. 374.

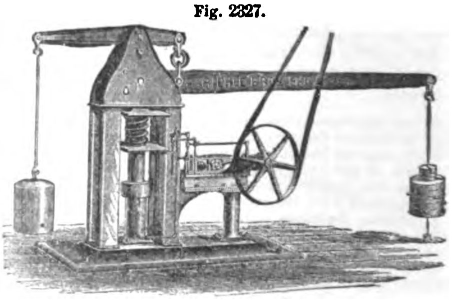
Spring Shelf. A ledge or bracket to afford a seat for a spring.

Spring Stud. A rod passing through the axis of a coil spring to hold the latter in place.

Spring Test'ing Ma-chine'. Fig. 2327 shows Riehlé Bros. machine for testing the elasticity of springs under pressure.

The power pump is operated by a pulley and belt. A lug projects from the corner of the lower table or compression surface; this lug intercepts a pawl that is connected with a valve that controls the flow of the fluid, and when the lower table moves upwards to the desired height, the fluid is diverted from under the plunger back into the reservoir, thus securing a uniform test.

Fig. 2327.



Spring Testing Machine.

The upper table bears against weighing levers, and is comparatively motionless, while the lower table moves upwards and communicates the pressure through the spring to the upper table, and thence to the levers and weights as shown.

Spring Valve. (*Steam.*) A spring balance is attached to the valve graduated to any number of pounds desired, and acts as a check on the valve till the indicated pressure is reached.

Spring Wash'er. A flat spiral spring is cut into sections of one or more laps, and used as

Fig. 2328.

Spring Washer.

a washer; will close up tightly and expand to take up looseness caused by shrinkage of woods or other cause.

Sprink'ler. A machine for spraying or irrigating plants; notably for destroying insects.

See SPRAYING MACHINE; FOUNTAIN PUMP.

Robinson's combined sprinkler and duster for destruction of the cotton worm is shown in *Comstock's "Report upon Cotton Insects,"* 1879, * p. 252.

Sprinkler, automatic fire, *Conant*, * "*Scientific American*," xxxiv. 114.

Sprue Hole. (*Founding.*) A gate, ingate, or pouring-hole in a mold.

Spud. (*Surgical.*) (*a.*) A small instrument with an enlargement on the end, used in withdrawing foreign matters from the eyeball and orbit. It is not so pronouncedly hollow as the curette or spoon.

(*b.*) A dermal instrument of the same shape; used in scarifying.

Spun Glass. (*Glass.*) Drawn by a workman from a hot bulb, or, on a larger scale by means of a wheel. See GLASS SPINNING, p. 983, "*Mech. Dict.*"

In the Austrian section at the Paris Exposition was one of the attractions of the day, viz., the manufacture of toilet articles and stuffs for ladies' wear, made out of spun glass, by Madame Jules de Brunfaut, Vienna. The glass, shown on the counters in large bundles, to all appearance looks like cotton, and is of a remarkable fineness. This glass is spun into threads like ordinary cotton, and is woven into different colored fabrics, sometimes entirely of glass and sometimes with a chain of silk or cotton.

The novelty of seeing fancy articles made of spun glass attracted the eye of the visitor. Ladies were particularly astonished at seeing collars, neckties, cords and tassels, fringes, pin-cushions, little caskets, curled feathers, belts, etc., made of glass. A very handsome ladies' buff-colored bonnet, made of spun glass, with the orthodox feather and ribbons, lined with silk, was the center of attraction. A bonnet of this kind can run the risk of a shower without being spoiled; glass will only look brighter for being washed.

The exhibit included a very handsome cloak, made of knitted wool and lined with glass cloth, the threads being woven a certain distance apart and laid at right angles. This made a very pretty and bright lining, offering a pleasant contrast with the colored knitted wool. The different articles exhibited were made in various-colored glasses. There was quite a variety of colored and white laces; cloths embroidered with glass; very thin woven glass cloth, in which now and then a fine thread of gold-colored glass appeared, making a very handsome fabric. These goods are easily washed by simply dipping in a bath of water and soda, and brushed with an ordinary soft brush.

See SLAG, *supra.*

Fr., *coton de verre*; Ger., *glaswolle.*

Spur. The far-projecting point on the circumferential edge of an auger. It makes the cut, while the *lip* raises the chip.

(*Ceramics.*) A small piece of refractory clay ware having one or more points, and used to support an article in the seggar while firing in the kiln. Also called a *stilt*. Fr., *colifichet.*

Sput. A thimble or annular reënforce to a hole in a boiler.

Squab Cush'ion. A cushion consisting of a bag filled with curled hair, feathers, or whatnot.

Square Tank Coil. A condensing coil of rectangular shape.

Squar'ing-off Saw. A circular saw, fitted to a bench with a sliding table, to square the ends of work.

Squar'ing Plow. For squaring paper in bookwork. The paper being placed on a table, with a board of required size on top, the paper is held firmly down by a screw having a bearing above. The board is provided near its edge with a groove or track for the plow or knife-carrier to travel in. The knife overhangs the board, and cuts the paper to size of the same.

Squar'ing Shears. (*Sheet-metal Working.*) A machine for squaring up tinned plate. It has scales of inches upon the adjustable table, and similar scales upon the arms that support the back gage, which latter has a rack-and-pinion adjustment.

The blade and treadle are balanced by an adjustable counter-weight; the treadle-springs are relieved of the weight of those parts, their only duty being to quicken the return movement of the blade. Page 110, "*Bliss's Catalogue*," 1881.

Another form has two blades set at right angles one with the other, and moving in unison, so that a sheet of tin may with one motion be squared on two sides, or the whole sheet squared in two motions. There are suitable front gages as well as independent back gages, one for each blade.

The gage on one blade can be set to cut a different width from the other, so that part of a sheet of metal can be cut up into a certain width for one article, and the remainder into a different width for another article.

Squaring shears, *Stiles & Parker*, * "*Scientific Amer.*," xl. 82.

(*Bookbinders.*) A curved hand-shear for squaring paper and cardboard is pivoted at one side of a table, and is held up by a balance-weight. The operator adjusts the material to be cut, and bears down on the handle of the shear. A foot treadle presses on the paper alongside of the shear to keep it firm.

Squeez'er. In sheet-metal working, a machine for squeezing or crimping, on the tops and bottoms of sheet-metal cans. See illustrations, p. 90 *et seq.*, "*Bliss's Catalogue*," 1881.

A series of compressing walls, to consolidate and clear of cinders the large masses of crude wrought-iron often produced in the process of puddling.

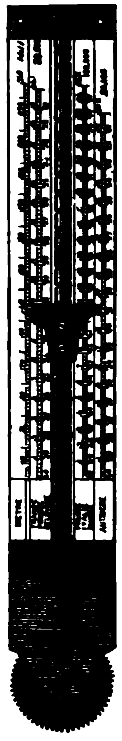
Menelaus . . . . "*Scientific American Sup.*," 1284.
Squeezer, *Head*, Br. . * "*Engineer*," xliii. 358.
Iron, *Head* . . . . "*Iron Age*," xx., July 5, p. 9.
Squeezing, puddlers' balls mach., *Suckors* * "*Scientific American Sup.*," 1288.

Sta-di-om'e-ter. The geographic stadiometer devised by Captain Bellomayce, is designed to show at a single reading the measure of any line, right, curved, or broken, on maps or charts executed on any scale. The toothed wheel shown at the bottom is moved over the line and imparts motion to the longitudinal screw. This, in rotating, causes the ascent or descent of the carriage, the straight edge of which serves as an index.

Eight scales are used, one of 1-80000 for Prussian, French, and Belgian maps; one of 1-100000 for Prussian, Italian, and Swiss maps; one of 1-86400 and another of 1-144000 for Austrian maps, two respectively of 1-21600 and of 1-424000 for Russian maps; one of 1-63360 for English maps, and finally a graduation corresponding to the natural metric scale. This last marking by a simple reduction allows of the instrument being used for maps constructed on any other scale than those mentioned.

The device is held in the hands like a pencil, and as the wheel runs over the line it is only necessary to read the distance traveled on the proper scale to know the exact length of the line. When the index reaches the top of the screw, the instrument is turned around and pushed forward as before, the marking being now read from the top downward instead of in the reverse direction. It is especially useful in the field for military operations, as it does not require the entire map to be spread out flat before it can be used. It of course obviates the employment of dividers, and the usual scale of distances printed on charts.

Fig. 2329.



Stadiometer.

Sta'di-um. The leveling rod of a surveyor. See illustration, "*Van Nostrand's Mag.*," xxi. 141, 142.

Staf'ford-shire Ware. (*Ceramics.*) Household earthenware made in Staffordshire, in England, where pottery had been made as far back as the Roman period.

The red ware of the brothers Elers, from the Netherlands, was the beginning of the new era for the district. Delft was copied; then came Wedgewood, who made the greatest improvements due to one man, so far as we know the history of the art.

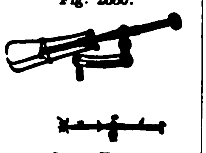
He improved and decorated the old wares; in 1762 invented the *cream* or queen's ware (not the modern invention), made of clay and silex with a clear glass glaze. In 1766 he made his black basalt ware. In 1773 he invented the fine paste for cameos, reliefs, and statuettes, which came to be known as jasper ware.

The queen's ware or ironstone china is perhaps the best known of Staffordshire wares, though many others are made in that country.

See STONEWARE.

Stage For'ceps. Adjustable clamps for fitting on to one side of the stage of a microscope to hold an object for examination.

Fig. 2330.



Stage Forceps.

Stage Mi-crom'e-ter. (*Optics.*) A piece of glass upon which fine lines are engraved, usually of 1-100 and 1-1000 of an inch or parts of a millimeter. It is placed on the stage of the microscope and used for the measurement of objects.

Stain'ing. (*Leather.*) Applying with a hair brush to the grain side of leather a solution of logwood, sal-soda, and soft water. It gives a dark color to the leather.

Stain'ing Met'als.

Metals may be colored quickly and cheaply by forming on their surface a coating of a thin film of sulphide. In five minutes brass articles may be coated with any color, varying from gold to copper-red, then to carmine, dark-red, and from light aniline-blue to a blue-white, like sulphide of lead, and at last a reddish-white, according to the thickness of the coat, which depends on the length of time the metal remains in the solution used. The colors possess a very good luster, and if the articles to be colored have been previously thoroughly cleaned by means of acids and alkalies, they adhere so firmly that they may be operated upon by the polishing steel. To prepare the solution, dissolve one-half ounce of hyposulphite of soda in one pound of water, and add one-half ounce of acetate of lead dissolved in a half pound of water. When this clear solution is heated to from 190° to 200° Fah., it decomposes slowly, and precipitates sulphide of lead in brown flakes. If metal be now present, a part of the sulphide of lead is deposited thereon, and, according to the thickness of the deposited sulphide of lead, the above colors are produced. To produce an even coloring, the articles must be evenly heated. Iron treated with this solution takes a steel-blue color; zinc, a brown color; in the case of copper objects, the first gold color does not appear; lead and zinc are entirely indifferent. If, instead of the acetate of lead, an equal weight of sulphuric acid is added to the hyposulphite of soda, and the process carried on as before, the brass is covered with a very beautiful red, which is followed by a green (which is not in the first scale of colors), and changes finally to a splendid brown with green and red iris glitter. This last is a very durable coating, and may find special attention in the manufactures, especially as some of the others are not very permanent. Very beautiful marble designs can be produced by using a lead solution, thickened with gum tragacanth on brass which has been heated to 210° Fah., and is afterwards treated by the usual solution of sulphide of lead. The solution may be used several times.

Stain'ing Wood. Oak may be dyed black, and made to resemble ebony, by the following means: —

Immerse the wood for 48 hours in a hot saturated solution of alum, and then brush it over with a logwood decoction, as follows: Boil one part of the best logwood with 10 parts of water, filter through linen, and evaporate at a gentle heat until the volume is reduced one-half. To every quart of this add from 10 to 15 drops of a saturated solution of indigo. After applying this dye to the wood rub the latter with a saturated and filtered solution of verdigris in hot concentrated acetic acid, and repeat the operation until a black of the desired intensity is obtained.

Stains for wood, *Black*. "*Scientific American Sup.*," 1994.

Stake. The stanchion, standard, or post placed in a socket on the edge of a gondola or flat car to hold sideboard or freight, as the case may be.

Stake Hook. The clevis or iron loop on the edge of a platform car to hold the stake or stanchion.

Stake Net. (*Fishing.*) A net secured by stakes.

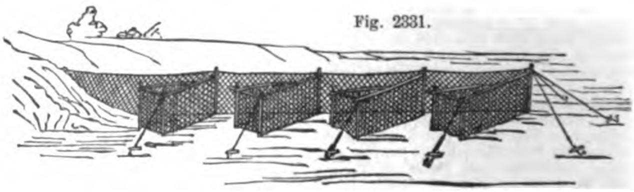
In the example, it is hung on stakes about 21′ apart in a line at right angles to the shore. This part of the net is known as the *bar*-net. At from 30′ to 40′ down stream another row of stakes is set, each opposite a stake in the *bar*-net, and between these stakes a *wing*-net is stretched, having several yards of netting more than suffices for the distance. This end is carried round in the form of a triangle and held in position by poles lashed together at their ends. The free end of one pole is secured to the stake, and of the other to the seaming of the wing-net, and thus secured they float at the surface of the stream.

The triangular portion of the wing is arranged so as to allow an opening between the end of the *hook* and the *wing* through which the salmon enter the triangle.

The netting is made of strong gilling-twine, the minimum mesh allowed being 5″.

The salmon, swimming up the current, come in contact with the bar-net, and turning to pass around it, find themselves opposed by the *wing*; they turn again up-stream, and are pretty certain to enter the *hook*, the netting of which hangs slack. In their efforts to escape they become gilled.

Fig. 2331.



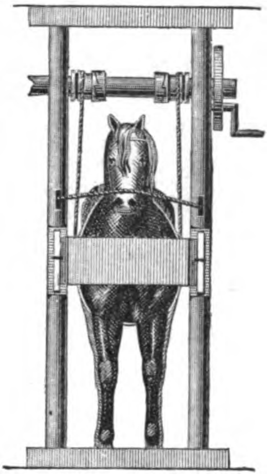
Staked Gill-net for Salmon on the St. Lawrence.

A gill net set in a channel attached to stakes. Such are very common in the Potomac and other Atlantic rivers.

Stall. Fig. 2336 shows a stall for transporting horses or cattle on ship or cars.

Each horse has his own separate box and sling. A shaft runs along above the row of stalls, and on this are loose clutch-pulleys, to which the ropes of the several slings are attached. These pulleys can be clutched with a corresponding clutch on the shaft, and any one or all the horses swung from the floor at will. The sides of the stall are of stout canvas.

Fig. 2332.



Stall.

Stamp. (*Mining.*) Machines for crushing ores.

The old practice of running high stamp-heads at a low speed and high drop has been changed by Western mill men, who erect heavy stamp-heads working at a high speed with a low drop, claiming that they get better results. The weight of a heavy head may be taken at 700 pounds, medium drop of head 10″, number of drops per minute for high speed, 90.

* "*Scientific American Sup.*," 1512.

Stamp, *Ball.* * "*Min. & Sc. Press,*" xxxiv. 337, 345.

Canceler, electr., *Dow.* * "*Scientific Amer.,*" xl. 38.

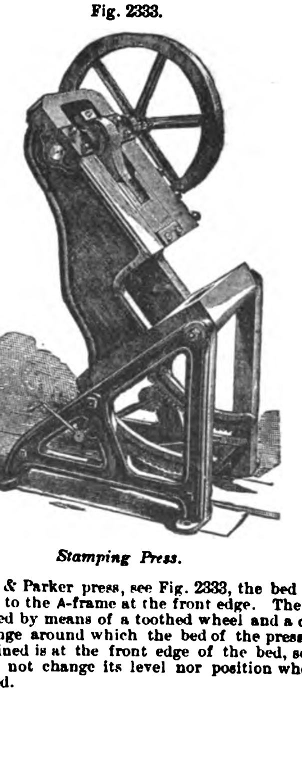
Canceling . . . . . . "*Iron Age,*" xix., Jan. 25, p. 19.

Stamp'er. A machine used in cleaning or filling textile goods. It may have one or more oak tubs about 3′ in diameter, with fallers or stampers of birch, while the framing is of pine bolted together. The tub is fixed on an iron plate which revolves by gearing, while the stampers are lifted by cams and are released so as to fall in succession on the goods being operated upon.

Stamp'ing Ma-chine'. For stamping the soles of boots and shoes with monogram or trade-mark.

Stamp'ing Press. A press for stamping or punching sheet metal.

Fig. 2333.



Stamping Press.

In the Stiles & Parker press, see Fig. 2333, the bed of the press is hinged to the A-frame at the front edge. The inclination is secured by means of a toothed wheel and a curved rack. The hinge around which the bed of the press turns when it is inclined is at the front edge of the bed, so that this edge does not change its level nor position when the press is inclined.

The adjustment of the slides in the guides is made by a very neat arrangement of a V-shaped liner, put into the guide in such a way that it takes up the wear upon the side where the wear comes. As the diagonal pressure in these presses is, owing to the length of the connecting rod, or pitman, very slight, the wear is merely nominal.

The pressure from the eccentric is transmitted to the slide in the form of compressive strains entirely, the end of the pitman bearing in a cup-shaped hollow, the pin merely serving to lift the slide by. The adjustment of the press is secured by a couple of eccentrics, one of which is movable about the other. By loosing the clamp screws shown in the top of the pitman, the outer eccentric may be turned so as to obtain any desired throw, after which the screw is set up and the press is ready for operation. This method gives exceeding delicacy of adjustment, and makes the press capable of doing work of the most difficult character.

Presses of this kind are capable not only of punching plate iron, but of decorating silver-ware. The two operations are fair examples of the extremes of coarse and fine work, though both require about the same amount of power and equally heavy pressures.

Stamping press, *Gordon* * "*Iron Age,*" xxiii., Feb. 6, p. 9.
Stiles & Parker . . . * "*Iron Age,*" xxiv., Sept. 4, p. 1.
Bliss & Williams . . * "*Scientific Amer.,*" xxxix. 406.
Stiles & Parker . . . "*Scientific American,*" xxxix. 69.
Foot, *Ferracute Co.* . * "*Iron Age,*" xix., April 26, p. 23.
Foot and hand, "Peerless" . . . . . * "*Iron Age,*" xxiv., Aug. 28, p. 1.

Stamp Mill. A mill for reducing ores to a comminuted state preparatory to extracting the precious metals by amalgamation.

This ore is worked by the wet amalgamation process. The ore is introduced in an automatic feeder, and is fed under the stamps as required.

It is stamped fine enough to discharge through a screen containing 120 holes to the square inch. Water is turned in the battery at the same time the ore is fed in, and the splash as the stamps drop causes it to discharge, and the water carries the crushed ore with it to the tanks, where it settles.

The battery consists of 5 stamps of 775 lbs. each; they are raised by cams on a revolving shaft, and drop 8″, at the rate of 95 drops per minute. The shoes and dies are of cast steel, and weigh 120 lbs. each. The mortar in which the stamps work is made of cast iron, and weighs 4,400 lbs.

The crushed ore is taken from the tanks, put in the grinding and amalgamating pan, heated by steam, in order to soften the sand, and assist amalgamation. It is ground here for three hours; the grinding muller revolving at the rate of 90 revolutions per minute. The mercury introduced and amalgamated for two hours more. The mass is then drawn off into the settler below, water turned in to cool it, and is stirred by the revolving shoes for two hours and a half, bringing all the particles of mercury together in a mass at the bottom. With the bottom is connected an inverted siphon-pipe, that conducts the mass of mercury containing the amalgam into an iron bowl; from there it is strained through a canvas sack, the mercury going through, and the amalgam containing the gold and silver remaining in the sack. It is then in a condition to be handled, and contains about four fifths of its weight in mercury. It is then put in dishes in an iron retort, placed in the furnace with the pipe at the end to conduct the mercury out. Fire is made in the furnace, and the heat drives off all the mercury, which is condensed and used over again. The bullion is left in the retort, and when taken out is ready to go to the mint for melting.

Ball's patent steam stamping machinery for stamping ores and minerals (see Fig. 2334), is a direct acting vertical stamp mill having a common steam cylinder and slide valve at the top, and the piston rod extended into the stamp stem which works in a cast-iron mortar supported on spring timbers resting on cast-iron sills.

The lower portion of the mortar is circular in form, the upper portion being oblong, with a flat top and vertical sides; on the front and back sides are inclined openings for receiving the screens. The mortar is cast in one piece, and is lined throughout with hard iron linings. There are two feed-hoppers bolted to the top of the mortar, through which the ore is fed to the mortar.

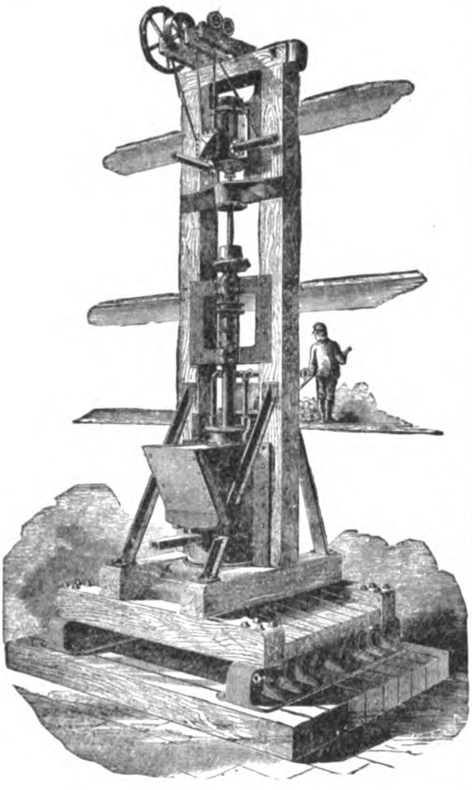
There is also a water urn arranged about a circular opening in the center of the top of the mortar, through which the water is conducted to the mortar.

The stamp shaft or stem works through two boxes which are attached to an iron frame that is bolted to the two upright posts that form the main framework of the machine.

Between the boxes and about the stamp-shaft is a revolving clamp and pulley, having feathers which work in splines in the stamp-shaft; and, by means of a belt on the pulley, a rotary motion is given to the stamp-shaft during its upward and downward motion.

The piston rod passes from the steam cylinder downward through the center of the bunter beam, and into the stamp-

Fig. 2334.



Stamp Mill.

shaft bonnet in which the connection to the stamp-shaft is made. The bunter beam contains a cushion against which the top of the stamp-shaft bonnet would strike, should the stamp-shaft lift too high.

The slide-valve works independent of the stamp-shaft, running a regular number of strokes per minute, and is driven by an eccentric on a shaft, which receives its motion from a countershaft; the two shafts being geared together with two cam gears, by means of which the motion of the eccentric shaft is changed into an irregular motion, and gives the eccentric and steam valve a motion corresponding to the slow upward and quick downward movement of the stamp-shaft.

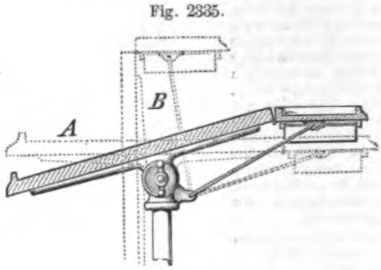
Stamp mill, "Elephant" * "*Min. & Sc. Press*," xxxvii. 81.
Kendall . . . . . * "*Min. & Sc. Press*," xxxvii. 112.
For silver ores (80-stamp), Peru . . . * "*Engineering*," xxviii. 359.
Rotary, *Taylor* . . . * "*Min. & Sc. Press*," xxxvi. 193.
Stamp mills, Cal. . . . * "*Engineering*," xxx. 19, 85, 163, 254, 338.
Cam for mill stamps. *Cochrane* . . . . . * "*Min. & Sc. Press*," xxxv. 81.
Cam for stamp mills. *Moore & Dykes* . . . * "*Scientific American*," xlii. 169.
Cams for stamp-mills: consideration of single "*Mining Journal*." and double arms . . * "*Scientific American Sup.*," 1512.

Stamp Mu'cil-age. The following is said to be the formula for the mucilage used on the United States postage stamps: Dextrine, 2 oz.; acetic acid, 1 oz.; water, 5 oz.; alcohol, 1 oz. Add the alcohol to the other ingredients, when the dextrine is completely dissolved.

Stamping mill, *Ball* . . * "*Eng. & Min. Jour.*," xxii. 359.
Rotating, *Fisher*, Br. * "*Engineering*," xxx. 371.
* "*Scientific American Sup.*," 4135.

Stand. 1. For holding materials for drawing or painting. The Washburn stand, manufactured at Worcester, Mass., can be fixed at any required height, so that one can use it either sitting or standing; and by turning back the screw at the right, it is allowed to rotate, bringing either side in front. The shelf or ledge for instruments is attached to the back side of the table, so that it is always level, whatever inclination is given to the desk; convenient for the water-cups, ink-stands, etc. Fig. 2335

Fig. 2335.



Washburn Stand.

shows the table fixed at a slight inclination, the dotted lines showing it horizontal at *A* or vertical at *B*. When the table is nearly vertical the whole occupies but little space, and forms a perfect easel. When used for this purpose an attachment is furnished for holding the picture, and the adjustments are so simple that a mere touch is sufficient to effect an entire change in the light which falls upon the work. Under the instrument shelf are provided two drawers for working materials. The table and drawers are made of black walnut or other appropriate wood, nicely finished.

2. (*Microscopy.*) The framework of a microscope, usually implying all save the object glasses and the accessory apparatus.

Stand'ard Bat'te-ry. (*Electricity.*) One to be used as a standard, having a perfectly constant electro-motive force.

Such an one is Latimer Clark's battery, described in "*Phil. Trans. Royal Society*," June 19, 1875.
Niaudet, American translation, 148.

Stand'ard Gage. (*Railroad.*) "Standard gage" means 4′ 8½″ between centers of rails.

Stand Pipe. A vertical pipe in which a column of water is made to rise to give sufficient head for forcing the water to elevated portions of the circuit. See "*Mech. Dict.*," p. 2308.

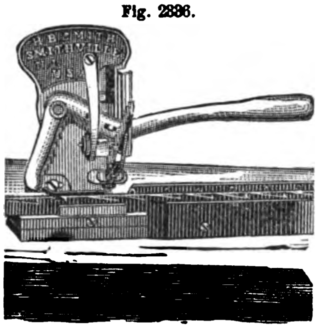
Stand-pipe, Blooming-ton, Ill. . . . . . * "*Scientific American Sup.*," 164.
* "*Engineer*," xli. 51.
Centennial . . . . * "*Scientific American Sup.*," 233.
Sandusky . . . . * "*Scientific American Sup.*," 1746.

Stand Pipe Fire Ap'pa-ra'tus. A portable stand-pipe for obtaining a higher head of water at fires. One section of a pipe is attached permanently to trunnions; other sections are carried in a side rack and attached at the fire. The pipe, 50′ long or more, is raised by means of a wheel after coupling the hose. The lower end is attached to the water supply. Less power is required at the engine to raise the water.

Staph'y-lor'a-phic Ap-pli'ance. *Dr. Gummings'* appliances for congenital cleft palate, * *Dr. J. H. Thompson's* report in "*Centennial Exhibition Reports*," vol. vii., Group XXIV., p. 28.

Sta'ple Dri'ver. An instrument for driving the staples in window-blinds. The one shown in Fig. 2336 feeds the blind the proper distance, supplies the staple, and drives it either in the rod or slat as desired.

Fig. 2336.



Staple Driver.

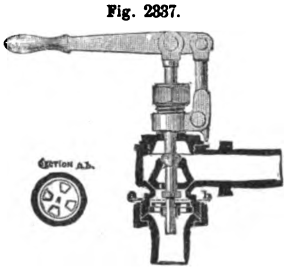
Sta'ple Fas'ten-er. A spring punch for driving and clinching a staple against an anvil block beneath.

Star Feed. A star-shaped device for improvising a feed motion to a slide-rest or to a tool-holding device not actuated by the self-acting feed motion of a lathe or machine. Upon the outer end of the feed screw of the slide-rest a star-shaped plate is fastened. For a slide-rest feed a pin is fastened to the lathe face-plate in such position that it will strike one of the star wings at each revolution.

For a revolving boring bar the pin is stationary and the star revolves with the feed screw of the bar.

Start'ing Valve. The starting valve, shown in Fig. 2337, is operated by a lever; its stem is attached to the valve with a lost motion, and has a small valve in the center of a larger valve. Pressure of the boiler is on top of the valves. Raising the lever and drawing up the valves, the small valve will leave its seat and rise until a check nut has brought up against *d*. This resistance can be distinctly felt, and indicates when the small valve only is open. Through this small valve enough steam will pass to start the jet. A further motion of the lever then raises the large valve, and the pressure, acting on the steam, forces it wide open and holds it in this position.

Fig. 2337.



Starting Valve.

Star Tor-pe'do. A movable chamber or mine charged with an explosive that is fired by contact or by fuse. The star torpedo has a single platinum fuse and battery and one set of wires, and can be fired either on contact or at will as desired. There are two wires leading from the opposite poles of the battery to a contact maker on the nose of the torpedo, by which contact is made between the wires whenever the torpedo is touched by the vessel attacked, and the current thus being free to pass through the fuse, the torpedo is thereby exploded.

Torpedo, *McEvoy*, Br. . . . * "*Engineer*," xliii. 340.

Stath'mo-graph. An instrument invented by Dato, of Cassel, for recording the velocity of railway trains.

"*English Mechanic*" . . . . xxv. 229.

Sta'tic E'lec-tri'ci-ty. (*Electricity.*) Electricity at rest.

Sta'tion-a-ry Bed Pla'ner. The bed is stationary, and the stuff is fed by feed-rollers. The bed has sliding rollers, flush or a little above its face.

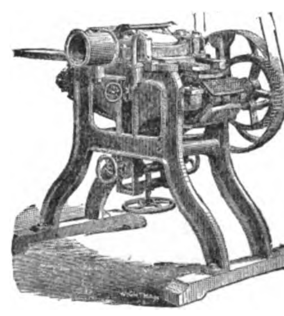
Sta'tion In'di-ca'tor. An indicator operating in connection with the driving-wheels to exhibit automatically the name of the station or street immediately preparatory to arrival.

Sta'tion Me'ter. (*Gas.*) A meter of the largest class for measuring the flow of gas at the works; made from 30″ wide and 30″ long, to 15′ × 15′, of a capacity from 15,000 cubic feet to 2,000,000, per 24 hours. The smaller are in one cylinder and the larger in two sections. They are made with water-line, pressure, and overflow gages, and register clock and tell-tale attachments. The tell-tale tells at a glance any irregularity of manufacture during the 24 hours, the cards being attached and removed daily.

Stave Dress'ing Ma-chine'. This machine has a rotary cutter-head and revolving bed with continuous motion.

The stave is placed on the bed and carried forward in a direct line to the rollers, which are straight, convexed, or concaved, to fit the shape of the stave.

Fig. 2338.



Holmes's Machine for Dressing Sawed Staves.

The rotary head cutters are so made as to smooth and finish the stave, perfect its shape, and give it uniform thickness.

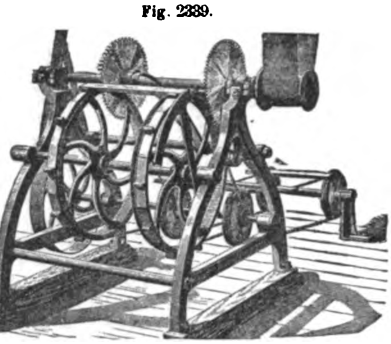
The form may be changed at pleasure and may be made to operate upon one or both sides of the stave.

Revolving cutters are used for dressing staves of all thicknesses; dressing both sides of the staves at the same time without cutting the wood across the grain, that is, leaving the staves winding and crooked as they were rived from the block. This is accomplished by allowing the frame, which supports the cutters, to oscillate or rock in all directions, by which the cutters adapt themselves to the crooks and winds of the stave, the stave having control of the cutter frame. It dresses rived and sawed staves of different lengths and curves, for making kegs, barrels, and hogsheads, and dresses crooked and winding stock to a uniform thickness, leaving it concave and convex as required.

Stave dresser, barrel.
Holmes . . . . * "*Engineer*," xli. 431.
Jointer, *Holmes* . . . . . "*Engineer*," xli. 431.
Jointing machine, Br.
Richards . . . . * "*Engineering*," xxiii. 189.
Saw, *Ransome* . . . . . * "*Engineering*," xxi. 452.
Shaper & bender.
Ashey, Fr. . . . . . . * "*Engineer*," xlvii. 255.

Stave E'qual-i-zer. In Holmes's equalizer, Fig. 2339, the feed is continuous, the staves being simply laid upon the reel, which passes them between the saws and delivers them on to the stave conveyer, which carries them where they are needed.

Fig. 2339.



Barrel Stave Equalizer and Conveyer.

Stave Ma-chin'e-ry. See list under BARREL MACHINERY.

Stay End. The end of a back-stay in a carriage. Stay-ends are sold separately as pieces of carriage hardware, the lengthening rod being added by the blacksmith.

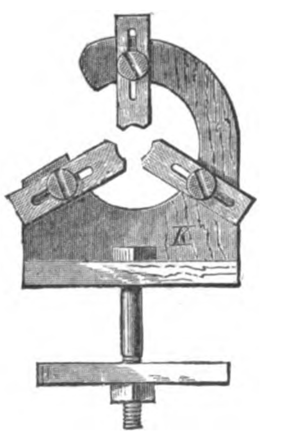
The ends of the stay are bolted or clipped to the perch and hind axle respectively.

Stay End Tie. The rod which connects the stay-end on the reach with the one on the axle.

Stay Rod. A rod which connects two objects to prevent displacement of one or both.

Stead'y Rest. For centering a cylindrical piece in a lathe, slotted pieces are adjustable lengthwise to accommodate the size and position of the shaft.

Fig. 2340.



Steady Rest.

Steadying tools, lathe work, * "*Scientific American*," xl. 100.

Steam. For appliances, machinery, and uses, see the following references: —

Steam building crane .
Florio, Palermo . . * "*Engineer*," xlvi. 369.
Brake, continuous.
Kendal, Br. . . . * "*Engineer*," xlviii. 272.
Canoe, *Roper*, 14′ × 17″ × 12″ . . . . . "*Scientific American*," xl. 261.
Car, *Ransomes*, Engl. * "*Scientific American*," xli. 50.
Clyde, "Lord of the Isles" . . . . . * "*Scientific American Sup.*," 1525.
On common roads . . "*Scientific Amer.*," xxxix. 96.
Steam crane, *Appleby*, Engl. . . . . . * *Thurston's* "*Vienna Rept.*," iii. 335.
Caillard, Fr. . . . * "*Engineering*," xxvii. 123.
60-ton, St. Petersburg * "*Engineering*," xxv. 64.
Locomo., *Janson*, Br. * "*Engineer*," xlix. 160.
Portable, *Brown Bros.*, Eng. . . . . . * "*Scientific American Sup.*," 932.
Brown, Br. . . . . * "*Engineer*," xliii. 428.
Burrow, Engl. . . . * "*Scientific American Sup.*," 3879.
Steam digging-engine.
Darby, Br. . . . * "*Engineer*," xlvi. 43.
Escape, quieter . . See QUIETING CHAMBER.
In factories . . . . * "*Iron Age*," xxv., Jan. 1, p. 1; Jan. 8, p. 1.
Ferry, "*Iron*," *Egerton*, Eng. Channel . "*Van Nostrand's Mag.*," xiv. 284; xv. 92.
Ferry steamer, light draft, *Denny*, Br. . * "*Engineering*," xxviii. 377.
Fire-engine boiler. *La France* . . . . . * "*Scientific American*," xlii. 404.
Fittings factory . . * "*Scientific American*," xliii. 367.
Fitting, piping a building . . . . . . * "*Scientific American*," xli. 355.
For common roads (Wisconsin law). . "*Scientific American*," xxxiv. 64.
Generator, *Franke* . * "*Scientific American*," xliii. 115.
Ward . . . . . . * "*Scientific American*," xli. 323.
Goode . . . . . . * "*Am. Man.*," Feb. 28, 1879, p. 6.
Herreshoff . . . . * "*Engineering*," xxvii. 122.
Horse for street R. R. * "*Scientific American*," xxxiv. 51.
Steam and hydraulic press, direct acting.
Tweddell, Br. . . * "*Engineering*," xxv. 92.
Steaming app. for printed textiles, *French* . * "*Scientific American Sup.*," 2274.
Steam, light draft, *Yarrow & Co.*, Br. . . * "*Engineering*," xxiii. 45.
Steam launch gager . . * "*Engineer*," xlix. 121.
Outtridge . . . . * "*Engineer*," xlix. 489.
Engine, *Selfe*, Sydney * "*Engineering*," xxi. 129.
Pressure gage, *Edson* * "*Am. R. R. Journal*," li. 288.
Stewart, Br. . . . * "*Engineering*," xxvii. 37.
Dewrance, Br. . . . * "*Engineering*," xxvii 100.
Indicator, *Darke* . . * "*Engineering*," xxix. 241
Regulator for portable engines, *Stannah*, Br. * "*Engineer*," xlix. 421.
Road wagon . . . . "*Scientific Amer.*," xxxix. 208.
Scoop-excavator.
Fowler, Br. . . . * "*Engineer*," xlvii. 475.
Stop valve.
Cormack, Br. . . . * "*Engineering*," xxv. 221.
Towage, Illinois canal * "*Eng. & Min. Jour.*," xxiii. 109.
Water in, measurement of, *Guzzi* . . . . * "*Scientific American Sup.*," 1807.
Whistle signaling inst. "*Telegraphic Journal*," iv. 178.
Yacht "Livadia," Rus. * "*Scientific American Sup.*," 3866.
* "*Engineer*," l. 24, 45, 48.
Stearing gear.
Lafargue, Br. . . . * "*Engineer*," xlvi. 71, 88.

Steam'boat. For sketch of the progress and history of steamboat building, see "*Mech. Dict.*," pp. 2321–2326.

Steamboat, Symington Engine . . . . . * "*Scientific American Sup.*," 711.
Engines, early Amer. * "*Engineering*," xxviii. 327.
"Clermont." "Chancellor Livingston."
Engine, light draft.
Wilson & Co., Engl. * "*Scientific American Sup.*," 1220.
Early history . . . "*Iron Age*," xix., June 7, p. 5.
Fulton. *Bell.*
"Grand Republic" . "*Scientific American Sup.*," 1921.
On Mississippi, first . "*Scientific Amer.*," xxxvi. 20, 68.
First voyage of Fulton's "*Iron Age*," xxii, July 4, p. 3.
For shallow water.
"Silva Americano" * "*Scientific American Sup.*," 1486.
Towing, Ohio river "J. B. Williams," . * "*Engineer*," xli. 416, 420, 428, 434.
Speed, Engl. . . . "*Scientific Amer.*," xxxix. 193.
Steamboats, Fulton's letter . . . . . "*Scientific Amer.*," xxxvi. 388.
Small, *Firth* . . . . "*Scientific Amer.*" xxxix. 325.
Unsinkable.
Thompson, Engl. . * "*Scientific American*," xxxix. 18

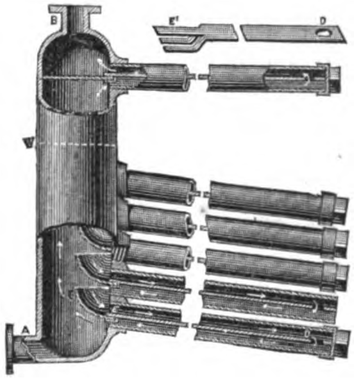
Steam Boiler. A vessel in which water is converted into steam, to be used as a power, a medium, and for other purposes. For early forms of steam generators and the adaptation of steam to mechanical and other uses, see "*Mech. Dict.*"

Of boilers of later construction, and unnoticed in the original volumes of the "*Mechanical Dictionary*," we have the "Corliss," an upright tubular boiler, with a cylindrical shell.

The "Exeter" has a series of sections, each a boiler in itself, rectangular in form. Each section has twelve openings, and is practically a series of connected boxes.

In the "Kelly" (see Fig. 2341) sectional safety boiler, the front chamber of each section is vertical, and the tubes are inclined over the fire at an angle of about one to eight. In

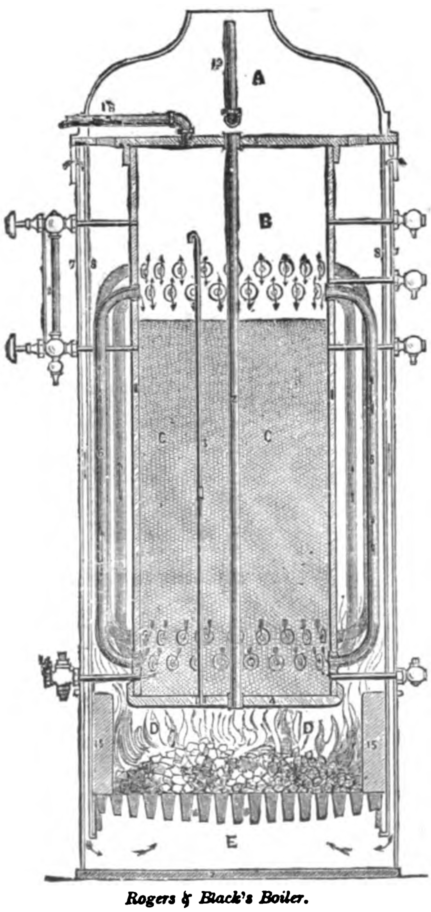
Fig. 2341.



Kelly's Steam Boiler.

each tube there is a partition with diaphragm, and the water-line of the boiler is above all the water tubes, but below a horizontal tube for the superheating of the steam. The

Fig. 2342.



Rogers & Black's Boiler.

theory of the circulation of the water is that the lower portion of the tube will be the most highly heated, and so generate the most steam, which, being intercepted by the partition plate and prevented from rising to the upper part of the tube, passes along the lower side of the partition to the front chamber and thence to the dome.

"Lowe's" tubular boiler has a cylindrical shell and horizontal tubes, like those of a locomotive boiler, through which the heated air and gases pass. Thence the hot air is carried round and under the boiler in front.

The "Howard" sectional safety boiler has tubes inclined from front to rear, with wrought iron steam drum.

"Root's" sectional boiler has an automatic feed regulator regulating the supply of water to the boiler by admitting steam from the boiler into the regulator when the water falls below a certain level.

The "Babcock & Wilcox," is a sectional tubular boiler with horizontal steam and water drum. The tubes are staggered. The end connections are each cast in one piece of steel, and connected with the steam and mud drums by short tubes expanded into bored holes, doing away with bolt connections.

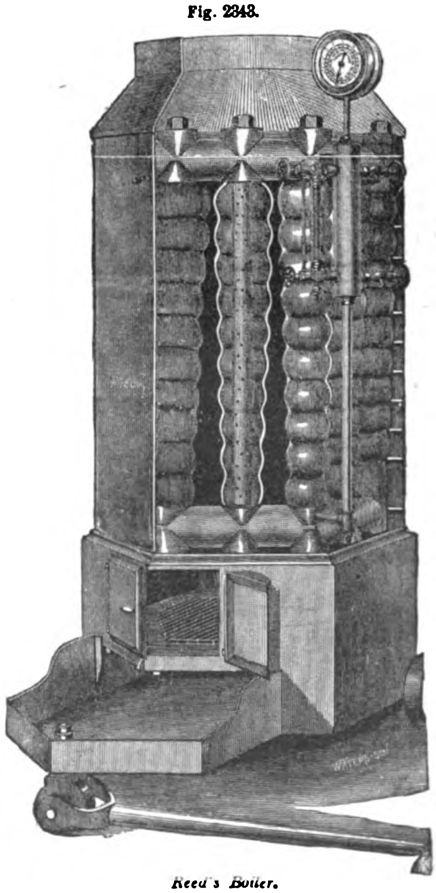
The "Firmenich," is an upright tubular boiler. The base is two large mud drums, one on each side, but two feet below the fire grate. From these rise obliquely over the fire, stacks of wrought iron water tubes that end in two water and steam drums, which are connected with a steam drum in the center, forming the crown of this pyramidal structure.

The "Pierce" boiler is a cylindrical, tubular boiler. The outer row of tubes are nearly surrounded by buckets that keep them submerged in water, and also drench the inner surface of the boiler shell above the water line.

The "Anderson"; each section of this boiler has two front manifolds, and a rear one connected by horizontal sets of tubes. The sections are united to each other by nipples, and the sets of sections by a central column, to the top of which is attached the steam dome.

The "Rogers & Black" (see Fig. 2342), is a cylindrical boiler with tubes outside for heating and circulation.

Fig. 2343.



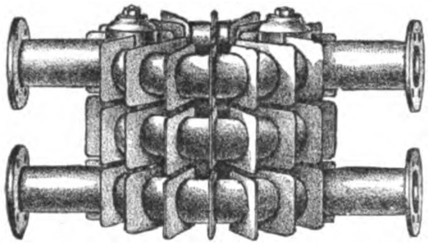
Reed's Boiler.

The "Reed" (see Fig. 2343) **is a corrugated sectional boiler. The sections are of cast iron, being three corrugated pipes, joined at the bottom, top, and at the water-line.**

The "Sectional Ring Boiler" (see Fig. 2344) **is a cylindrical manifold boiler of unique arrangement.**

The "Lynde" generates its steam in tubes that return over the fire seven times, and has a large steam drum. It has an eclipse injector, acme governor, and stop-valve, and Lynde's low-water alarm.

Fig. 2344.



Sectional Ring Boiler.

The "Eclipse" is adapted to either heavy or light service. The castings are of charcoal iron and the tubes lap-welded. All the parts being iron to iron, no calking or packing is required. A large steam drum is attached to the boiler.

In the "McLauthlin" the two heads are stayed by vertical braces, and the smoke bonnet has its aperture over the center of the boiler. The feed-pipe extends across the boiler inside far above the tube-sheet, and is perforated so as to secure extended distribution of the feed-water in minute jets pointing upward.

Steam boiler and superheat, steamer "Ban-Righ," Br. . * "*Engineering*," xxii. 48.
Steam boiler. * "*Man. & Builder*," ix. 100; xi. 78.
Babcock & Wilcox . . * "*Eng. & Min. Jour.*" xxv. 358.
Belleville Boiler Co., Fr. * "*Engineering*," xxv. 341, 358.
Connolly . . . . . * "*Am. Man.*," Jan. 16, 1879, p. 13.
Cooper, Br. . . . . * "*Scientific American Sup.*," 1047.
Comp. Twis-Lille, Fr. * "*Engineering*," xxvi. 251.
Haywood, Tyler & Co., Br. . . . . * "*Engineering*," xxvi. 254.
Daly . . . . . . * "*Scientific American*," xl. 342.
Davies, Br. . . . . * "*Engineering*," xxi. 176.
"Elephant," *Hall*, Br. * "*Engineer*," xlvi. 135.
"Eclipse" . . . . . * "*Am. Man.*," May 9, 1879, p. 13.
Firmenich . . . . * "*Am. Man.*," May 2, 1879, p. 16.
Firmenich . . . . * "*Iron Age*," xxi., June 6, p. 44.
* "*Scientific Amer.*," xxxviii. 398.
Hind . . . . . . * "*Scientific American*," xl. 358.
Lawson . . . . . * "*Scientific American*," xliii. 4.
Meunier, Fr. . . . * "*Engineering*," xxv. 493.
Ogle & Burnett . . . * "*Scientific American*," xliii. 178.
Root . . . . . . * "*Engineer*," xli. 351.
"Rover," Br. . . . * "*Engineering*," xxi. 245.
Thomas-Laurens, Fr. * "*Scientific American*," xl. 66.
Smeaton (1765) . . * "*Engineer*," xlvii. 459.
Circula., *Chambers*, Br. * "*Engineer*," xli. 226.
Experi., Franklin Inst. "*Manufact. & Builder*," xii. 274.
Exp., Manchester, Br. * "*Engineering*," xxi. 236.
Furnace, "Economy."
Smith . . . . . * "*Iron Age*," xx., July 19, p. 1.
Lancashire, *Livet*, Br. * "*Engineer*," xlix. 387.
Steam boilers, priming of.
Major . . . . . . * "*Scientific American Sup.*," 1299.
Steam boiler, sectional,
Tests, *Howard* . . . * "*Van Nostrand's Mag.*," xlv. 166.
Kelly . . . . . . * "*Engineer*," xlii. 198-206.

Anderson, * *Firmenich*, *
Babcock & Wilcox, * *Harrison*, *
"Exeter." * *Reed*. *

Tubular
Babcock & Wilcox . * "*Scientific American Sup.*," 483.
With *Ten-Brink's* grate.
Escher, Wyse & Co.
Switz. . . . . . . * "*Engineer*," xlvi. 5.
High pressure, *Hawksley, Welch & Co.*, Br. * "*Engineering*," xxvi. 519.
Lancashire . . . . "*Van Nostrand's Mag.*" xv. 210.
Galloway . . . . * "*Scientific American Sup.*," 449.
Exeter machine works * "*Scientific American Sup.*," 738.
Expe., Manchester, Br. * "*Engineer*," xli. 216.
"Elephant," Engl. . * "*Scientific American Sup.*," 2302.
Feed water heater.
Iron Clad Man. Co. * "*Manufact. & Builder*," ix. 265.

Feeder, *Bergstrom* . * "*Scientific American*," xlii. 386.
House of Corliss engine, Centennial . * "*Scientific American Sup.*," 213.
Marine vertical, S. S. "Vera Cruz" . . . * "*Engineer*," xlii. 273, 276.
Reversible, *Vail* . . . * "*Scientific American Sup.*," 57.
Sectional, *Root* . . . * "*Engineering*," xxx. 266.
Davies, Br. . . . . * "*Engineering*," xxiv. 122, 127.
Staffordshire, Br. . . * "*Engineer*, l. 327.
Setting, for plantation sugar houses, *Cort* . * "*Scientific Amer.*," xxxviii 388.
With *Ten-brink* fire-grate, Switz. . . . * "*Engineering*," xxvii. 437
Test, Manchester, Engl. * "*Scientific Amer. Sup.*," 1170
Vertical, *Barron*, Br. . * "*Engineer*," xlii. 321.
Allison, Br. . . . . * "*Engineering*," xxiv. 126.
Allison . . . . . . * "*Scientific Amer.*," xxxvii. 194.

Steam boiler. See VERTICAL STEAM BOILER.

Steam Boilers, *Mulhaise*. * "*Scientific Amer. Sup.*," 1202.
Philadelphia, 1800 . . * "*Scientific American Sup.*," 706.
Havemeyer sugar-works . . . . . * "*Scientific Amer. Sup.*," 1215.
Crown Point, N. Y. . * "*Engineering*," xxv. 217.
At Centennial. . . . * "*Scientific American Sup.*," 703
Philadelphia, 1876. . . "*Engineering*," xxii. 74.

Black & Rogers. *Lynde.*
Firmenich. * *W. D. Andrews & Co.*
Harrison. * *Wiegand.*

Tubulous, *Babcock-Wilcox* . . . . . * "*Manufact. & Builder*," xii. 127.
Forced circulation (7 Figs.) . . . . . * "*Engineer*," xlvii. 219.
Société Alsaciennes Mulhouse . . . . * "*Engineering*," xxi. 4, 21, 56.
Centennial . . . . * "*Scientific American Sup.*," 214.
At Centennial, tests . "*Scientific American Sup.*," 1409.
For water-works . . * "*Iron Age*," xxv., Feb. 5, p. 1.
Lonsdale, Br. . . . * "*Engineering*," xxii. 481.
Mechanical firing, which see.
Perkins . . . . . * "*Scientific American Sup.*," 1282.
Philadelphia, 1876 . * "*Engineering*," xxii. 103.

Babcock & Wilcox. * *Kelly.*
Exeter Machine Works.

SS. "City of San Francisco," *Roach* . . * "*Engineering*," xxiii. 268.
Relation of grate surface and heating surface . . . . . . * "*Scientific Amer.*," xxxix. 224.
And engines, high pressure, on, *Perkins* . "*Van Nostr. Mag.*," xvii. 143.
Report of judges of Group XX., "*Centennial Exhibition Reports*," vol. vi., includes the following: —

Hoadley, (portable)	p. 155 *
Wiegand	p. 141, * 159
Harrison	p. 141, * 160
Firmenich	p. 141, * 161
Rogers & Black	p. 142, * 162
Andrews	p 142, * 163
Root	p. 142, * 164
Kelly	p. 143, * 165
"Exeter"	p. 143, * 166
Lowe	p. 143, * 167
Babcock & Wilcox	p. 144, * 168
Smith	p. 144, * 169
Galloway	p. 144, * 170
Anderson	p. 144, * 171
Pierce	p. 145, * 172

Steam boiler, horizontal.
Galloway, Gt. Br. . * *Thurston's* "*Vienna Rept.*," ii. 110.
Sect., *Howard*, Gt. Br. * *Thurston's* "*Vienna Rept.*," ii. 125.
Adamson, Gt. Br. . . * *Thurston's* "*Vienna Rept.*," ii. 127.
Vertical, *Davey-Paxman*, Gt. Br. . . . * *Thurston's* "*Vienna Rept.*," ii. 127.
Sectional, *Belleville*, Fr.* *Thurston's* "*Vienna Rept.*," ii. 131.
Two upright shells.
Meyer, Ger. . . . * *Thurston's* "*Vienna Rept.*," ii. 130.
Ehrhardt, Ger. . . . * *Thurston's* "*Vienna Rept.*," ii. 132.
Julius Bergman, Ger. * *Thurston's* "*Vienna Rept.*," ii. 132.
Tubular, *Paucksch & Freund*, Ger. . . . * *Thurston's* "*Vienna Rept.*," ii. 133.
Sigl, Austria . . . * *Thurston's* "*Vienna Rept.*," ii. 133.
Bolzano, Tedesco & Co., Austria . . . * *Thurston's* "*Vienna Rept.*," ii. 133.

Steam Boil'er Clean'er. The Hotchkiss boiler cleaner is composed of five principal parts: the reservoir, funnel, up-flow pipe, return pipe, and blow-off pipe; automatic in its action.

The funnel is partly submerged in such position that its opening intercepts the current of hot water flowing towards it. By the action of gravity in water of varying temperatures aided by the pressure on the surface, the hot surface water that enters the funnel flows into the reservoir through the up-flow pipe, displacing constantly an equal quantity of the cooler water therein, which flows back to the boiler.

Purves' automatic boiler cleaner draws impurities from the surface of the water through an automatic skimmer, from which they are passed on into the top chamber, which is constructed with deflecting plates, causing the impurities to fall into the lower chamber, while the pure water passes through a pipe into the lower part of the boiler.

Steam Boil'er Feed'er. Pratt's boiler feeder is also a return steam trap with an automatic device, that drains the water of condensation from heating coils, and returns the same to the boilers, thus doing away with pumps or other mechanical devices for such purpose.

Steam Boil'er Feed'-wa'ter Heat'er. Strong's feed-water heater and filter is a device that in connection between the feed-water and the boiler raises the temperature of the water and cleanses it of impurities.

Steam Boil'er Fur'nace. The heating chamber that is generally placed beneath or inside of a steam boiler. There are various plans of construction in accordance with the description of fuel to be used, the consumption of the gas escaping therefrom, the plan of the boiler with which it is connected, etc.

It is claimed that the fuel of the future will in a great measure be gas, generated by the furnace that then utilizes it not only in the generation of steam, but also in the production of a future supply of gas itself.

The great advance made in the manufacture of steel is due in a great measure to the use of hot air, and to-day steel is manufactured cheaper than iron in the Siemens' gas regenerative furnace.

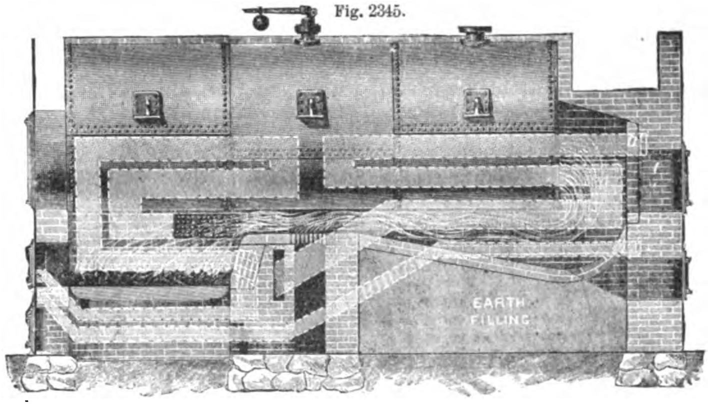
In the old style iron furnaces only a small per cent. of the power of coal was realized. The giant power was unbound, let loose, and after doing but a small percentage of the work it was capable of performing, escaped for parts unknown.

It is claimed that the Siemens' system has so improved the combustion of fuel that it now realizes 20 per cent. of the units of heat contained in coal, a saving of 40 or 50 per cent. in fuel over the old way. In this furnace coal is burned in a retort, and the smoke and gases (carbonic oxide) are carried up a large vertical tube from 12′ to 15′, after which it proceeds horizontally any required distance, and then descends to the heat regenerator, through which it passes before entering the furnaces. Two generators are used on each side, the gas ascending through one, while pure atmospheric air intensely heated by its passage through the regenerator, ascends through the neighboring passage, and both are conducted through passage outlets, at one end of the furnace, where mingling they burn, producing the heat due to their chemical action.

Smith's smoke-consuming furnace (see "*Mech. Dict.*," p. 2330) has a further improvement in its adjustable arrangement; the grate being elevated or depressed, so as to increase or diminish the distance between the fire and the bottom of the boiler at pleasure.

The grate consists of a series of bars, supported by a frame that rests upon a standard which slides in a hollow post, that is slotted on one side to admit the end of a lever which sets into a recess in the standard, and elevates or depresses the same. The lever is pivoted in the upper end of another standard, forming a fulcrum, and is provided with a handle by means of which it is operated. The lever has an attachment by which it can be fastened to hold the grate in any fixed position. There are columns or heaters on the sides of the boiler that take the place of the brick walls, and being always filled with water get the benefit of the heat that would have been absorbed by the brick walls. The bridge wall is hollow and always filled with water and is connected with the main boiler.

Fig. 2345.



Steam Boiler Furnace.

The Jarvis furnace, Fig. 2345, has a unique feature in its setting whereby air is admitted by small flues in the front, and then conducted through a number of horizontal expanding ducts, in which it traverses forward and backward, until finally in a heated state it enters by the furnace bridge-wall and other places, uniting with the products of combustion and causing consumption of the gases. By the arrangement of this furnace it is claimed that all kinds of cheap fuel can be used without a blower. Seeing that it is generally admitted that perfect combustion of fuel does not take place till the gases are fully generated, it follows that gas fuel is one of our first necessities. To get this it requires in the fuel about 40 per cent. of moisture to generate hydrogen, and then utilize the gas with hot air (oxygen), thus giving a hydro-oxygen or compound blow-pipe flame.

In carrying out the idea of the necessity of hydrogen, a wet screening mixture is used in the Jarvis furnace to produce a gas flame.

Steam Cap'stan. (*Nautical.*) A capstan intended for use on steamboats, operated through its connections with the steam power on board.

Steam Car'riage. A form of carriage like the ordinary road carriage, but having steam motive power.

Steam carriage, *Lauck*	* "*Scientific American*," xxxvi. 57.
Steam carriages	"*Scientific Amer.*," xxxiv. 383.

Steam Carv'ing Ta'ble. A table heated by steam for keeping fowl, fish, or meat warm, previous to and during the process of carving.

Steam Crane.

Steam crane, portable.	
Grieve	* "*Engineer*," l. 477.
Russell, Br.	* "*Engineering*," xxix. 63.
Radiating, *Coode*, Br.	* "*Engineer*," xliii. 341.
Traveling, *Smith*, Br.	* "*Engineer*," xliii. 182.
With self-acting bucket.	
Priestman, Br.	* "*Engineering*," xxviii. 129.
Steam-cutter engines and boilers, Washington navy yard	* "*Engineering*," xxi. 508.
Steam cultivator, *Barford*	* "*Engineer*," xlvi. 19.
& Perkins, Br.	* "*Engineering*," xxx. 77.
Steam cutter engine, U. S. *Loring*	* "*Engineering*," xxii. 76.

Steam Dry'ing Ap'pa-ra'tus. Drying rooms and houses for seasoning timber, drying purposes in laundries, etc., through the radiating heat engendered by coils of steam pipes.

Steam En'gine. The first steam engine, — the Æolipile of Hero, 150 B. C., — is described in "*Mech. Dict.*," p. 2334, and the subsequent attempts to utilize this powerful agent.

The Westinghouse engine (see Fig. 2346) has the cylinders cast in one piece with the valve chamber, and bolted to the top of the bed-case. The cylinder heads cover the upper ends of the cylinders only, the lower ends being uncovered and opening directly into the chamber of the bed or crank-case. The pistons are of the trunk form, double walled at the top to prevent condensation, open at the bottom, and carrying the wrist pin. The annular exhaust is a narrow belt surrounding the cylinder, opening into it by the ports, and communicating directly with the exhaust outlet. The position of the annular exhaust is such that the ports are uncovered by the piston just before the completion of the stroke. The cranks balanced by the bobs, the crank-pin and the crank-shaft, are all of steel, and may be removed by taking off the crank case-head. The crank-shaft bearings, in the form of removable shells, are lined with babbitt metal.

Dr. Engel, director of the Prussian statistical bureau, gives the following figures: —

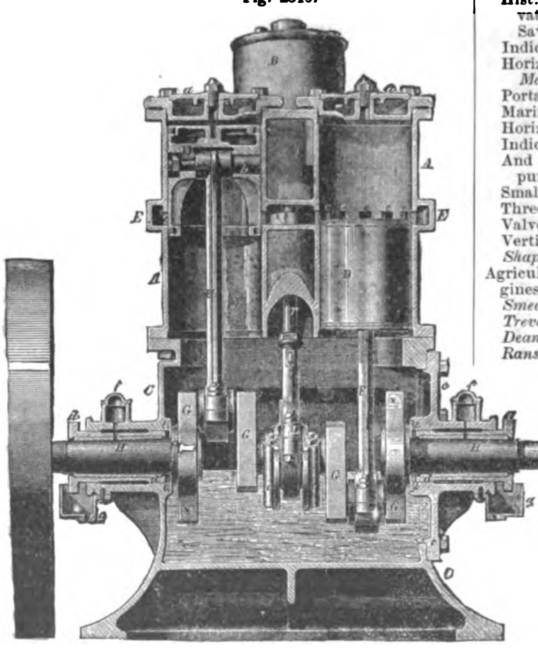
	Year.	No. of Locomotives.	No. of Stationary Engines.	Horse Power.	Ocean Steamers.	Tonnage.
United States	1873	14,223	40,191	1,215,711	3,061	2,624,431
Great Britain	1872	10,933	40,000	936.405	403	483,040
Germany	1871	5,927	-	-	225	171,039
Russia	1873	2,684	-	-	-	-
Austria	1873	2,369	-	-	-	-
Hungary	1869	506	-	-	-	-
France	1869	4,933	27,141	325,507	-	-
East Indies	1872	1,323	-	-	-	-
Italy	1872	1,172	-	-	-	-
Holland	1872	331	-	-	-	-
Belgium	1870	371	-	-	-	-
Switzerland	1868	225	-	-	-	-
Egypt	1870	212	-	-	-	-
Sweden	1872	185	-	-	-	-
Denmark	1865	39	-	-	-	-
Norway	1871	34	-	-	-	-
Total	....	45,467 = 10,000,000 h. p.				

Report of *Chas. E. Emery*, "*Centennial Exhibition Reports*," vol. vi., Group XX., p. 97, *et seq.*, includes —

- *Corliss*, beam . . . . * p. 97
- *Wheelock*, horizontal . . . . * p. 101
- "Buckeye," horizontal . . . . * p. 104
- Launch, vertical . . . . * p. 107
- *Dudgeon*, rotary . . . . * p. 108
- Thompson, indicator . . . . * p. 112
- Edson, recording gage . . . . * p. 118

Steam engine, *Tyson* . * "*Am. Man.*," Aug. 1, 1879, p. 8.
Corliss . . . . . * "*Scientific Amer.*," xxxiv. 351.
"Corliss" . . . . * "*Scientific American Sup.*," 561.
De Caus . . . . . "*Scientific Amer.*," xxxvi. 208.
Ericsson's contribu. to "*Scientific American Sup.*," 105.
Harris-Corliss . . . * "*Scientific American*," xxxv. 95.
Head "Prime mover" * "*Engineer*," xli. 210, 212.
"Little Giant," *Snyder* * "*Iron Age*," xx., Oct. 4, p. 1.
Maxim . . . . . * "*Scientific Amer.*," xxxiv. 287.

Fig. 2346.



Westinghouse Steam Engine.

Newcomen . . . . * "*Engineer*," xlvii. 408, 412, 430.
Smeaton-Newcomen.
Newcomen, 1712 (old print) . . . . . * "*Engineer*," xlviii. 400.
Niles . . . . . . * "*Min. & Sc. Press*," xxxviii. 65.
Snyder . . . . . * "*Min. & Sc. Press*," xxxv. 321.
Symington . . . * "*Engineering*," xxiii. 64.
Symington (1788) . . * "*Engineer*," xlii. 1.
Trevethick (1811) . . * "*Engineer*," xlvii. 448.

Steam Engine. See BELLOWS' STEAM ENGINE.

Steam engines, Centennial stationary . . . "*Iron Age*," xviii., Oct. 12, p. 3.
Ervien. *Snyder.*
Lovegrove. *Wells.*

Steam engine, compound * "*Scientific American Sup.*," 438.
Experimental.
Liège School of Music * "*Engineering*," xxx. 517.
Frame, *Finney* . . . * "*Scientific American Sup.*," 89.
Headless cyl., *Smith* * "*Scientific American*," xxxv. 198.
Hist. of the water elevators, Worcester, Savery, Pulsometer "*Scientific American Sup.*," 1821.
Indicator, *Prof. Sweet* * "*Iron Age*," xxi., June 20, p. 1.
Horizontal, *Putnam Machine Co.* . . . "*Scientific American*," xxxv. 351.
Portable, *Armitage* . * "*Scientific American Sup.*," 772.
Marine, *Cramp* . . * "*Scientific American Sup.*," 463.
Horizontal, *Niles* . . * "*Scientific American*," xxxv. 370.
Indicator, *Sweet* . . * "*Engineering*," xxviii. 117.
And street vacuum pump, *Gleason* . * "*Scientific American Sup.*," 488.
Small, *Tyson* . . . * "*Engineer*," xlix. 279.
Three-cyl., *Brotherhood* * "*Scientific American Sup.*," 538.
Valveless . . . . . "*Scientific American Sup.*," 497.
Vertical, *Niles* . . . * "*Scientific American*," xxxv. 370.
Shapley . . . . . * "*Scientific American Sup.*," 482.
Agricultural steam engines, notes on early . "*Engineering*," xxvii. 543.
Smeaton, 1765 . . * "*Engineering*," xxvii. 548.
Trevithick, 1811 . . * "*Engineering*," xxvii. 548.
Dean, 1844 . . . . * "*Engineering*," xxvii. 548.
Ransome, 1841 . . * "*Engineering*," xxvii. 549.
Tuxford, 1842. * "*Engineering*," xxvii. 549.
Cambridge, 1847. * "*Engineering*," xxvii. 549.
Willis, 1849 * "*Engineering*," xxvii. 558.
Clayton & Shuttleworth, 1853. "*Engineering*," xxvii. 560, 572.
Steam engines, early, in America. * "*Engineering*," xxii. 383.

Turnbull's "A Treatise on the Compound Engine."
Bourne's "Catechism of the Steam Engine."
Bourne's "Handbook on the Steam Engine."
Bourne's "Treatise on the Steam Engine."
Rankine's "The Steam Engine."
King's "Notes on Steam."
Auchincloss' "Link and Valve Motions."
Bacon's "Steam Engine Indicator."
Isherwood's "Engineering Precedents."
MacCone, "Slide Valve Eccentrics."

Stillman's "*Steam Engine Indicator.*"
Porter's "*Steam Engine Indicator.*"
See *Burgh's* "*Practical Illustration of Land and Marine Engines.*"
Burgh's "*Practical Rules for the Perfecting of Modern Engines and Boilers.*"
Burgh's "*Slide Valve.*"
Burgh's "*Modern Marine Engineering.*"
Main and Brown's "*Marine Steam Engine.*"
Colburn's "*The Locomotive Engine.*"
Templeton's "*The Practical Examinator on Steam and the Steam Engine.*"
Forney's "*Catechism of the Locomotive.*"
Mallet's "*Compound Engines,*" from the French.

Steam, Gas, and Air En'gines. See under the following heads: —

Aëro steam engine.
Agricultural engine.
Air bridge.
Air cock.
Air engine.
Air motor for cars.
Alarm whistle.
Ammoniacal gas engine.
Ammonia engine.
Angular safety valve.
Annular piston engine.
Anti-clinker grate.
Anti-incrustator.
Arch bar.
Atmospheric engine.
Atmospheric-gas engine.
Automatic cut-off engine.
Automatic steam engine.
Back cylinder head.
Baffle plate.
Balance engine.
Bar.
Beam engine.
Bellows steam engine.
Boiler.
Boiler covering.
Boiler feeder.
Boiler feed regulator.
Boiler ferrule.
Boiler fittings.
Boiler flue.
Boiler lining.
Boiler tube.
Boiler-tube cleaner.
Boiler washing apparatus.
Box engine.
Calking.
Caloric engine.
Circular slide valve.
Circulating boiler.
Circulating drum.
Circulating generator.
Circulating steam boiler.
Circulating tube.
Coal-dust-burning grate.
Coal dust furnace.
Coil steam boiler.
Compound beam engine.
Compound steam boiler.
Compound steam engine.
Compressed air engine.
Compressed hot-air engine.
Compression engine.
Condenser.
Condensing apparatus.
Condensing engine.
Controlling valve.
Corliss engine.
Cornish boiler.
Coupled steam engine.
Crank-pin cup.
Cross head.
Cross-tube boiler.
Cut-off.
Cylinder cock.
Cylinder lubricator.
Damper.
Damper regulator.
Demi-fué.
Diminishing valve.
Direct acting steam engine.
Disk engine.
Double-lip safety valve.
Double piston engine.
Double safety-valve.
Draft regulator.
Drop cut-off.
Dumping grate.
Easing valve.
Eccentric valve.
Economizer.
Egg-end steam boiler.
Electro-capillary motor.
Engine regulator.
Equilibrium cock.
Equilibrium valve.
Exhaust chamber.
Exhaust nozzle.
Expansion steam engine.
Expansion valve.
Expansion valve gear.
Farm locomotive.
Feed pump regulator.
Feed-water apparatus.
Feed-water cleaner.
Feed-water heater.
Feed-water regulator.
Ferrule.
Fire engine.
Fire regulator.
Flue.
Flue boiler.
Front cylinder head.
Fuel economizer.
Fuel feeding apparatus.
Furnace feeder.
Furnace regulator.
Fusible plug.
Gas and steam motor.
Gas boiler.
Gas engine.
Gas machine.
Gas, steam, and air engine.
Globe oil-cup.
Globe safety-valve.
Governor.
Governor valve.
Greaser.
Hanging leg boiler.
Hanging tube boiler.
Horizontal steam engine.
Hot air engine.
Hot air pumping engine.
H-piece.
Hydraulic engine.
Hydro-carbon engine.
Hydromotor.
Inspirator.
Inverted steam engine.
Lancashire boiler.
Launch engine.
Launch steam engine.
Lever and cam valve.
Lime catcher.
Lime extractor.
Lock-up safety valve.
Low water alarm.
Low water detector.
Low water valve.
Lubricator.
Lubricator alarm signal.
Lubricator cup.
Marine boiler.
Marine engine.
Marine tubular boiler.
Marine whistle.
Mechanical stoker.
Mercurial safety valve.
Metallic packing.
Mining engine.
Multicylinder engine.
Multiflue steam boiler.
Multitubular boiler.
Needle lubricator.
Offset glass.
Oil cup.
Oil engine.
Oiler.
Oleojector.
Oscillating cylinder engine.
Oscillating paddle engine.
Oscillating steam engine.
Over-pressure valve.
Packing.
Packing expander.
Packing gland.
Packing leather.
Petroleum engine.
Pile driving engine.
Piston packing.
Piston packing expander.
Piston-rod packing.
Piston spring.
Piston valve.
Plowing engine.
Portable steam engine.
Relief valve.
Reversible steam boiler.
Reversing and expansion gear.
Reversing engine.
Reversing gear.
Revolving boiler steam engine.
Road locomotive.
Road roller.
Road steamer.
Rotary steam engine.
Rotary tubular boiler.
Rubber packing ring.
Safety cock.
Safety cylinder cock.
Safety disk.
Safety valve.
Screw engine.
Screw-propeller engine.
Sectional steam boiler.
Sectional ring boiler.
Semi-fixed.
Semi-multiflue boiler.
Semi-multitubular boiler.
Semi-rotary engine.
Semi-tubular boiler.
Siphon condenser.
Six-cylinder steam engine.
Slide cut-off.
Slide-lubricator.
Slide valve.
Slide-valve oiler.
Smoke-burning furnace.
Smoke consumer.
Smoke preventive.
Solar boiler.
Solar-caloric engine.
Spiral tube boiler.
Speed recorder.
Spray condenser.
Sput.
Steam boiler.
Steam boiler covering.
Steam boiler feeder.
Steam boiler furnace.
Steam carriage.
Steam engine.
Steam engine governor.
Steamer.
Steam fire engine.
Steam gage.
Steam greaser.
Steam hammer.
Steam indicator.
Steam machinery.
Steam motor.
Steam packing.
Steam-pipe covering.
Steam piston.
Steam power.
Steam pressure recorder and high pressure alarm.
Steam pressure regulator.
Steam stamp.
Steam stoker.
Steam trap.
Steam valve.
Steam wheel.
Stoker.
Stoker, mechanical.
Straw-burning engine
Suet lubricator.
Surface condenser.
Tallow cock.
Tallow cup.
Tallow lubricator.
Tank engine.
Three cylinder steam engine.
Tire.
Traction engine.
Tramway engine.
Trip cut-off.
Triple cylinder steam engine.
Triple cylinder compound steam engine.
Trunk engine.
Tube cleaner.
Tube scraper.
Tubulous boiler.
Twin-cylinder steam engine.
Two-piston steam engine.
Underground running engine.
Unit area safety valve.
Up-take.
Valve gear.
Valveless engine.
Variable cut-off steam engine.
Variable exhaust steam engine.
Variable expansion gear.
Variable expansion steam engine.
Velometer.
Vertical steam boiler.
Vertical multiflue boiler.
Vertical steam engine.
Vertical tubular boiler.
Wagon.
Wall steam engine.
Water engine.
Water gage.

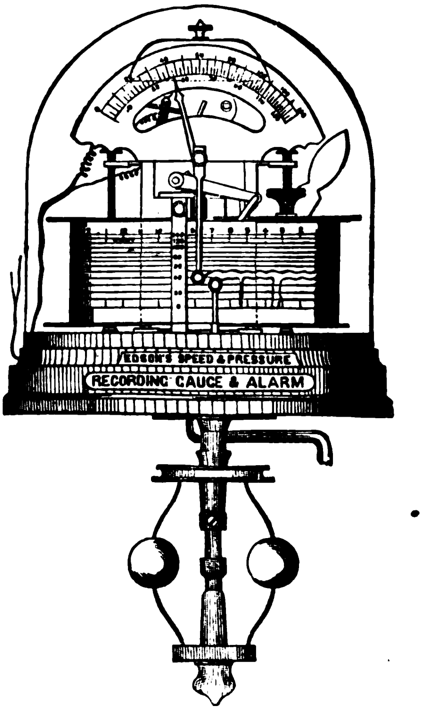
Steam En'gine In'di-ca'tor. An instrument for recording the pressure of steam at any point of the motion of the piston.

Steam Flour Core. This term is applied to dry-sand cores in which the flour has been steamed before it is mixed with the sand. What is meant by steamed flour is flour that has been mixed with water into paste and boiled with a jet of steam turned into it from the boiler.

Steam Gage. An attachment to the boiler to indicate the pressure of steam. See "*Mech. Dict.,*" p. 2344. The apparatus shown in Figs. 2347 and 2348 represents Edson's recording steam gage and speed recorder.

The mechanism of the instrument is first, a train of clockwork which controls the motion of a cylinder covered with a strip of paper, a pencil-arm with a pencil bearing on the paper, and a steel diaphragm of peculiar construction by which, through the details shown, the pencil is worked. This is in brief the construction of the steam gage. The speed-recording apparatus is similar, except that it has a governor driven by a belt from any principal part, and shows the fluctuations from a regular velocity on the same chart as the steam gage. This through the pencil attached to what is in ordinary governors the thrust collar communicating with the throttle-valve. So soon as the engine or train, if the ma-

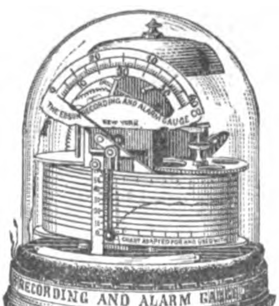
Fig. 2347.



Combined Speed and Pressure Recording Gage and Alarm.

chine is attached to a locomotive, is started, the governor is put in motion and the pencil connected with the paper cylinder. If the speed is uniform the line drawn on the cylinder is straight or nearly so, but any diminution in speed, any stoppage from any cause, is detected at once by the nature of the diagram. If the speed is slower than schedule time, the instrument shows it by fluctuations, or speed-curves in the horizontal line. As will be readily seen, any stoppage outright is shown by the instrument in the form of a loop. This, of course, from the reason that when the train stops the instrument stops, but the paper cylinder goes on tracing a horizontal line, the length of the base of which, or the area of the loop, indicates the time lost by stopping. The place stopped at is also shown, for as all stations can be marked on the paper on the cylinder, any loop occurring between stations shows a stop at once. This record, in connection with the steam card from the gage, forms a very complete diary of the working of the train it may be applied to, and is entirely removed from external interference or being tampered with by interested parties by surrounding it with a glass dome, fitted with a lock.

Fig. 2348.



Recording Steam Gage.

Similarly in regard to the gage recording the steam pressure — its construction and operation are as follows: the readings are obtained from the dial by an index and pointer as usual, operated by a corrugated steel diaphragm of peculiar construction in some respects. Instead of a small disk, such as is commonly used for this purpose, Mr. Edson employs a very large one. The object of this is to equalize the action of the diaphragm and render it more sensitive and even. With the construction of diaphragm, as shown by the dotted lines in the engraving, the elasticity is greatly increased, and the dial indications, as well as the records of pressure, are peculiar to each intrument.

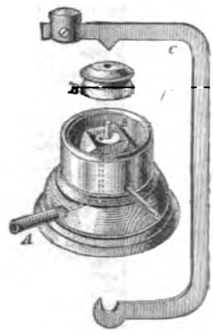
Besides these features there is an electric bell at the back of the instrument which by a simple and obvious arrangement opens and closes the circuit at any desired pressure, giving instantaneous warning of high or low pressures as required.

Ashcroft's "bourdon" steam gage, Fig. 2349, is provided with an elastic ring that prevents moisture caused by steam from gage-cocks entering the interior of the gage and corroding the movement.

Fig. 2349.

Steam Gage.

Fig. 2350.



Steam Gage Tester.

Steam Gage Test'er. An instrument to test the accuracy of the steam gage. See Fig. 2350.

The apparatus consists of a brass base, provided with a pipe, *A*, to be connected with a pump. At *B* is a hardened steel valve and seat, the latter having knife edges for the valve to rest upon, and being made exactly one square inch in area. The valve is guided by a guide-stem in the seat. The water-pipe *A* opens directly under the valve, as shown by the dotted lines. The valve, when in place, makes a tight joint with the knife edges, and the pressure beneath is confined until it exactly balances the combined weight of the valve yoke *C* (which rests by a pointed projection on the valve), and any extra weight which may be suspended from the lower hook of the yoke. With this the accuracy of a gage, at any specified point of its registry, can be ascertained.

Steam Greas'er. An impermeator to deliver the lubricant into the current of the steam, which it impermeates, being carried into the interior parts of the engine in minute globules.

Steam Ham'mer. One operated by steam; technically one in which the hammer reciprocates in guides, the shaft being usually in line with the engine piston, — the piston-rod, in fact, forming the hammer rod.

The steam hammer is usually vertical.

Plate XLVI. shows the immense 80-ton steam hammer of Schneider & Co., Creusot, France. This hammer was finished in 1877 and represented by wooden model of the exact proportions at the Paris Exposition of 1878. This hammer is the largest in the world, and is said to possess more than three times the power of the 50-ton Krupp hammer at Essen. A 100-ton forging may be readily turned upon its anvil by means of four powerful cranes.

The cost was $500,000, including its accessories and the building in which it works.

Machinery is now required to deal with immense masses. Witness the 100-ton Italian cannon for the "Duilio" and sister ship; the Siemens-Martin steel ingot of 120 metric tons, cast at Creusot; a rolled armor plate 13′ 10″ × 8′ 5″, 2′ 7″ thick, weighing 65 metric tons, and exhibited at Paris, 1878. One plate train of the Terre Noire works will roll an armor plate 36.08′ long, 8.2′ wide, and 3.9′ thick.

The hammer made by Ramsbottom, of England, is an innovation upon the usual method.

Instead of a vertical hammer, it consists of two immense masses of iron forming the hammers, which are mounted on carriages sustained by small, strong, friction-wheels, and move toward or separate from each other by moving horizontally on rails. Between them is the anvil, which merely takes the weight of the piece to be worked, while it is struck simul-

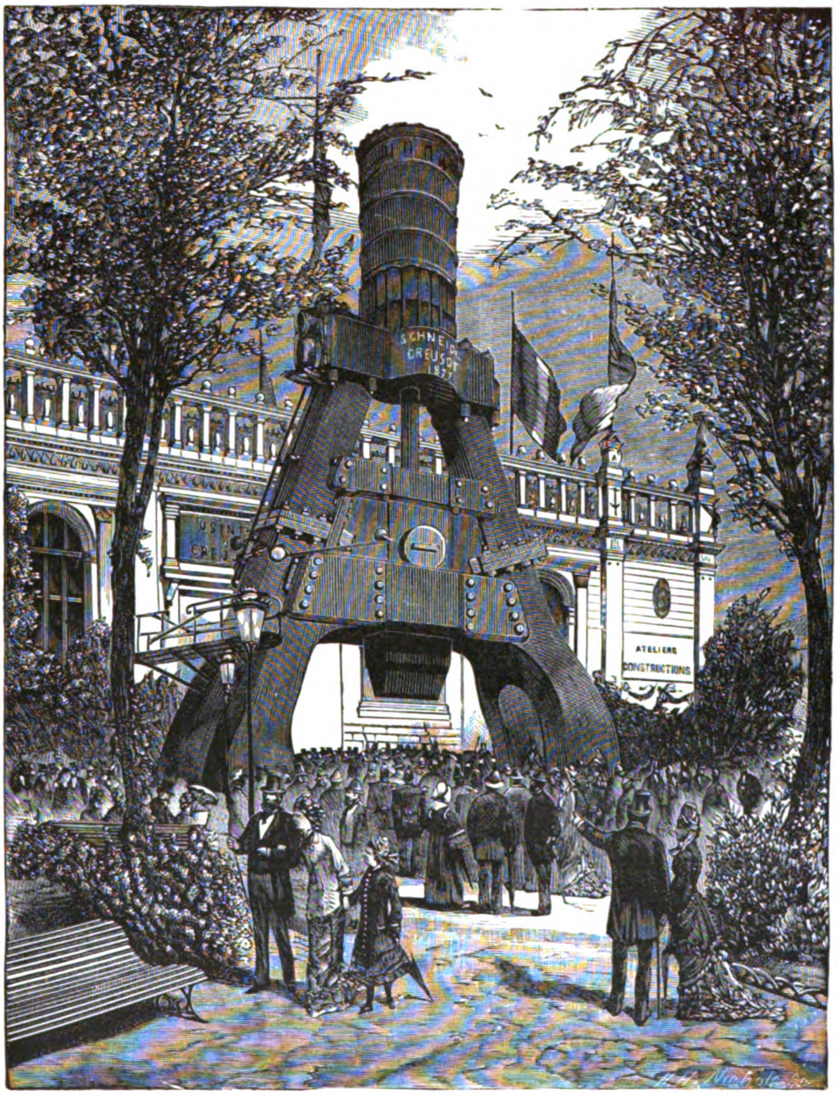
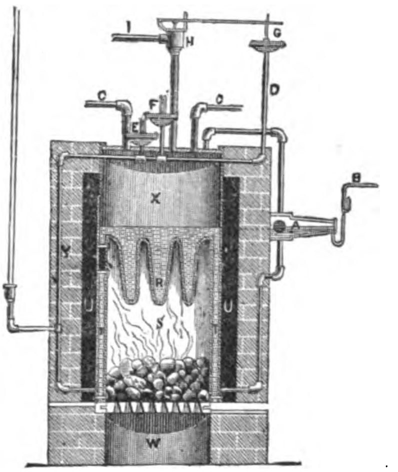


PLATE XLVI. EIGHTY-TON STEAM HAMMER. (SCHNEIDER & CO., CREUSOT, FRANCE.) *See page* 860.

taneously by the two hammers which approach it from either side. The hammers are driven by large steam pistons, which are, in this case, set below the floor and under the anvil. This hammer requires no such foundation as is needed by the usual form of steam hammer, and it possesses the apparently generally unrecognized, but nevertheless important, advantage, that none of the energy of the blow is misapplied to the shaking of the earth and the injury of the buildings; it is all usefully applied to the shaping of the work. For many kinds of work this hammer has such decided advantages over the standard forms that it seems surprising that it has not become more widely known and more generally introduced. Three of these hammers are in use at Crewe, England.

Steam Heat'er. Warner's heater, Fig. 2351, is a low pressure steam-heating apparatus, with the hydrostatic or open column connected with the boiler at the bottom, standing at its side to such a height as to allow a pressure of only two pounds of steam to be generated.

Fig. 2351.

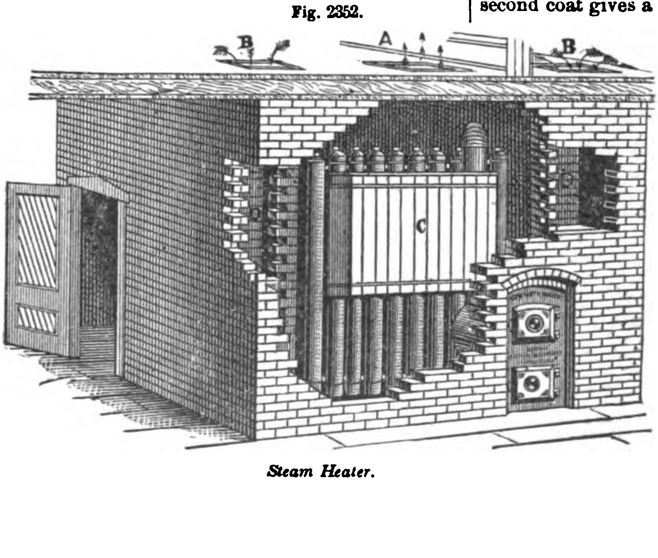


Steam Heater.

In Campbell & Pryor's method of steam heating for dwellings, the steam boiler and radiators are inclosed in a heating room in the cellar, doing away with pipes and radiators in the living rooms, the heat ascending through ordinary registers, while the cold air is drawn off the floors down flues leading to the bottom of the heating-room. Fig. 2352 shows the heating room, hot and cold air registers, and a hot-water battery, used without the steam boiler. The arrows at *A* show the direction of the current of warm air; *B B*, currents of cold air passing off the floor, down flues *D* to near the bottom of the heating room. The water battery, *C*, is a series of connected pipes holding 50 to 100 gallons of water, having a gas-pipe attached and passed around the heating bowl of the stove. When the fire is the warmest this water becomes heated to nearly boiling, giving out its heat again at any time the fire should slacken. By uncovering these water pipes the air may be moistened to any degree desired. A small pipe leads from the bottom of the heating room into the smoke flue to carry off the foul air that may accumulate. The furnace is fed from outside of the heating room.

This method is the invention of A. K. Campbell, Newton, Iowa, who claims that by establishing a current of air through the house and heating chamber he equalizes the temperature of the living rooms so that the difference between the floor and ceiling of a room is only 6° to 10°, while with the ordinary method the thermometer will show a difference of from 30° to 50° between the temperature of the floor and ceiling. He does not warm the large current of outside air usually necessary to force the hot air up into a room already full of air. Fresh air in plenty, he claims, is supplied any house through the crevices of the doors and windows; but he uses a small side pipe, if requested.

Fig. 2352.



Steam Heater.

Steam Heat'er for Steam Fire En'gines. A device for attachment to steam fire engines for heating the feed-water before its passage into the boiler.

Steam Me-tal'lic Pis'ton. A tight elastic piston with equal expansion, and a revolving tendency in the packing rings.

Steam Mo'tor. A small engine for household use, attachable by bracket to the wall, for running sewing and knitting machines, fans, churns, etc.

Steam motor, small . .	* "*Scientific American*," xliii. 390.
Davis	* "*Scientific American*," xliii. 278.
Mayhew	* "*Scientific American*," xliii. 66.
Tyran	* "*Scientific American*," xlii. 163.

Steam Nav'vy. A steam excavator.

Steam Pack'ing. Asbestos steam packing, intended to contend with high temperature, moisture, and friction.

Steam Pipe Cov-er'ing. The peculiarity of the Chalmers steam pipe covering consists in leaving an air space, or dead-air chamber, of 1″ or more, between the covering and surface covered. This is obtained by taking heavy wire cloth, to which is fastened, every four or six inches, a stud one inch or more in length. The wire cloth is then placed over the surface to be covered, the studs keeping it off the necessary distance. A non-conducting composition is then applied from one half to one inch in thickness, which partly penetrates the meshes of the wire cloth and keys itself. The second coat gives a smooth finish.

Leroy's composition: Mix thoroughly 448 parts of a paste of clay, 80 parts of paper pulp, 10 parts zinc wool, 10 parts of hemp, 8 parts of cocoa-nut fiber, 55 parts of charcoal powder, 23 parts of sawdust, 8 parts of flour, and 22 parts of tar. Heat the mixture until it is uniformly pasty.

See also STEAM PIPE COVERING, "*Mech. Dict.*"

Steam Plow.

Dr. Knight's report on Class 76 at the Paris Exposition contains views and descriptions of the following engines, apparatus, and modes of installation. See "*Paris Exposition* (1878) *Reports*," vol. vi. pp. 53-89.

Double-engine steam-plowing tackle, *Fowler*, England.

Steam-plowing engine, *Fowler*, England.

Rope-porter, *Fowler*, England.

Locomotive for the double-engine system, *Aveling & Porter*, England.

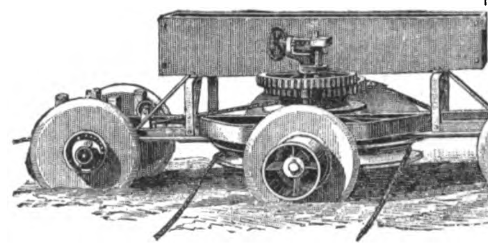
Farmer's engine for all purposes, *Howard*, England.

Single-engine and headland-anchor plan of installation, *Howard*, England.
Engine with two winding-drums, *Fowler*, England.
Movable headland anchor, *Fowler*, England.
Agricultural locomotive, *Aveling & Porter*, England.
Roundabout plan of installation, *Fowler*, England.
Windlass for the roundabout system, *Fowler*, England.
Anchor for the roundabout system, *Fowler*, England.
Portable engine and rear windlass for the roundabout system, *Howard*, England.
Roundabout system, with detached windlass, *Barford & Perkins*, England.
Roundabout system, engine, and windlass combined, *Barford & Perkins*, England.
Self-acting and self-moving anchor, *Barford & Perkins*, England.
Howard's roundabout tackle, *Bodin*, France.
Engine and windlass for roundabout system, *Debains*, Fr.
Installation of the roundabout system, *Debains*, France.
Six-furrow balance-plow, *Fowler*, England.
Three-furrow balance-plow, *Barford & Perkins*, England.
Plow and subsoiler, *Howard*, England.
Steam grubber, *Fowler*, England.
Double-action steam cultivator, *Howard*, England.
Turning cultivator, *Fowler*, England.
Turning harrow, *Fowler*, England.
Steam harrow, *Fowler*, England.
Combined harrow and seeder, *Fowler*, England.
Steam roller, *Fowler*, England.
Disking machine, *Fowler*, England.
Draining plow, *Fowler*, England.
Reclamation plow, *Fowler*, England.

Steam Plow Anchor.

Fig. 2353 shows Fowler's headland anchor, or rope carrier, which is moved along the headland by the motion of the pulley that is turned by the rope; the sheave is connected by a gear to a drum, which winds up a rope stretched along the headland and keeps the anchor opposite its work.

Fig. 2353.



Steam Plow Anchor.

Steam Pres'sure Re-cord'er and High Pres'sure A'larm. See under STEAM GAGE, p. 859, *supra*.

Steam'-proof Ce-ment'. "*Dingler's Polytechnic Journal*" gives a description of the manufacture of a new steam-proof cement, discovered by Mr. A. C. Fox, which it is claimed is not affected by hot or cold water, nor by acids or alkalies. First, a chromium preparation is made in the following manner: 2.5 parts, by weight, of chromic acid are dissolved in a mixture of 15 parts of water and 15 parts of ammonia. To this solution about 10 drops of sulphuric acid, and, finally, 30 parts of sulphate of ammonia and 4 parts of fine white paper, are added. When about to be used, gelatine dissolved in dilute acetic acid is added.

Steam Pump.

The large Blake mining pump has a double plunger, 16″ in diameter, and steam cylinder 23″ in diameter, with a stroke of 24″. This pump discharges 1,000 gallons per minute when running at the regular speed of 23 strokes per minute. These double plunger pumps are intended for mines and for pumping gritty water, they being very hard to wear out. The small cylinder surmounting the main cylinder contains an ordinary spring ring steam piston,—not a valve,—which is the motor for the main valve. The cylinder heads of both cylinders through which the piston passes are cast in one piece, with the connection between them, as in many other steam pumps. At each joint of the valve gearing there is a steel friction roller that can be renewed when worn.

In H. R. Worthington's duplex steam pump, the valve motion is the prominent and important peculiarity, as being that to which the pump owes its exemption from noise or concussive action. Two steam pumps are placed side by side, and so combined as to act reciprocally upon the steam valves of each other. The one piston acts to give steam to the other, after which it finishes its own stroke, and waits for its valve to be acted upon before it can renew its motion. This pause allows all the water valves to seat quietly, and removes everything like harshness of motion. As one or the other of the steam valves must be always open, there can be no center or dead point. The pump is, therefore, always ready to start when steam is admitted, and is managed by the simple opening and shutting of a valve.

The "Knowles" steam pump is a long, connected pump. In the steam chest there are only "two pieces," the valve (which is a flat slide valve) and the valve-driving piston, each being made all in one piece, thus giving only two moving pieces in the steam chest, to produce the entire motion. The steam valve of the pump, being an ordinary flat slide valve, does not have a rotary motion, but simply a horizontal motion, the same as any slide valve. This style of flat valve embodies the most favorable possible conditions for tightness, even after the wear consequent upon a long use. The slight rotary motion imparted to the valve-driving piston, by the rocker arm, simply puts it in a position to be driven horizontally by the steam, in which motion it carries the slide valve with it, the two being directly connected together. It has no springs, screws, yokes, nuts, followers, rings, plunger-cushion springs, movable seats, poppet valves, or studs, inside of the steam chest. The driving piston is entirely independent of exhaust steam for cushioning, thereby working with the same certainty and exactness when exhausting into vacuum (working condensing) as when exhausting into atmosphere. It will also work equally well in a vertical as in a horizontal position.

Steam Ram'mer. One designed to supersede hand-work in the paving of the streets of large cities, where extensive surfaces of stone blocks and cobble-stones are constantly requiring to be laid or repaired, and which can only be imperfectly put down by hand. The apparatus is operated on the principle of the trip-hammer; it can be speeded to strike fast or slow, and will deliver a blow of from 1 lb. up to 1,500.

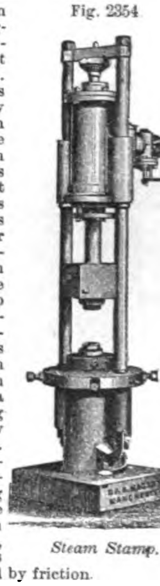
Steam Reap'er.

Aveling & Porter, * Knight's report "*Paris Exposition*," vol. v., p. 158.

Steam Stamp. One for stamping out articles from heavy sheet metal.

Fig. 2354 shows a 3-cwt. steam stamp, specially designed for forging articles of which large quantities are used, by means of dies cut to the form of the finished article. The stamp is not self acting, but is regulated either by the foot or by the hand. When left to itself with the steam turned on, it rises to the top of its stroke and remains in that position until the valve is brought down by the hand or foot of the attendant. It then delivers a single "dead-blow," and rises again, as before, leaving the lower die clear for the removal of the finished article and the introduction of the hot iron for a new one. The upper die is fixed rigidly in the tup or hammer-head, the lower one being adjusted by strong poppet-screws until it exactly coincides with it. The tup is fitted between slide-bars which guide it down upon the lower die, and, with a stamp of adequate size, the forging can be finished at a single blow with a great degree of accuracy. Special arrangements are introduced for facilitating the adjustment of the dies, for removing bolts and similar articles from the dies, for preventing the piston from striking the cylinder-cover, and for adjusting the slides so as to compensate for the wear caused by friction.

Fig. 2354.



Steam Stamp.

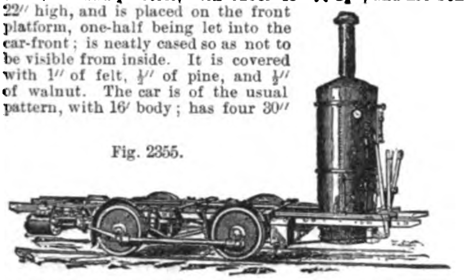
The 5 cwt. stamp will make a bolt 1¼″ diameter, with large square head 2¾″ diameter and 1″ thick, and with very deep square neck, at a single blow.

The principal sizes of these stamps weigh from ½ to 10 cwt.

Steam Street Car. Fig. 2355 shows the operating part of the Baldwin steam street car.

Two 6″ × 10″ cylinders are attached to an inverted cast-iron bed-plate, bolted to the car-bottom near the center-line and in front of the rear axle. The cranks are on the front axle, which has both inside and outside bearings. The jaws for the inside bearings are cast on this bed-plate. The valve-gear is the usual shifting link. The exhaust is carried through a system of pipes, so that it is partly condensed before escaping, and is nearly noiseless. The boiler is vertical, 72″ × 30″ and ⅜″ steel, with tubes 48″ × 1½″, and fire-box 22″ high, and is placed on the front platform, one-half being let into the car-front; is neatly cased so as not to be visible from inside. It is covered with 1″ of felt, ½″ of pine, and ½″ of walnut. The car is of the usual pattern, with 16′ body; has four 30″ wheels, only one pair driven by the engine. Steam brakes stop it in half its length.

Fig. 2355.



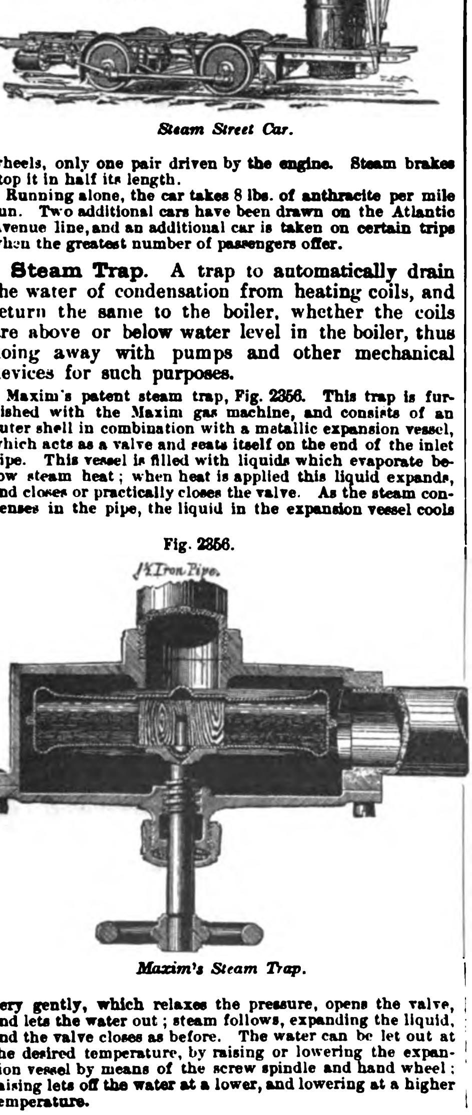
Steam Street Car.

Running alone, the car takes 8 lbs. of anthracite per mile run. Two additional cars have been drawn on the Atlantic Avenue line, and an additional car is taken on certain trips when the greatest number of passengers offer.

Steam Trap. A trap to automatically drain the water of condensation from heating coils, and return the same to the boiler, whether the coils are above or below water level in the boiler, thus doing away with pumps and other mechanical devices for such purposes.

Maxim's patent steam trap, Fig. 2356. This trap is furnished with the Maxim gas machine, and consists of an outer shell in combination with a metallic expansion vessel, which acts as a valve and seats itself on the end of the inlet pipe. This vessel is filled with liquids which evaporate below steam heat; when heat is applied this liquid expands, and closes or practically closes the valve. As the steam condenses in the pipe, the liquid in the expansion vessel cools very gently, which relaxes the pressure, opens the valve, and lets the water out; steam follows, expanding the liquid, and the valve closes as before. The water can be let out at the desired temperature, by raising or lowering the expansion vessel by means of the screw spindle and hand wheel; raising lets off the water at a lower, and lowering at a higher temperature.

Fig. 2356.



Maxim's Steam Trap.

Steam Valve. A door-like cover or device to regulate the passage of gases or fluids through a port. See list, p. 2688, "*Mech. Dict.*"

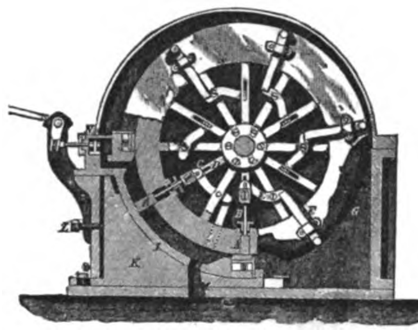
Purvis's steam valve is actuated directly by the motion of the engine piston without the aid of valve gear, and without the assistance of an auxiliary valve. The whole area and length of the cylinder are utilized. The valve is thrown through its entire stroke by line steam upon its differential areas, and cushioned by the same.

High pressure valve.
Dennis & Co., Br. . * "*Engineering*," xxii. 111.
Steam valve, *House* . . * "*Scientific American Sup.*," 1569.
Saunders . . . . . * "*Scientific American*," xxxix. 86.
Steam and water valve.
House, Br. . . . . * "*Engineering*," xxiv. 194.

Steam Wheel. In Thomas' steam wheel, Fig. 2357, the impulsive power is communicated only over a segment of the periphery instead of following the piston around the circle.

See Rotary Steam Engine, *supra*, and "*Mech. Dict.*"

Fig. 2357.



Steam Wheel.

Stear′ic Ac′id Ap′pa-ra′tus. Devices used in the extraction of the tallow from the original fats. The fats are inclosed in hair or cloth bags, and subjected to pressure to extract the fluid fats, or the fats are mixed with from 20 to 100 per cent. of water and 1 or 2 per cent. of lime, and kept at a heat of 200° C. for several hours.

Steel. 1. Steel is made direct from the ore by deoxidation followed by carburization.

2. It is made from pig-iron by decarburization. Oxidizing agents, solid or aëriform, are applied to it to eliminate the carbon.

3. It is made from wrought iron by carburization.

Professor Young gives the following outline of the two latter: —

Pig iron converted into steel by —
Solid oxidizing agents, iron ore, saltpeter, etc., without fusion: *Examples* — Puddled steel; Riepe process; Ellerhausen process; Heaton steel.
Solid oxidizing agents, such as spathose iron ore, with fusion, — Uchatius steel.
Oxidizing agency of air, with fusion, — Bessemer steel.
Oxidizing and reducing gases, — Berard steel.
Wrought iron converted into steel by —
Fusion with pig iron, — Martin process.
Fusion with charcoal, — Wootz process.
Heating in charcoal without fusion, — Cement steel.
Heated in carbureted hydrogen, — Mackintosh process.

As steel occupies nearly the middle place between cast and wrought iron in its proportion of carbon, it may be prepared either by decarburizing pig iron, or, on the contrary, by causing wrought iron to absorb carbon. The processes to accomplish these ends may be arranged under five principal heads: A, Fabrication of steel by decarburization of crude or pig iron; B, by carburization of wrought iron; C, by mixing a wrought iron poor in carbon with a pig iron rich in same; D, by mixing pig iron with ore (the pig yields carbon which reduces the ore and transforms the reduced iron into steel); E, directly by means of ore; F, cast steel. Subdividing these systems, we have the following methods under each heading: —

A. — METHODS OF DECARBURIZING THE CRUDE IRON.

1. Steel obtained by a long heating of the crude iron in an oxidizing atmosphere, the metal not being brought to fusion. (a) Tunner's method in sand, where the deoxidation is produced by means of the oxygen in the air. (b) Jullien's method, in forge scales or spathic ore. This produces malleable iron. (c) Herzeeles' method in steam. (d) Thomas' method in carbonic acid. The last two processes have not been employed to any great extent.

2. Natural steel: In this method, employed since the earliest times, the crude iron is melted in a refining furnace with wood charcoal, and decarburized by the ferrous oxide of the scoria. The product is purified by repeated refining.

3. Puddling: This process is the same as the preceding, from a chemical point of view, but is practiced in a reverberatory furnace heated with coal. It is necessary to purify the product by repeated refining or by transforming it into cast steel.

The construction of puddling furnaces has undergone many changes. We may distinguish (a) the ordinary puddling furnace with fixed hearth and heated by coal, (b) the same heated by lignite or peat, (c) the puddling furnaces of Schafhäutl and others, with mechanical rabbles designed to diminish the labor so fatiguing to the workman. These, however, have been entirely superseded by new systems. (d) The Danks furnace, the hearth of which is formed of a hollow cylinder placed horizontally, and turning on its axis, gives a product of excellent quality, and is economical. The interior lining, however, is difficult to maintain. (e) The Ehrenwerth furnace has a horizontal circular hearth turning on a vertical axis. (f) The Pernot furnace also has a circular sole, which, however, is not horizontal, but slightly inclined, so that during its rotation the iron and scoriæ run to the lowest point and are thus in a state of continual motion; while the elevated parts of the hearth, together with the iron and scoriæ thereto adherent, are submitted to the oxidizing action of the air. This furnace realizes the advantages of mechanical puddling without needing any special lining.

4. The Bessemer process: A current of air, finely divided, is passed through the liquid crude iron. The carbon, silicon, and a part of the iron burn, and the temperature is so highly elevated that the iron, decarburized in part or transformed into steel, remains molten. It is then run into molds.

5. Bérard's modification of the above: Air and gases are alternately introduced into the retort with different advantages.

6. Peters' process: The liquefied crude iron in a reverberatory furnace falls in the form of rain in a vertical chamber in which the furnace gases also pass, and in which air is blown so as to decarburize the metal to the desired degree.

B. — METHODS BY CARBURIZATION OF WROUGHT IRON.

1. Indian or Wootz steel: Wrought iron of extraordinary purity, obtained by treating a very pure ore in small chamber furnaces by the direct method, is hammered, made into bars, cut into short pieces, and placed in small crucibles with a few green leaves. The crucibles are hermetically sealed and heated for a long time at a high temperature. The iron is transformed into steel by uniting with it the carbon contained in the leaves, and the steel even partially melts. These half melted masses furnish the famous sword blades and plates of Persia and Damascus.

2. There are several other processes resembling the Indian, which, however, are not carried on on a large scale. There are (a) the Mushet process, in which wrought iron obtained by the ordinary refining method is melted with powdered wood charcoal. (b) The Vickers' process, analogous to the preceding, with the addition of oxide of manganese. (c) The Stourbridge, Brooman, Thomas, and Binks processes, based on identical principles.

3. English cemented steel: Wrought iron of the best possible quality is, in the shape of bars, packed in clay boxes, together with wood charcoal coarsely pulverized. The heating continues for two or three weeks. Without melting, the iron is changed into steel, which by remelting is transformed into cast steel.

4. Parry's cupola steel: Fragments of wrought iron, melted in the cupola with a large consumption of coke or wood-charcoal, may be transformed into steel or even into cast iron according to the length of the operation. This system offers an advantageous method of utilizing scrap, and requires no special apparatus.

5. Chenot's process: In this the ore is reduced by heating it progressively with coal. A non-melted iron sponge is obtained, which is ground and separated as well as possible from the gangues by the aid of a magnet. Lastly, it is mixed with carboniferous substances, and melted under pressure. The principal disadvantage of this process is the difficulty of separating the gangues without losing the steel.

6. Casehardening has for its object the transformation of the surfaces of wrought iron objects into steel. It is done in two ways. (a) The pieces are placed in small sheet iron boxes and surrounded with chips of wood. The boxes are hermetically closed and heated in a forge fire, for 15 or 30 minutes, to an intense red heat. They are then removed quickly, opened, and their contents thrown into cold water, whereby the exterior steel shell is rendered as hard as glass. (b) The pieces are heated to a whitish red and moistened with ferrocyanide of potassium, which acts, by its cyanogen, on the iron, and transforms the surface into steel.

C. — METHODS BY FUSION OF A MIXTURE OF CAST AND WROUGHT IRON.

The two materials may be, both or only one of them, used in a melted state.

1. Bessemer steel, prepared by the ordinary method. The crude and wrought iron here are both liquid, while, as we have previously said, cast iron may be directly transformed into steel. The method most followed, and which leads most surely to the end in view, consists in completely decarburizing the crude iron in the converter, and in adding to the melted metallic iron a rigorously determined quantity of liquid crude iron. The carbon of the latter affects the previously decarburized iron, and makes a steel containing a given proportion of carbon.

2. Crucible steel is obtained by melting in crucibles a mixture of crude and wrought iron. The former liquefies first, and slowly melts the latter.

3. Martin's steel is similarly made, but replaces the crucible with a reverberatory furnace. The crude iron is liquefied under a thin layer of scoria on the concave hearth of a reverberatory furnace, heated to an intense red-white heat by a Siemens regenerator. Scraps of steel and wrought iron of all kinds in desired quantity are added, and the steel is run into molds of cast iron.

D. — METHODS BY A MIXTURE OF CAST IRON AND ORE.

Uchatius steel: The cast iron is granulated by running it into water while molten, and the grains are melted with spathic ore, peroxide of manganese, and wrought iron in crucibles. The ferrous oxide of the spathic ore is reduced by the carbon of the cast iron, and the surplus of carbon unites with the wrought iron to make steel.

E. — METHODS BY PREPARATION DIRECT FROM THE ORE.

The Siemens direct process: The ore is melted alone, without addition of reducing material, at a very elevated temperature; then the iron is reduced and transformed into wrought iron or into steel by adding coal.

E. — CAST STEEL.

For the purification of steel by fusion, cemented, forged, and puddled steel are employed. To improve the qualities of the steel, and notably to augment its hardness, diverse substances are added. Thus we have: 1, silver steel; 2, nickel steel; and 3, wolfram or Mushet special steel.

The Japanese method of making steel is to mix a certain quantity of iron in pigs and iron in bars, cover the mixture with borax, and melt the whole for a week in a small fire-proof crucible. The borax serves to dissolve the impurities in the dross. When the metal is separated from the dross (which floats on the surface) and cooled, it is hammered hard, and alternately plunged into water or oil, after which it is cemented and tempered. The mode of cementing is as follows: The steel, on coming from beneath the hammer, is covered with a mixture composed of clay, cinders, marl, and charcoal-powder. When this plaster is dry, the whole is subjected to a red heat, and the steel is afterwards cooled very slowly in warm water which is allowed to become tepid. Steel thus obtained is not very supple, but extremely hard, because it is not properly tempered or completely freed from its impurities. It would not do for making watch-springs, but is used by the Japanese for swords and sabres which are tempered as many as eleven times, and knives which are tempered four times.

(*Metallurgy.*) Greiner's classification of iron products: —

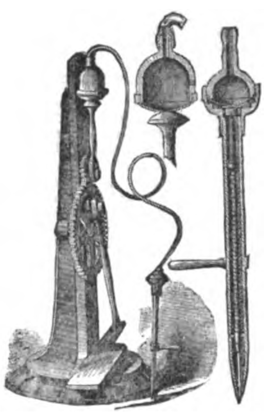
Carbon, per cent.	Iron Series (welded).	Steel Series (melted).
0. to 0.15	Ordinary iron.	Extra soft steel.
0.15 to 0.45	Granular iron.	Soft steel.
0.45 to 0.55	Steely iron or puddled steel.	Semi-soft steel.
0.55 to 1.50	Cemented iron or steel.	Hard steel.

See Sponge Process, *supra.*
See "*Mech. Dict.*," pp. 2363, 2364, 2365, 2366.
Henderson Steel . . "*Iron Age*," xix., Feb. 1, p. 15.

Sten'cil Paste. A mixture of any ordinary pigment with chalk or carbonate of magnesia, to form a paste of the required consistence.

Sten'cil Pen. A pen or needle reciprocated by electric or pneumatic force, for multiplying tracings, etc. Fig. 2358 shows a simple form of pneumatic pen.

Fig. 2358.



Stencil Pen.

Sten'o-chrome. A print showing the colors, shades, and arrangement of a mosaic, made by forming a mosaic plate of colored sections similar to the one to be copied.

Ste'no Com-press'or. (*Dental.*) A spring pad for closing the saliva duct, and absorbing the saliva during operations.

Step Gage. The standard double corrective gage, Fig. 2359, is for testing and correcting fixed caliper gages, and also as a reference to prove dimensions within its range.

Fig. 2359.

Double Corrective Step Gage.

Step Head'stock. In a watchmaking lathe the step head stock, as its name indicates, has a step or conical bearing at the rear of the spindle to reduce friction. This head is for pivoting, jewel polishing, and other work requiring very high speed.

Step Pad. The foot-rest or tread of a carriage step.

Ste-re-om'e-ter. An apparatus for illustrating various mathematical problems.

It has two frames, the upper one being a square, the sides of which are three feet long; and the longer one is formed by two such squares. Both frames are kept in position by four small columns, 4' in height, and standing on four legs, by which the whole is supported and fastened to a common table. In these squares graduated cross-bars (of any desired number) are fastened by screw-clamps. They move horizontally in two directions, parallel to the sides of the square, while similar bars, 4' long, are perpendicular to the frames and parallel to the columns. The cross-bars and framework are made in two pieces of ½" by ⅛", leaving between them an open space of 3-16", in which again a simple screw-clamp moves, holding a needle in position, perpendicular to the bars and frame. These needles are pieces of strong common wire, flattened a little on one end, with an oblong hole in the end. By this arrangement a mechanical way is found to determine the position of any point in space within the apparatus. The shifting of the cross-bars (say north or south), the moving of the clamp in the split of the cross-bars (east and west), and the moving up and down of the needle in the clamps, are true representations of the equations of a point in space. The position of an unlimited number of points can be determined, and, consequently, any solid figure can be represented in contour lines by drawing wires — or, better still, elastic silk cords — through the corresponding points.

Stif'fened Chain Sus-pen'sion Bridge. The first bridge of this kind was erected at Pittsburg, Pa., in 1876-1877. The bridge is stiffened by means of rigid cords which extend (above the chains), at an undeviating angle from the towers to the center of the middle span (800 feet long), where they are connected by a hinge to allow for expansion and contraction.

Stif'fen-ing Ma-chine'. A trough and pair of squeezing rollers used in putting the stiffening into felt hat bodies.

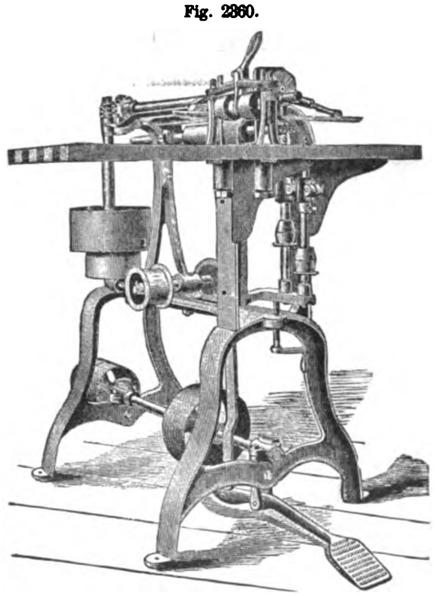
The stiffening is to enable the hat to maintain its shape. a thicker stiffening material is used for the brim than for the crown, and a more expensive material for fine hats than for common ones. A solution of shellac for first-class goods; Irish moss and glue for the rougher article. Two vats are employed and contain the respective stiffenings; the whole hat is submerged in the thinner stuff and the superfluous matter is squeezed out of it by passing it upward between the rollers. The brim alone is dipped in the other vat.

The troughs are heated by steam to keep the stuff liquid, and the hats after this process are ready to be blocked. This is the shaping, flattening the tip, stretching out the brim, etc. See Hat-blocking Machine.

Stile Bo'rer. A machine for boring holes in the vertical parts of a window or shutter frame.

In Fig. 2360, the two vertical bits are used for blinds only, and will bore without any previous marking or laying out,

Fig. 2360.



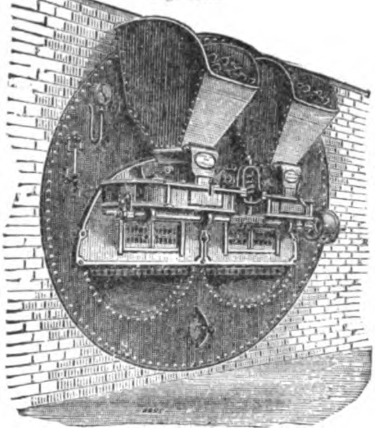
Colburn's Blind Stile Borer.

8,000 holes per hour. The stiles, after being jointed, are placed upon the table, with a ratchet or pattern between them, the lower ends of the stiles resting against two blocks, which are securely fastened to the end of the pattern, and are moved over the bits by means of a pawl working in the notches of the pattern. It spaces its own work at any distance apart, from 1" to 1½", and bores the entire length of the stile without stopping. The mortises are marked on the edge of the stile while the machine is in operation, from corresponding marks on the edge of a thin strip which has been previously laid off and tacked to the side of the pattern, and which can be replaced with any length required. The boring being done from the under side of the stile, the chips drop freely from the bits, and leave the holes of a uniform depth, so that the pivot of the slat may work on the end instead of the shoulder, which renders them less liable to bind or stick fast on the paint.

Stock Stone. (*Leather.*) A flat rectangular scouring-stone, 5" or 6" long and 0.5" thick, fixed in a stock or handle. It is used for scouring, stretching, and removing inequalities in the leather.

Sto'ker, Me-chan'i-cal. Henderson's mechanical stoker (English) has a fuel hopper placed over the fire-door, and from which it is gradually fed into the furnace by automatic gear driven by the engine. See Fig. 2361.

Fig. 2361.



Henderson's Mechanical Stoker.

Stone, Ar-ti-fi'cial. Stones formed by a process of treating a combination of lime and sand.

Ternikoff exposes equal parts of lime and sand to a temperature of 150° C. for several hours in the presence of steam. The material is then pressed and exposed to the air.

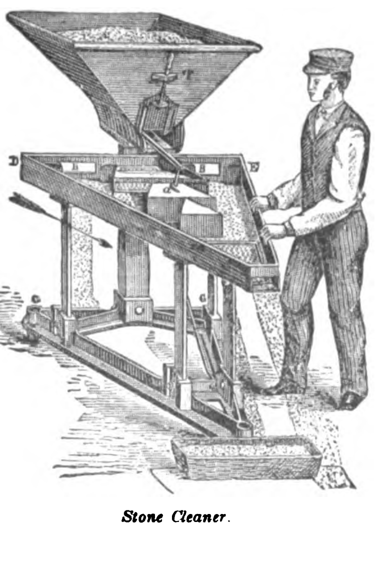
Glaser mills 4 to 6 parts fine sand to 1 of slaked lime and exposes for three days to a high temperature under a pressure of more than three atmospheres; it is then pressed.

Hosmer subjects limestone, cut to shape desired, in boiling water to 5° atmospheric pressure, and then places them in an alum or colored bath, to color as desired. See p. 2392, "*Mech. Dict.*"

Hammered artificial stone, "*Iron Age*," xviii., September 7, p. 3.

Stone Clean'er. For cleaning stones or clods from wheat or other grain.

Fig. 2362.



Stone Cleaner.

In Fig. 2362 the tray has a rocking motion on its supporting bars, the crank making 115 turns per minute. The grain placed in the hopper discharges at the lifted gate, runs over the slanting board, and into the bed of the tray. It is divided to each side, and, as the tray is pushed laterally back and forth by a quick motion, the contents are sorted according to gravity. The wheat issues at the rear ports, *B*, and the stones at the front, *C*, the lowest part of the tray. The apparatus is adjustable for inclination, the front end being kept the lowest. The stones being heavier than the grains and of angular shape, resist the backward blow of the oblique faces of the central block and pursue their way down the slope to the front while the grain passes out at the rear. See SEPARATORS.

Stone Cleav'ing Ma-chine'.

Stone cleaving for dividing granite is effected by means of a prismatic steel cutter inserted with wedges in the under side of the hammer, and opposite a similar one below on the anvil bed. The granite block to be cleft is pulled on rollers over the lower cutter (which is slightly higher than the rollers), and into the proper position. Then a rapid series of blows is given from a short height, followed by a strong blow from a great height. Thus a plate is cut vertically with accurately even surface. The block is next pushed on one plate-thickness, and the process is repeated. The plates obtained are afterward divided into cubical blocks by means of a steam hammer, arranged quite like the former except that the plates, instead of lying on rollers, are placed on small tables resting on spiral springs. By the weight of the stones the springs are compressed, so that the stones come to lie on the lower cutter.

Stone Cut'ting. The modes of dressing stones for masonry come under several heads. Unsquared stones or rubble are perhaps hardly included in the definition, but may be included for completeness of statement.

See under the following heads: —

Bush hammered.	Pitched-face stone.
Crandaled.	Quarry faced.
Cut stone.	Rough pointed.
Diamond paneled.	Rubbed.
Drafted stones.	Rubble.
Fine pointed.	Squared stones.
Peen hammered.	Tooth-axed.

All stones used in building come under one of three classes, namely: —

I. Rough stones that are used as they come from the quarry.

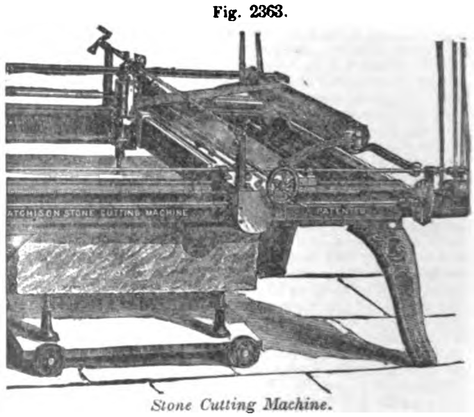
II. Stones roughly squared and dressed.

III. Stones accurately squared and finely dressed.

In practice, the line of separation between them is not very distinctly marked, but one class gradually merges into the next.

Stone Cut'ting Ma-chine'. The Tilghman sand blast will execute in ten minutes what would take a skilled stone-cutter a whole day. The pattern to be worked is cut in and through a flat iron or wooden plate which is fastened on to the stone. The jet-pipe traverses the pattern and the sand cuts away the parts of the stone not protected by the plate. Common sand, crushed agate, and small granules of iron, are used in cutting stone.

Fig. 2363.



Stone Cutting Machine.

Atchison's stone cutter, Fig. 2365, has two tools arranged in a strong head piece, attached to a moving platen, similar to the iron planing machine.

This platen, with the head-piece, is made to move forward and backward over the stone, and the tools, having a perpendicular, reciprocal, rotating motion, cut the surface at the rate of not less than 6,000 blows per minute. The tools are semi-circular in shape at the edge, and can be used constantly for at least forty-five minutes without changing; thus one set of tools will cut not less than 270,000 blows without re-sharpening.

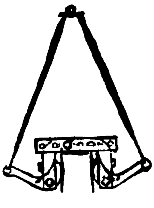
One man can operate three machines, and sharpen his own tools, which sharpening is done readily by the use of a "die."

Among the advantages claimed for this machine are: —

The slight cutting blows produced by this peculiar motion leave the surface "solid" and free from "stunning"; all "wind" or irregularity of surface is overcome, without the process of "sighting" or measuring; the edges of the stone are evenly and perfectly cut without "chipping." This principle is applied to machines for ornamental as well as plain work, in cutting moldings, cornices, ornaments, letters, etc., on all kinds of stones.

Stone Lift'er. Shepherd's lifter, Fig. 2364, has a pair of eccentric lever griping jaws, pivoted in a frame formed of two parts. These parts are adjustable along each other, and may be secured by pins so as to shift the jaws nearer together or further apart in order to adapt for different sized stones. The arms of the jaws are connected by chains to an eye plate, and to the latter the hoisting rope is attached.

Fig. 2364.

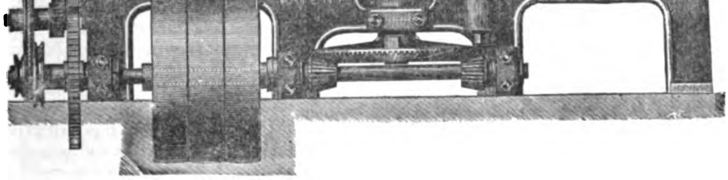


Stone Lifter.

Stone Mold'ing Ma-chine'. In Hunter & Fothergill's stone-molding machine the chief feature is the employment of cutting plates of different lengths, all lettered, so as to be easily picked out and set, like types, to mold. These being built on a shaft, revolve, and take out the rough or waste, comparatively near the mold, when a tool to profile passes several times over and finishes the work. The stone is laid on a cant-table to cant to the proper angle.

The tools in the planing and molding machines are fastened to holders that are bolted to the shafts. There is a pair of tools at each end of the holder. Although the holders, when fixed upon the shafts, act obliquely, as appears upon the stone passing under the cutters, and in such manner as seems incompatible with the production of any definite form, they are nevertheless so arranged, and so act as to turn out moldings of a large size, with many members, rough-cut, with great accuracy. The work is finished by being passed two or three times under cutting or scraping tools of the precise form of the molding to be produced. For a molding of many members, some of them deeply cut, more than one of these finishing-tools is sometimes employed. Mitred work is also executed by the machines with perfect accuracy.

Fig. 2365.



Hunter & Fothergill's Stone Molding Machine.

Stone Sep'a-ra-tor. A device invented by Higuette for removing stones and clods from grain. See STONE CLEANER, *supra*.

Stone Split'ting Ma-chine'. Brook's splitting machine has a row of upright square-shaped bars of steel, bevel-pointed, on which the stone sits. The steam hammer has a corresponding set, with a tooth immediately over each lower tooth. The sudden shock disintegrates the stone in the line of the teeth.

Stone'ware. (*Ceramics.*) *Grès cerame.* A class of ware which may be said to hold a middle place between hard porcelain and fine English faïence.

The paste is composed of fat clay with quartzose sand, and gives a very solid and strong ware, varying in color from a pearl gray to a brown red. It is dense and impermeable, and resists corrosion by acids, being specially adapted for table use.

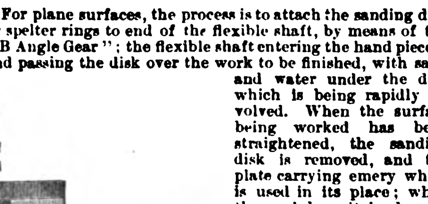
Fine varieties consist of ornamented objects made of a fine paste, white or of various colors, delicately fashioned and enriched with figures in relief, often in paste of another color.

Stone'ware Force-pump. One for pumping acids, bleach, alkalies, vinegar, or other liquids injurious to metals. The working parts are composed entirely of stone-ware, and the gland packed with asbestos.

Stone'ware Kiln. (*Ceramics.*) The stone ware is a reverberatory on the same principle as the common faïence furnace. See FAÏENCE.

Stone'-work'ing Em'e-ry Tools. In the tools shown in Fig. 2387 *A* is the sanding disk; *B* the "B Angle Gear," for emery wheels; *C* the "C Angle Gear," for buffing wheels; *D* fluting roll; *E* disk, for cutting medallions.

Fig. 2366.



Emery Tools.

For plane surfaces, the process is to attach the sanding disk or spelter rings to end of the flexible shaft, by means of the "B Angle Gear"; the flexible shaft entering the hand piece *F* and passing the disk over the work to be finished, with sand and water under the disk which is being rapidly revolved. When the surface being worked has been straightened, the sanding disk is removed, and the plate carrying emery wheel is used in its place; when the work has attained a sufficient smoothness, it is thoroughly cleaned, and then "buffed" by means of the disk shown in "Angle Gear *C*." This buffer is made of heavy felt, or similar material covered with canvas; it is revolved much more rapidly than either of the preceding disks, and the surface being finished is coated with "Tutty," during the operation; finally, a second buffing disk is used without the tutty, which brings the work up to completion. This process is varied somewhat with different grades of stones, but is in the main the plan adopted. The roll *D* is used for fluting work — as columns, edgings, moldings, etc., etc. A rough channel is cut where flute is desired, the roller placed in it, and rapidly revolved; sand and water is also used as with the sanding disks, and the roll is passed back and forth in the channel being cut. In this way channels of 12′ long can be cut and finished in a few minutes. *E* shows a corrugated disk for cutting medallions or rosettes in stone. They are attached to the "Angle Gear *B*," and held up to the work to be done; used as sanding disks they cut rapidly and effectually, doing their work at a very low price.

Ston′ing. (*Leather.*) Driving the stock stone over the leather to remove inequalities, stretch it, and render the grain smooth.

Ston′ing Jack. (*Leather.*) A machine in which the jack is furnished with a stock stone to work the leather.

Stope. (*Mining.*) One of a series of steps or beds into which the upper surface of an excavation is cut; to excavate in the form of steps above a drift.

Sto′ping. (*Mining.*) The act of stoping or breaking down the surface of an excavation with a pick.

Sto′ping Drill. (*Mining.*) One for excavating drifts or horizontally lying beds or steps. Fig. 2367 represents a stoping drill mounted on a column, with a claw-foot and and a jack-screw at top for securing the same in an upright position. This is peculiarly adapted to small tunnels, adits, and stopes, from 4½′ × 6′ to 6′ × 6′ or even larger drifts, and is a simple, cheap, and good arrangement for the desired purpose.

Fig. 2367.

Drill Mounted for Shaft Work.

Stop Plate. A metallic plate in the inside of a journal-box which forms an end-bearing for the axle and checks its end-motion. The plate is either held in position by flanges cast in the box, or is attached to the journal bearing or its key. — *Forney.*

Stop Watch. A time-piece registering seconds and minutes, used in making tests for density.

Goodwin's "American Gas-light Journal," * July 3, 1876, p. 7.
Minute clock, *Ibid.*

A time-piece marking fractions of a second which can be stopped instantly by pressure on a pin.

Stor′age Bat′te-ry. (*Electricity.*) A secondary battery. A galvanic battery devised to act as a conservator of electric force to be withdrawn as required. See *Hinston & Thomson's* battery, "*Journal Franklin Inst.,*" 1880, noted in "*Manufacturer and Builder,*" * xii. 36.

The Faure battery is thus described in the London "*Times*": —

A Faure battery (improvement on Planté's *pile secondaire*) was charged with the electric fluid direct from the ordinary Grove battery. The receptacle consists of four Faure batteries each about 5″ diameter and 10″ high, forming a cylindrical leaden vessel and containing alternate strips of metallic lead and minium wrapped in felt and rolled into a spiral wetted with acidulated water, and the whole placed in a square wooden box, measuring about 1′ cubic and weighing 75 pounds. This was protected by a loose wooden cover through which the leaden electrodes protruded, they being flattened down for convenience of transport.

This box of "electric energy" was sent by M. Faure, in Paris, to Sir Wm. Thomson, in Glasgow, where the "box of electricity," was received intact and potent, holding by measurement within that small space of 1′ cubic a power equivalent to nearly 1,000,000 foot-pounds.

Storm Valve. A screw-down valve to supersede the duty of a gravitating valve in a ship's side during bad weather.

Stove Truck. A truck to run under a stove, having a platform operated by a lever to raise the stove off its feet. The lever is then locked and used as a handle to guide the truck.

Straight′en-ing Block. The anvil on which buckled saws are straightened.

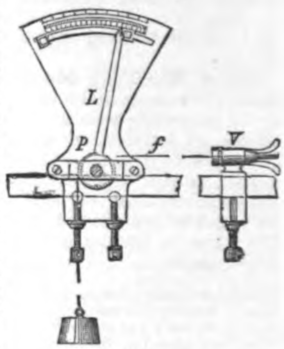
Strain In′di-ca′tor. An instrument for determining by optical means the extension or compression of materials under strain.

Stromeyer . . . . . . * "*Engineering,*" xxx. 337.

Strain Meas′ur-er. An apparatus designed to measure directly the strains to which the different parts of any structure are submitted. It will operate in any position whatever, and under all possible conditions, multiplying the amount of flexure itself, — a result not always obtained in apparatus of this nature.

A metallic wire, *f*, is attached at one end to a winged nut, *V*, which allows of the instrument being adjusted for use. This wire passes over a pulley, *p*, and carries a counterpoise. To keep it from slipping it is held by a small clamp placed in the channel of the pulley. The latter carries an index needle, *L*, which multiplies the distance traversed by its circumference ten times, and the extremity of which moves across an arc graduated in millimeters. The index needle also moves two slides which show the maximum of elongation or compression. The apparatus and the screw to which the wire is attached are mounted in two different ways, one designed to fasten the whole to a truss rod or to the foot of a T-iron, and the other to attach the apparatus to any ordinary surface. The apparatus having been placed in position, the index having been brought to zero, and the wire being kept at a uniform tension by the weight, it will be seen that if the object to which it is attached elongates or shortens, the pulley will be actuated by the wire, and the lever *L* will multiply the actual amount of the strain exerted. To study maximum strains the two sliders are moved up against the extremity of the needle. The apparatus may be used on parts of a structure inclined at any angle whatever. The sensitiveness of the apparatus may be known when it is stated that a lighted match placed under the wire will cause the needle to be immediately deflected one, two, and three millimeters. See Fig. 2368.

Fig. 2368.



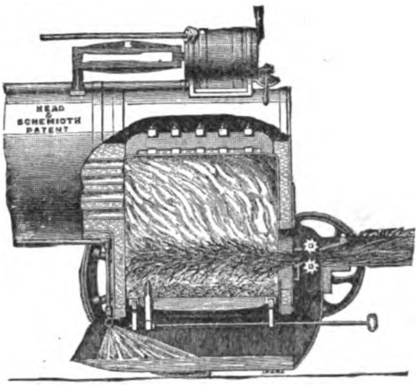
Strain Measurer.

Strap. (*Nautical.*) Or *strop*. The band of iron or rope which goes around a tackle-block.

Strass. (*Glass.*) A variety of lead glass made for imitating gems.

Straw′-burn′ing En′gine. An engine to enable persons residing in countries where coal and wood are not indigenous, or are only to be obtained at a great cost, to generate steam from the vegetable products on their estate. In Russia, Hungary, and on the borders of the Danube, this engine has been found to economize from 30 to 40 francs per day by using the refuse straw instead of coal and wood. In Egypt it is used for working the irrigating machinery of the cotton fields with the refuse cotton stalks, and actual practice has shown that the refuse stalks of a crop of cotton are sufficient to generate steam for working the pumps for irrigating the land, consequently the land finds its own fuel for irrigation. In India these engines are used in the tea plantations for driving the machinery, and

Fig. 2369.



Straw Burning Engine.

the jungle grass which grows outside the tea-gardens is used as fuel instead of coal and wood. In some cases it is used for burning the refuse of the sugar-cane from the mills. See Fig. 2369.

Stream Fence. One across a water-gap. A common form has the panels pivoted permanently to the part at one side of the stream, while the other end is held by pins that will either break under the pressure of the freshet, or allow the end to rise when the stream reaches the board, and allow it to swing loose from the pins. Barbed wires are stretched in same manner with a floating block attached to the loose end.

Street Car. See STEAM STREET CAR, *supra.*

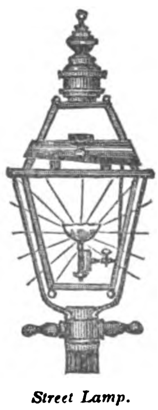
Street Car Mo'tors. See "*Scientific American Supplement,*" p. 2125, for an account of the early street-car efforts of *Latta* and *Todd;* the *Lamm* fireless locomotive at New Orleans; *Baxter's* engine with compound cylinders; *Grantham's* engine (Eng.) improved by *Wood.*

Loftus Perkins. Belgian street-car engine.
Société Métallurgique et Charbonnière, of Belgium.

Francq.	*Bède & Co.*
Merryweather.	*Hughes.*
Holt.	*Ransome.*
Baldwin, et al.	

See *Clark's* "*Tramways, their Construction and Working.*" London.
See also Mekarski compressed air street-car motor.*
Lamm & Francq fireless locomotive.*
"*Paris Exposition* (1878) *Reports,*"
*iv. 62-65
See STEAM STREET CAR.

Fig. 2370.



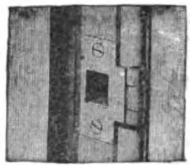
Street Lamp.

Street Lamp. Fig. 2370 shows a tank or reservoir, adjusted to the outside of a street lantern. Connected with the reservoir is a pipe and valve, to which is attached the solar gas burner. By means of a chemical process, the liquid, on its passage through this burner, is converted into gas, which gives a bright, steady flame.

The material used in making the gas is re-distilled naphtha of 72° to 74° gravity.

Strike. The piece on which the latch of a door impinges in closing.

Fig. 2371.



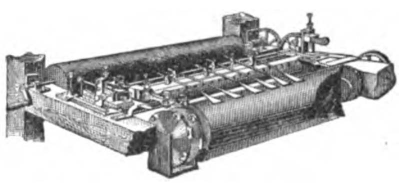
Strike.

Fig. 2371 has a roller for the bolt or latch to strike against, reducing the friction, and forcing the bolt back without noise.

(*Mining.*) The extension of a lode in a horizontal direction.

Stri'ker. The regulator which causes the pens of a ruling machine, in perpendicular work, to strike the head- or cross-line at regular intervals. In the illustration, Fig. 2372, are the cams with sloping corners for opera-

Fig. 2372.



Striker.

ting pen-beams and pens; the cams operating short line, the lifting arms and lifter; and the cam operating gate.

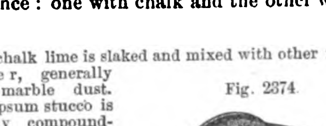
Stri'ker Plate. The nosing of a lock-keeper.

Strop. (*Nautical.*) Preferably *strap.* The band around a tackle-block.

Stub. 1. A blunt-pointed pen.

2. Short files for finishing in and around de-

Fig. 2373.



Stub.

pressions; has a holder fitting in top for parts where the fingers cannot get. See Fig. 2373.

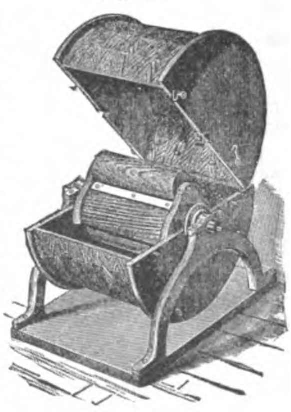
Stuc'co. There are two species of stucco used in France: one with chalk and the other with gypsum.

The chalk lime is slaked and mixed with other matters in powder, generally white marble dust. The gypsum stucco is similarly compounded, but is principally used in interiors. To imitate colored marbles the colors are added before the surface has entirely dried.

In Paris elaborate cornices and architectural moldings are made by forming them *in situ* by means of pattern gages or templets, projecting nails driven into the wall serving to hold the plaster in relief.

Polishing is done by a whetstone of fine grain, one hand holding a sponge with which the surface is occasionally wetted. The last polish is given by a piece of felt, saturated with oil.

Fig. 2374.



Stuffing Machine.

Stuf'fing. (*Leather.*) A mixture of tallow and either neat's foot oil or sperm oil, with which dampened leather is coated. The object is to render the leather supple and impervious to water.

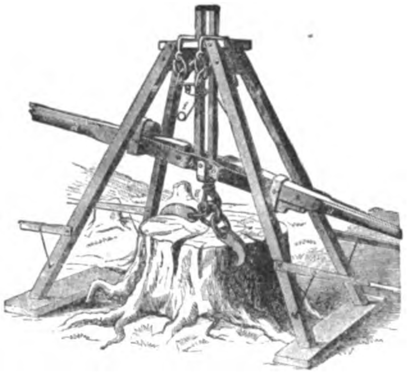
Stuf'fing Brush. (*Leather.*) A stiff brush used in stuffing leather.

Stuf'fing Ma-chine'. A steam chest into which the oil and tallow are introduced and rubbed into the leather by the action of rollers and beaters. See Fig. 2374.

Stull. (*Mining.*) A framework covered with timber or planks to support rubbish in working a stope.

Stump Ex-tract'or. In Fig. 2375, from the center of a tripod is suspended a ratchet wheel, over which a chain is loosely thrown, each link fitting in a corresponding groove. To this wheel a lever is attached, and so arranged that twenty pounds' power will raise, it is said, a ton. See Figs. 6011–6016, "*Mech. Dict.*"

Fig. 2375.



Stump Puller.

Stump pullers are of the lever and claw style, or the tackle, toggle, screw, windlass, or capstan order.

Stump Joint. The form of joint used in the folding carpenter's rule. The ends or stumps of the parts when in line, abut against each other, and allow movement in only one direction.

Sty'lo-graph'ic Pen. A reservoir pen, shaped like a pencil, in which the flow of ink is regulated by pressure of a style upon the paper.

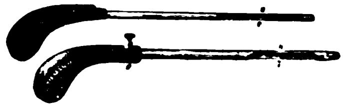
Sub'cu-ta'neous In'stru-ments. (*Surgical.*) See

Shrady's saw, knife, and bone rasp,	Fig. 87, Supplement.
Adams's saw	Figs. 10, 11, Supplement.
Knife	Fig. 9, Supplement.
Hypodermic syringe	Pages 70, 71, Part I.
Tiemann's "*Armamentarium Chirurgicum.*"	

Sub'cu-ta'ne-ous Saw. One to bare and roughen the ends of fragments in bony sections without injuring the flesh.

Fig. 2376 consists of a trocar, fenestrated canula, and staff, with handle and blunt extremity. A portion of this staff

Fig. 2376.



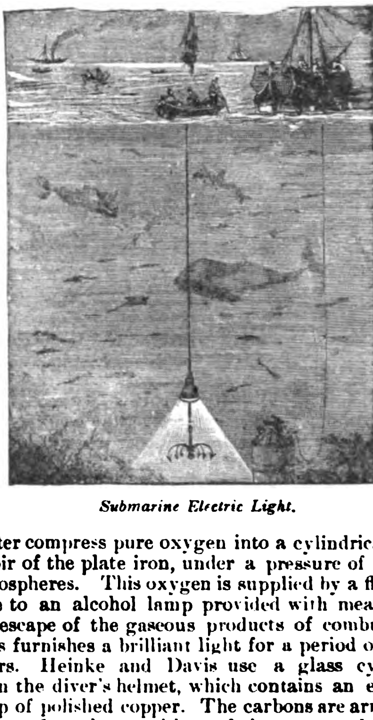
Subcutaneous Saw.

at a short distance from the extremity is flattened, one edge, *B*, being made into a knife-blade, and the other edge, *C*, being provided with saw-teeth. This staff is intended to replace the trocar in the canula after the latter is introduced. When in position, either the saw (*C*) or the knife (*B*) edge of the shaft, according to the way the latter is turned, corresponds with the opening in the canula.

Sub'li-ma'tion. (*Mining.*) The theory that the vein matter was introduced in a gaseous condition.

Sub'ma-rine' E-lec'tric Light Barnet and

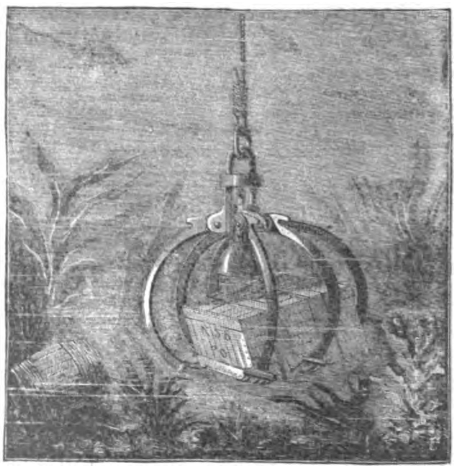
Fig. 2377.



Submarine Electric Light.

Foster compress pure oxygen into a cylindrical reservoir of the plate iron, under a pressure of thirty atmospheres. This oxygen is supplied by a flexible tube to an alcohol lamp provided with means for the escape of the gaseous products of combustion. This furnishes a brilliant light for a period of four hours. Heinke and Davis use a glass cylinder upon the diver's helmet, which contains an electric lamp of polished copper. The carbons are arranged to last four hours without being renewed. The whole apparatus weighs about 27 kilograms, and is capable of furnishing a light equivalent to 20 000 standard candles. See Fig. 2377.

Fig. 2378.



Submarine Grapple.

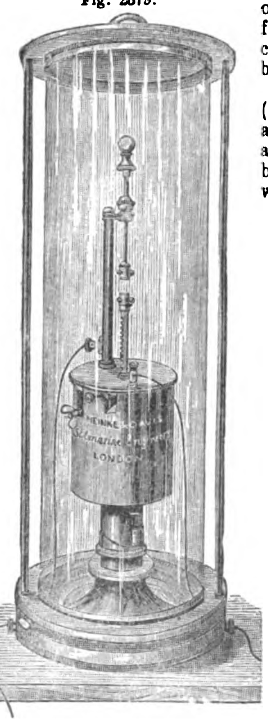
Sub'ma-rine' Grap'ple. For recovering articles on the ocean bed. In Fig. 2378 the grappling fingers pivoted in the head of the block are kept distended by the weight in the center. On the grappling of an article by one or more of the claws the weight is pulled up against the head, and the remainder of the claws close around the article.

Sub'ma-rine' Gun. Experiments on firing guns under water, with a view of sinking vessels by penetration of the hull below the water-line, extend over a long number of years. St. Cyr, 1797, suggested suspending a mortar between two boats. Fulton, 1814, succeeded in penetrating a bulk-head by a cannon fired under water. Philips, of Indiana, 1855, Woodbury, Boston, 1861–1864, arranged ports permitting guns to be fired from below the water-line. See "*Mech. Dict.*," p. 2439.

Sub'ma-rine' Lamp. One for explorations in the ocean's depths. The electric light has taken the place of the oil lights formerly used, requiring no tubes or pumping to supply air to the flame, and giving a sure and brilliant light. See Fig. 2379.

Suc'tion Fan. One for withdrawing the chaff and dirt from grain, or steam and hot air from meal as it comes from the burrs, by suction.

Fig. 2379.



Submarine Lamp.

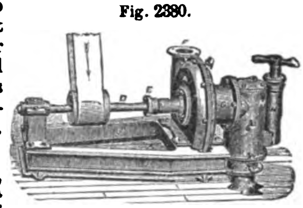
Suc'tion Pipe. (*Hyd. Eng.*) The air-tight pipe under a water-wheel, turbine for instance, which intervenes between it and the level of the tail race. Believed to be the invention of Z. and A. Parker, of Ohio, now common in Europe. It makes the wheel to be placed not exceeding 30′ above the tail race and yet render the whole fall available.

Suc'tion Pri'mer. A device to charge a steam pump ready for starting.

At the extreme right in Fig. 2380 is a small force-pump, worked by hand, used in charging the main pump. Before starting the large pump, the pet-cock, shown on the top of the shell, is opened, and the primer is worked until no more air is driven from the cock. When the pump is evidently full, the pet-cock is closed, and the main pump is then ready to be started.

The pump may be emptied by withdrawing the two screws shown near the top of the suction-pipe.

Fig. 2380.

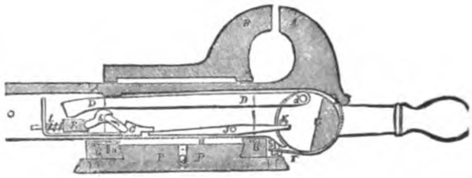


Suction Primer.

Sud'den Grip Vise. One that can be opened or closed the full play of the jaws without the tedium of turning up. See Fig. 2381.

To open the jaws, lift the handle to a horizontal position or as high as it will go, and draw towards you. To grasp the work, push in the sliding jaw until it presses against the work, then depress the handle, which causes the jaws to securely grasp the work and at the same time locks the swivel.

Fig. 2381.

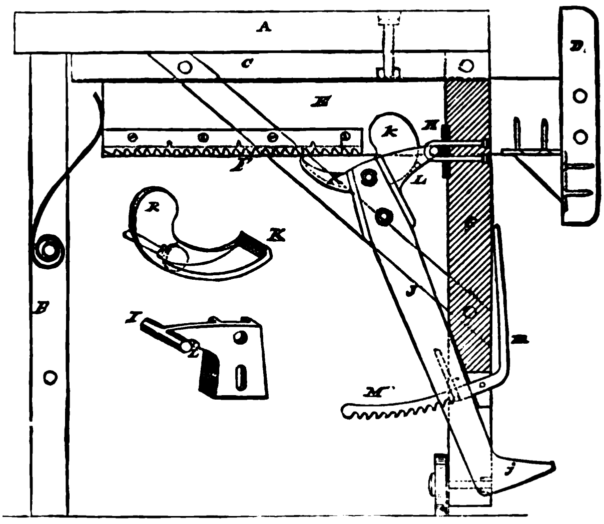


Sudden Grip Vise.

Fig. 2382 is a complementary vertical section of a bench vise devised by Messrs. G. H. and W. H. Knight, of Cincinnati.

The invention is an improvement on those bench vises whose movable jaw is capable of being quickly opened or closed by hand, and, after closure, of being clamped with great force so as to grip the work.

Fig. 2382



Improved Sudden Grip Vise.

A, is a bench top. *B*, a portion of supporting frame. *C*, a vise frame preferably capable of being swung horizontally about a vertical bolt *V*. *D* represents a movable jaw. *E* the customary wooden shaft of same. *F* is a metal rack fastened in a rebate on under side of jaw-shaft. *H*, a step or bearing in breast-board *G*, for fulcrum *I* of bent lever *J* having treadle projector *j*. *K*, a pawl, which when the lever is forced back by the operator, engages in rack *F*, and operates to press back the sliding jaw *D* with the great accumulating force of a toggle. *L*, a stud to hold pawl clear of rack when lever *J* is in normal or inactive position. *M*, a gravitating catch which, until released, holds lever *J* to its effective or gripping condition.

Sug'ar. For machines and processes, see pp. 2442–2452, "*Mech. Dict.*" J. W. Mallet's report, vol. iv., Group III., Centennial Exposition, summarizes the sugar making process as follows: —

CANE SUGAR.

Canes cut, and stripped of leaves.

Juice expressed from canes.

In presses with intermittent action (reciprocal motion).

In presses with continuous action (roller-mills).

Juice.

Bagasse.

Bagasse.

Juice.

Dried, used as fuel, and the ash as manure.

Returned to field as manure.

Macerated with water, or treated with steam, and again pressed.

Exhausted bagasse.

Weak saccharine liquid.

Might well be used as material for paper.

Canes cut into thin slices or chips by revolving knives.

Slices treated with water in a series of diffusion vessels.

Saccharine liquid from diffusion battery.

Exhausted chips (bagasse).

Dried in sun, used as fuel, and then ash as manure.

Spread upon land and plowed in as manure.

Cleared of fiber by settling in tanks.

Simply evaporated to dryness, producing "concrete," to be afterwards refined.

Liquid heated in clarifying-pans, with addition of lime (often of sulphurous acid, or calcium acid sulphite).

Skimmed.

Clear liquid, boiled down in open pans.

Scum.

Allowed to crystallize in coolers.

Drained in centrifugal machine.

Molasses. Reboiled for 2d products, used as food, or to make rum.

Soft centrifugal sugar.

Transferred to potting casks, and drained.

Molasses. Reboiled for 2d products, used as food, or to make rum.

Soft brown sugar (often called muscovado).

Transferred to forms or molds, and drained.

Clayed or washed.

Molasses and drainings. Reboiled for 2d products, used as food or to make rum.

Clayed sugar.

Skimmed, and run through coarse bag filters.

Scum.

Used to make rum (often thrown away).

Clear liquid, filtered through animal charcoal (either now or after partial evaporation).

Boiled down (sulphurous acid sometimes added).

In open pans.

Partly in open, partly in vacuum-pan.

In vacuum-pan.

Allowed to crystallize.

partially in pan, then in coolers.

Transferred to forms or molds, and drained.

Sugar. Washed with a little water or syrup.

Form sugar (nearly white).

Green syrup.

Drainings.

Drained in centrifugal machine.

Green syrup.

Used as food.

Drainings.

Returned to battery, to be reboiled.

Sugar. Washed with a little water or syrup.

Centrifugal sugar crystals (nearly white).

SUGAR REFINING. (CANE OR BEET.)

Raw sugar sifted free from lumps and trash.

Melted down with water (adding a little lime-water).

Clarified by addition of bullock's blood and fine animal charcoal, and heating (sulphurous acid now often used to save blood, and this step very often omitted altogether).

Drawn off, and filtered through bag filter.

Filtered through animal charcoal.

Boiled down in vacuum-pan.

(Filtration repeated, and boiling continued.)

Crystallized in coolers (ultramarine added if necessary for color).

Crystallized partially in pan.

Boiled down dry in pan (only applicable in case of purest syrups)

Transferred to molds, and drained.

Green syrup.

Reboiled, yielding at length molasses.

Used as food

Loaf-sugar.

Clayed, or washed.

Removed from molds, inverted, and dried.

Sugar loaves trimmed by cutting-knives.

Drained in centrifugal machine.

Centrifugal sugar crystals.

Washed.

Green syrup.

Used as food.

Reboiled, yielding at length molasses.

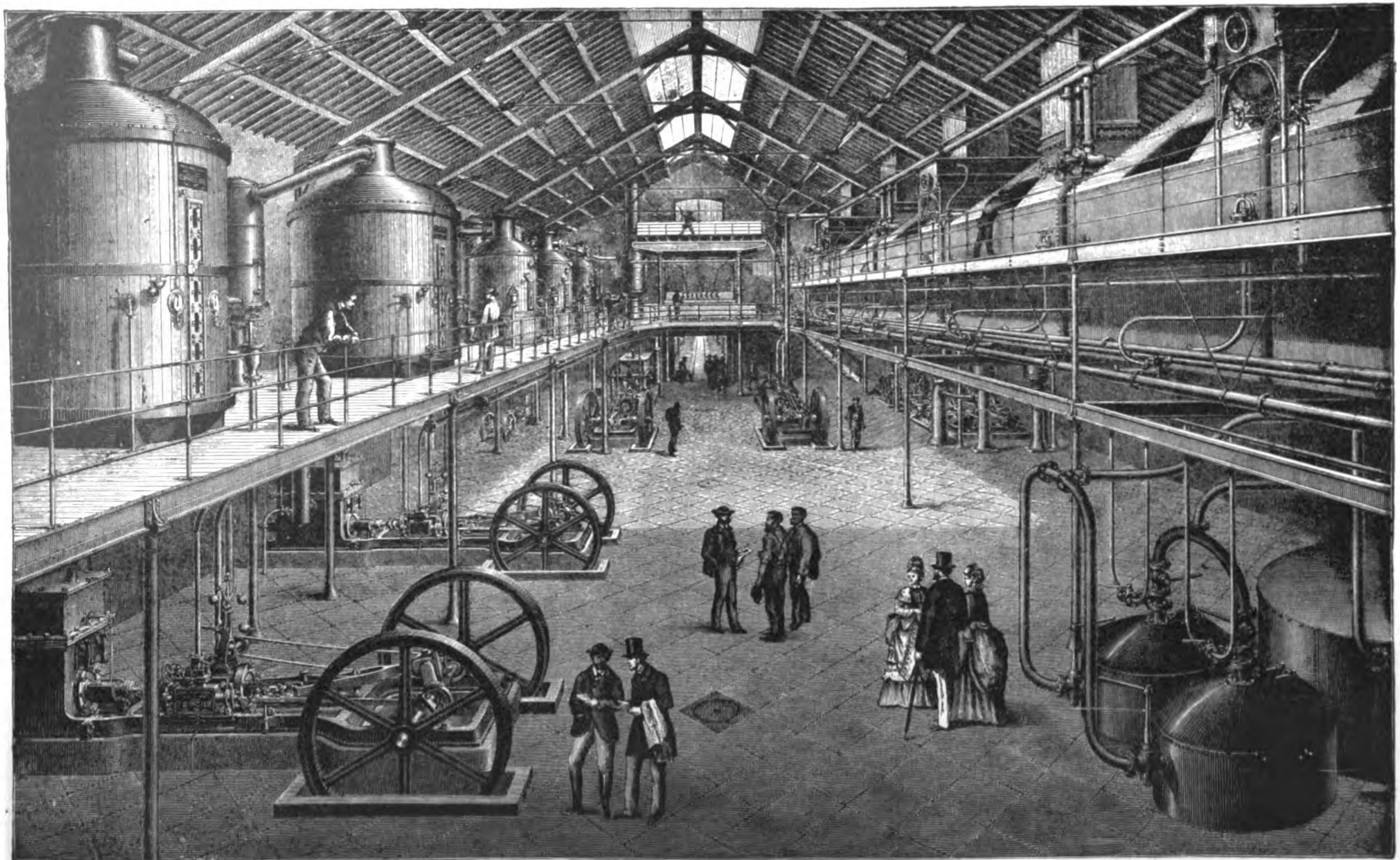


PLATE XLVII. SUGAR-HOUSE, COMPLETE INSTALLATION OF MACHINERY (COMPAGNIE DE FIVES LILLE, ABBEVILLE, FRANCE.) See page 878.

Su'gar House. Plate XLVI. represents a complete sugar house as manufactured by the *Compagnie de Fives Lille*, at Abbeville, France.

This company has built apparatus for operating on sugar-cane, for Java, Reunion, Brazil, the West Indies, and Egypt In the latter country one establishment, on account of the Khedive, is adapted to work 1,800 *tonnes* (Fr.) in 24 hours.

In an iron building 11,100 square meters in superficies are arranged —

4 cane mills.
2 vacuum pan apparatus, *à triple effet.*
4 vacuum pans.
60 centrifugal filters.
2 stills and apparatus.
3 rectifiers.

And various accessories for the crystallization of the sugar, fermentation of the molasses, revivification of the animal black, gasworks for lighting.

Repair shops.

A battery of steam boilers of collective force of 2,600 horse-power, to furnish the motive force, and the heat for the apparatus, is heated by the bagasse.

Railways of a total length of 22 kilometers, with the necessary locomotives and rolling stock, bring 250,000 kilos of cane each 24 hours to the mills. The mill has cylinders of 800 millimeters diameter, with an endless apron cane conductor 30 meters long, and a bagasse conductor of 12 meters.

The vacuum apparatus *à triple effet*, similar to the one shown in the far-end of the gallery to the left, in the plate, will concentrate to a density of 29° Beaumé, 2,200 hectoliters of juice per 24 hours. It is composed of three pans of different diameters, with tubular heating coils presenting a total heating surface of 300 square meters. A circumferential distribution of the vapor is secured by means of an envelope of perforated sheet metal interposed between the cluster of tubes and the exterior walls of the vacuum pan. By means of a central vertical tube of large diameter placed in the pan the juice is caused to circulate rapidly, and great activity given to the evaporation by bringing fresh quantities of juice in contact with the heating surface. Systems of pipes and cocks form communication between the juice and the vapor departments of each pan, so that the work proceeds in continuous order in the series of pans upon the juice which flows through them in succession.

An economy of 60 per cent is claimed to be realized in this apparatus over the single acting pan. An aspirator, feeding the first pan of the series, takes the place of the *monte-jus*: a vacuum chamber placed behind the third pan serves as a *réservoir d'aspiration* to a pump which elevates the sirups at 25° B. into the filters; a tubular condenser has a double action, in condensing a portion of the vapor in the third pan it heats the incoming juice to a temperature of 35° to 40° C.: the other portion of the vapor is condensed by an injection condenser; the apparatus is completed by a double-acting air pump, an aspirating sirup pump, and a pump for the water of condensation.

The plate shows a complete installation of apparatus for the treatment of beet-root juice for the manufacture of sugar, as manufactured by the *Compagnie des Fives Lille*. The establishments where the beets are rasped and the pulp pressed are situated at a distance, and the juice is conveyed by subterranean pipe-lines to the centrally situated sugar factory; the system of Linard, as described by Maumene in his "*Traité de la Fabrication du Sucre*," page 207, *et seq.*

The cartage of beet-roots is very heavy and injurious to the roads, and the area of beet culture which can be made tributary to a single sugar factory is not very large, and had been so frequently reached that it became necessary to devise other means of transportation. Hence the pipe-lines of Linard. Since 1867, the year of the establishment of the first pipe-line at Mont Cornet (*Aisne*), having a length of 8 kilometers, beet rasping works have been constructed in increasing numbers and at greater distances. There were in existence in 1875, 240 of these lines. One of them serves a factory 32 kilometers (20 miles) distant.

The juice should be limed at the works, as it cannot without injury be poured into the pipes in its natural condition. One per cent. lime is employed, which is immediately dissolved, and prevents all alteration of the juice in its travel. By the process adopted by Maumené the juice may even be kept several years without injury, and the liming to the extent of 1 per cent. is a modified application of the process. Derosne, about 1811, was the first to suggest quicklime in the purification of the juice, and the lime kiln or furnace, both for the milk of lime used in the preliminary treatment and for the production of gas for the subsequent carbonation of the lime in a subsequent part of the treatment, is a constant feature in the immense *sucreries* which dot the landscape in the northern part of France and the south of Belgium.

After liming, the juice is allowed to repose for 24 hours and then the limpid liquid is pumped into the pipe, which is buried below the line of frost, and reaches from the *râperie* to the *sucrerie*. The pipe may vary from 2.5'' to 5'' in diameter, according to the amount of juice to be delivered, generally along a roadside, where the *cantonnier* can observe any leak, which always shows itself at the surface of the ground. The highest parts of the conduit are provided with air traps to allow air to escape and avoid (*coups de belier*) concussion. See AIR TRAP.

The condition of the juice is verified from time to time, on arriving at the factory, to determine the proportions of lime added.

The advantages of the pipe-line system consist in spreading the work, as the rasping and pressing require a much larger number of men than the subsequent operations, and they are left in their villages near to their work and their fields; the saving in hauling and deterioration of the roads; leaving the pulp on the farms for cattle and sheep feed; the convenience of buying the juice by the saccharometer degree instead of by the weight of the beets of such varying qualities.

The conduit is used about 4 months, the length of the beet-working season.

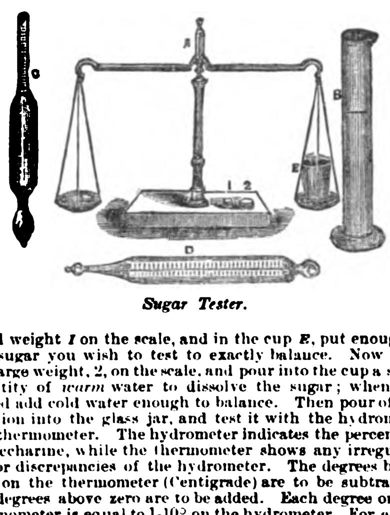
The apparatus shown in the plate will work up the juice of 80,000,000 kilos of beets in a season of three months. It employs carbonating boilers of 300 hectoliters capacity; the vacuum pan, *à triple effet*, will concentrate 10,000 hectoliters of juice in 24 hours

Su'gar Spile. A spile or spout driven into the sugar-tree to conduct the sugar-water or sap to the bucket. Commonly made of alder, although the iron spile to hang the bucket on is extensively used.

Su'gar Test'er. Apparatus for testing grape sugar.

In using, place the metallic cup, in Fig. 2383, on the scale, and balance it with weight not numbered. Then place the

Fig. 2383



Sugar Tester.

small weight *1* on the scale, and in the cup *E*, put enough of the sugar you wish to test to exactly balance. Now place the large weight, 2, on the scale, and pour into the cup a small quantity of *warm* water to dissolve the sugar; when dissolved add cold water enough to balance. Then pour off the solution into the glass jar, and test it with the hydrometer and thermometer. The hydrometer indicates the percentage of saccharine, while the thermometer shows any irregularities or discrepancies of the hydrometer. The degrees below zero on the thermometer (Centigrade) are to be subtracted, the degrees above zero are to be added. Each degree on the thermometer is equal to 1-10° on the hydrometer. For example, the hydrometer indicates 85°, the thermometer 8° above zero. This 8 is to be added to 85, making 85 and 8-10 per cent. If the thermometer should indicate 8 below, it would be necessary to deduct .8 from 85, which would make it 84.2°.

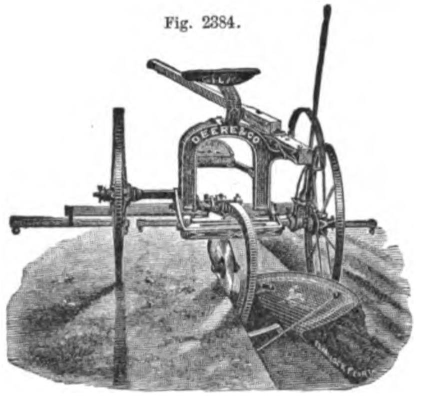
Sul'ky Plow. The Deere & Co.'s Gilpin Sulky Plow, Fig. 2384, is an iron and steel plow with the exception of the tongue and eveners. It is usually drawn by three horses abreast, one horse and one wheel in the furrow.

The team is hitched directly to the end of the plow beam in the natural way, and the plow is operated by a single lever, that locks it in the ground at various depths, so that it cannot jump out on encountering clods and trash.

The sulky plow of the Sacket Plow and Pulverizer Co., of New York, has two plows so arranged and run that one plow skims off the surface sods, stubble, and weeds, and throws them into the bottom of the previous furrow, where they are pressed down and cut by an iron wheel with curved knives, or sharp-edged cross-bars, around its rim.

Following this skim plow is a main plow, which takes up

Fig. 2384.



The Deere Sulky Plow.

the cleared soil to any depth desired, and throws it inside of the iron pulverizing wheel. As this wheel rolls along, the soil is lifted and thrown against its cutting bars and points, and these pare and break it finely, dropping it out loosely behind, putting not an ounce of pressure upon it, but leaving it light and porous and aërated (filled with air).

Sul'phate of Lead Bat'te-ry. (*Electricity.*) The invention of M. Becquerel; consisting of zinc in sulphate of zinc, and lead in sulphate of lead. As improved by Marie-Davy, it consists of a vertical series of tinned iron pans; each pan has a zinc disk fastened beneath it, and is coated inside with pulverized sulphate of lead, moistened with water. The battery is put in operation by pouring water into the pans.

Prescott's "*Electricity*" . . . . * 79.
Niaudet, American translation . . . . 150.
Moseley's modification, "*English Mechanic*" . . * xxiv. 463.

Sul'phate of Mer'cu-ry Bat'te-ry. (*Electricity.*) A battery in which sulphate of mercury is the exciting solution. See MERCURY BATTERY; MARIE-DAVY BATTERY.

Beaufil's sulphate of mercury battery has a solid depolarizer. — "*Teleg. Jour.*," * vi. 397.

Sul'phur and Am-mo'ni-a Test. In order to detect ammonia or sulphuretted hydrogen in illuminating gas it is only necessary to allow a jet of the gas to blow upon a piece of turmeric or reddened litmus paper to ascertain the presence of the former, or upon acetate of lead paper for the latter.

Dr. Letheby's sulphur testing apparatus is a meter with dial arranged to show any consumption from .01 to 1,000 cubic feet, a double dry governor fitted with a regulating cock to maintain an unvarying rate of consumption under the usual street pressure, connected to tube passing through the stand, and leading to a Leslie burner, under which stands a glass beaker containing the requisite quantity of standard liquid ammonia. On this beaker is placed a glass funnel passing up through the burner, and covering it is a trumpet-shaped glass tube gradually decreasing to about ¾" aperture at the top, where it passes through the neck of the large glass cylinder, which has a bent glass tube at the other end rising at an angle of about 45°, the rate of consumption being one cubic foot per hour. An apparatus for ammonia can be supplied with the above, consisting of an ammonia tube, with bulb, etc., at a small additional cost, as the meter and governor can be used — proper connections being made — to pass the gas through the meter "after" the ammonia apparatus.

Sul'phur Con'crete. Mix together 19 lbs. sulphur and 42 lbs. pulverized stoneware and glass. This mixture is exposed to gentle heat until the sulphur melts, when the mass is stirred until it has become thoroughly homogeneous and is then run into molds and permitted to cool. When required for use, it is to be heated to 248° Fah., at which temperature it melts, and may be employed in the usual manner.

At 230° Fah. it becomes as hard as stone, and, it is said, preserves its solidity in boiling water, unites stone, is waterproof, resists acids.

Sul'phu-rine. A new metallic compound. Sulphides of metals, combined with molten sulphur, form a liquid, which on cooling becomes a homogeneous mass of dark gray color and possessing great tenacity, while it is not affected by the atmosphere, and resists acids and alkalies well. It has a comparatively low melting point, 320° Fah., and expands in cooling so that it fills molds very accurately, so well indeed that the marks of a finger on a plate of glass are reproduced. Experiments are being made to test its adaptability for printing and stereotyping purposes, and casts from gelatine molds have been made without destroying them.

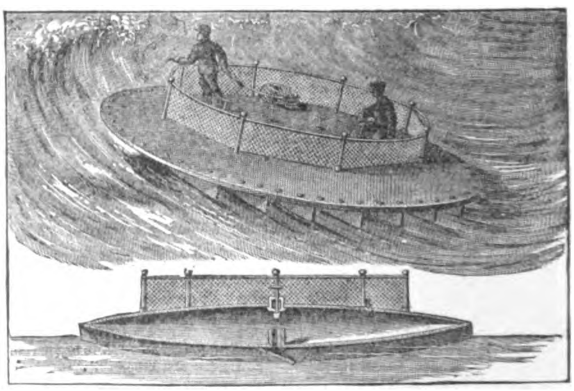
Sump. (*Mining.*) That part of the shaft below the platform used for receiving water.

Sun Burn'er. A burner for a mineral-oil lamp, provided with a chimney that is wide at its base, and held in place by a thin circular metallic plate, cut with indentations around its outer edge, the metallic points acting as springs to hold the chimney in place.

Surf Boat. Fig. 2385 represents a novel surf boat, the invention of Mr. Richard Tucker of Wiscasset. It is a circular boat, with convex upper and lower surfaces, and its entire interior forms a reservoir for holding compressed air to be used in the propulsion of the boat.

The propelling device consists in air nozzles projecting towards the stern, one being placed in each space between the keels, of which there are several. The air nozzles have valves that are operated from the deck. The boat is steered by closing the air valves on one side or the other, as may be required.

Fig. 2385.



Surf Boat.

Sur'face Con-den'ser. One form of surface condenser is recommended by Appleby, where the supply of water is limited or costly, a good vacuum being stated to be more readily attainable by it than by any other method of condensation. As it is a circulating system in which the boiler is supplied from the hot well, the loss of water from steam passing into the atmosphere is but small, and the saving in the avoidance of scale is a marked advantage in some localities. It is used for steam engines, vacuum pans, and elsewhere, when a vacuum is desirable.

The condenser is a vertical series of horizontal copper steam pipes, with cushion boxes at each end connecting with vertical hollow columns. Above is a copper trough with serrated edges, from which water trickles down over the pipes and falls eventually into the hot well from which the boiler is supplied.

The idea has been developed for some time in various branches

The ordinary tubular condenser, in which the coil is submerged in a cistern of cold water, differs in substantial respects (Fig. 1415, "*Mech. Dict.*"), and the condenser for alcoholic vapors of sugar has also the cistern in which the coil is submerged.

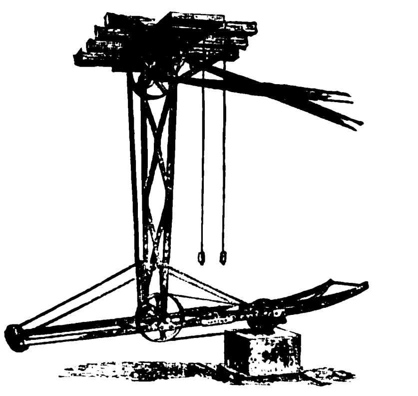
The Derosne condenser, however (Fig. 1421, "*Mech. Dict.*"), one of the train in the sugar apparatus, has the same appearance as the Appleby steam condenser, but their purpose and application are essentially different. In the Derosne the pipes are heated by steam, and the sugar-cane juice from the defecator trickles over them, being heated and partially evaporated on its way to the vacuum pan.

In Appleby's the steam in the pipes is condensed to form a partial vacuum in front of the piston, and the water heated thereby supplies the boiler.

For other systems of pipes in somewhat similar relation, see BEER COOLER, Fig. 631, "*Mech. Dict.*"; LIQUID COOLER, Figs. 2966–2968, "*Mech. Dict.*"; WORT COOLER, Figs. 7360–7372, 7364, "*Mech. Dict.*," etc.

Sur'face Grind'ing Ma-chine'. Thomson's surface grinder, Fig. 2386, has, depending from overhead, driving arrangements, constructed to grind and buff the surfaces of work too large or heavy to be taken to the ordinary grinding machines.

Fig. 2386.



Thomson, Sterne, & Co.'s (Glasgow, Scotland), Surface Grinding Machine.

The illustration, Fig. 2385, shows the machine in position for finishing the exterior of a fire-proof safe, which is run beneath it upon a truck.

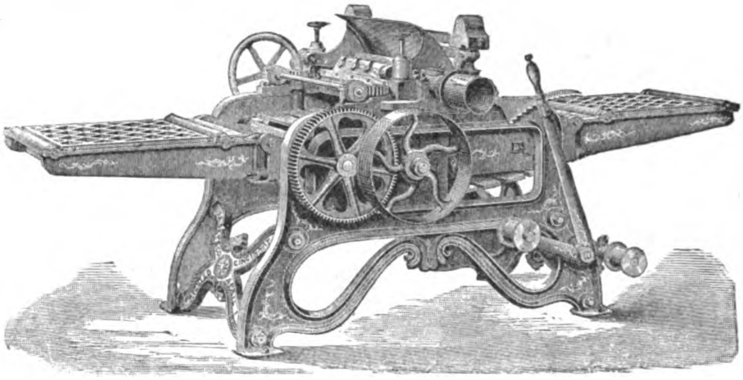
The machine carries a consolidated emery wheel 14″ in diameter by 2″ broad. When required for buffing, the emery wheel is removed and a buff-wheel with spindle and pulley complete put in its place.

The machine carries its own countershaft with fast and loose pulleys. The frame and grinding wheel are balanced by the weight at the opposite end of the frame, so that the operator has easy and complete control in moving the grinder or buffer backward and forward over the work, while the latter is moved sideways on the carriage, which traverses on rails.

Sur'face Mold'ing Ma-chine'. Boult's carver and moulder has a quick, reverse motion and double-edge cutters, cutting designs, either plain or molded, on the surface of the lumber in the solid wood. It molds any production of the scroll saw. It routs for stairs and pew ends, grooves and grounds for inlaying, and veins and traces for carving.

Sur'face Pla'ner. The Farrar surface planer, Fig. 2387, is a machine of a large size, intended for planing-mills, boat builders, etc. It has a stationary cylinder, convenient to have the countershaft either on the floor or overhead. It carries three knives with steel-lip chip breakers and steel journals, with pulley for two driving belts running in self-oiling boxes, with a wrought-iron bonnet, that can be swung clear of the cutters. The rollers have folding weighted levers that are self-adjusting to the thickness of lumber.

Fig. 2387.



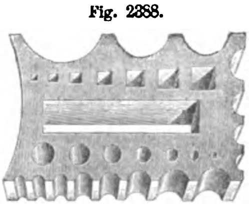
Surface Planer.

Sus-pen'sion Ap'pa-ra'tus. (*Surgical.*) To support a wounded, luxated, or fractured limb. Generally a splint with means of suspension from a frame. Illustrations of the following are in *Tiemann's "Armamentarium Chirurgicum,"* Part IV.: —

Smith's anterior splint for the leg, Figs. 120, 154.
Hogden's suspending apparatus, Fig. 130.
Salt's cradle or swing, Fig. 156.
Clark's suspended splint, Fig. 157.
Buck's suspension apparatus, Fig. 174.
Sayre's suspension apparatus, Figs. 193, 194.

Swage Block. A large perforated and indented iron block for swaging iron into its desired shape. See Fig. 2388.

Fig. 2388.



Swage Block.

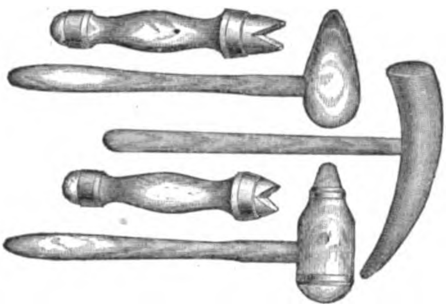
Swa'ging Mal'let. A tool for swaging up artificial plates. Fig. 2388 represents formers used in silversmith's work.

Swan'-neck Nee'dle For'ceps. (*Surgical.*) An instrument for use through curved passages difficult to reach.

Swash Plate. A plate set obliquely on its axis and acting as a cam in a line parallel to the shaft.

Sweat Rol'ling Ma-chine'. A machine for turning the edge of the sweat-leather lining of hats to prevent its marking or hurting the forehead.

Fig. 2389.



Swaging Mallets.

The machine has two rollers geared together and supported in a frame, the upper one held down by a rubber spring to allow it to yield to the varying thickness of the leather.

Sweat Sew'ing Ma-chine'. A machine for sewing the sweat lining in hats. See Fig. 2390.

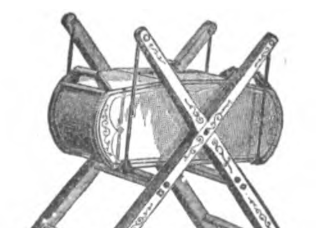
Fig. 2390.

Sweat Sewing Machine.

Sweep. (*Agric.*) A kind of plow used in cultivating crops planted in rows, corn or cotton for instance. The term is especially applied in cotton cultivation, the share or shares being wide and cultivating a wide space to a moderate depth. By the inclination of the share to the line of draft the soil is cast sideways and may throw it either away from the plants while small or towards the row when they are more advanced. See COTTON SWEEP.

Sweep Rake. The rake that clears the table of a self-rake reaper.

Fig. 2391.



Swing Churn.

Swing Churn. A box churn suspended on the pivoted bed irons of the folding frame on which it swings. See Fig. 2391.

Swing'ing Valve. A swinging straightaway check valve. The clapper swings on a pin loosely, and the disk being made separately can be ground in the same as other valves.

Swing Mo'tion Gear. (*Railway.*) The arrangement of parts, — consisting of bolster, spring-plank, swing-hangers, pivots, and pins, — supporting the springs and truck-bolsters by which a car is enabled to swing laterally on the truck.

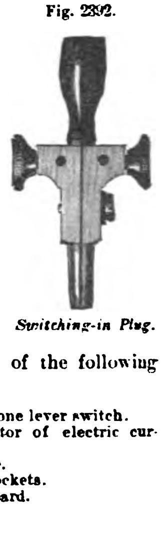
Swing Saw. The swing cut-off saw is used for cutting up stuff for packing boxes, etc. It has counter shaft, hangers, and pulleys.

Switch. For descriptions of switches, crossings, turn-outs, and frogs on Pennsylvania Railroad, see report of *F. Slataper*. "*Centennial Exhibition Reports*," vol. vi., Group XVIII., p. 68.

Switch'ing Eye. (*Railway.*) A cast-iron socket on the corner of a freight car to which a chain or push bar may be applied by an engine on an adjoining track.

Switch-ing-in' Plug. (*Electricity.*) A plug having its two brass sides insulated from each other by a strip of hard rubber and provided with a handle of the same material. The sides are adapted by binding screws to be connected respectively with the terminals of a loop or relay circuit so that when thrust into a plug-hole the two sides of which are similarly insulated and connected with the line terminals, the said loop and line will be in one circuit.

Fig. 2392.



Switching-in Plug.

Switch Ta'ble. The Jones (Fig. 2393) is a telephone exchange switch board or table through which all the subscribers can at any time communicate with each other. It is composed of the following component parts : —

Plug plates.	Telephone lever switch.
Plug connectors with flexible cords.	Generator of electric current.
Drop or electrical indicator.	Treadle.
Spring jack.	Plug sockets.
Engine or generator key.	Key board.
Telephone key.	
See TELEPHONE.	

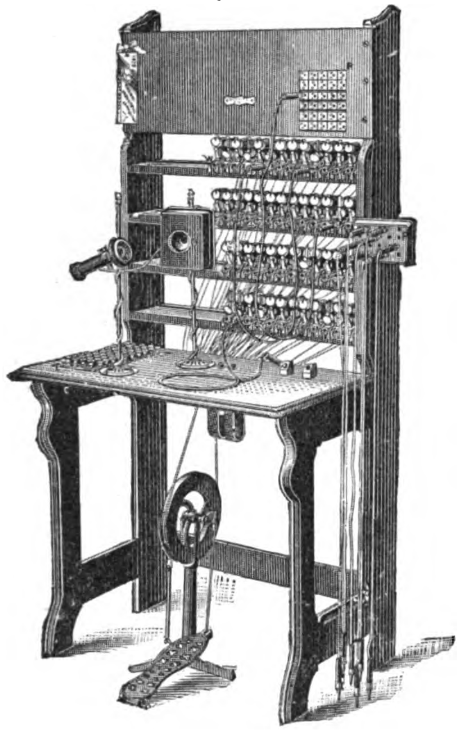
From the instrument of every subscriber in the city a wire is run to the exchange. When a subscriber wants to talk to any other subscriber, he calls up the Exchange by ringing his bell. The Exchange answers, finds out what he wants and who he wants to talk to, calls up that person, and connects or "switches" their wires together; then signals to subscriber No. 1 that he can go ahead and converse with No. 2, and leaves them to talk together as long as they please. When they are through, they signal to the Exchange, and he disconnects them. When it is stated that the average number of "switches" made in the twenty-four hours, in Cincinnati, is 6,000, it will be seen to what an extent the business has grown.

The "switch" tables, of which there are twelve in the Cincinnati Exchange, are in form of a common writing table, with a square frame standing up in front of the operator and fastened to the table. To this frame run the wires brought into the office through the cupola, each one of which is ticketed with the name of the subscriber to whose instrument it is attached.

In each frame are from forty to fifty magnets to which these wires are connected. These act as holders for the wires, and are numbered. Thus one end of each subscriber's wire is attached to the instrument in his office or home, and the other is fastened to this frame or the switch-board. The operator at every board knows the number of each subscriber. On the front of the frame facing the operator are a number of clamps, one to each magnet. There is also attached to each magnet a movable piece of metal, which works automatically. This is the marker, which tells the operator which line calls him, as it drops when the bell at the other end of the line is rung.

Underneath the table is a machine worked by a treadle, which generates the electric current by friction, and is con-

Fig. 2393.

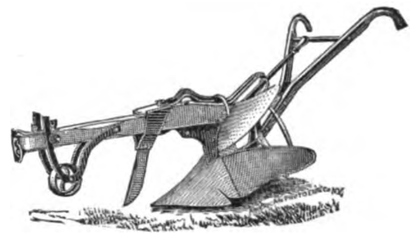


Switch Table.

nected by a wire with a clamp on the table On the table is a key-board, like the key-board of a type-writer. It contains two large keys and a number of small ones corresponding to the number of wires on the frame. One of the large keys is connected with the generator and the other with the telephone, which is fixed on an upright fastened to the table within reach of the operator's ear, leaving him at liberty to use both hands. Hanging on a hook within reach of each table are a number of loops or sections of flexible covered wire with a brass point at each end. This, with a microphone, also on the table, is the apparatus. Now as to how it is used. We will, to illustrate, take the first table, on which the connecting wires are numbered from 1 to 40. Suppose Mr. A. has the telephone No. 1 and Mr. B the telephone No. 25, and that A wants to talk with B. He goes to his instrument and rings the bell. At that instant the little marker attached to wire No. 1 in the Exchange rattles and falls, attracting the operator's attention. He has one of his loops attached by one point to the clamp on his table connected with the generator and as soon as he gets the call takes the other point and inserts it in the clamp attached to wire No. 1, thus connecting the latter with the generator. At the same time he works the treadle and generates a current of electricity, which, by pressing on one of the large keys, he directs into wire No. 1. At the instant he presses this key the current passes over the wire and rings A's bell. The operator slips his finger to the other large key, and applying his ear to the telephone, and speaking at the microphone, says, "Hello!" A, when he hears his bell ring, takes his telephone in hand, and, applying it to his ear, hears the "hello," and calls to the operator, "Put me on Mr. B," or "Connect me with Mr. B." The operator answers, "All right," and proceeds to call up B by directing a current of electricity from the generator through a loop, the point of which he has inserted in the clamp connecting with B's wire. This current rings B's bell. He goes to his instrument, rings back an answer, his marker rattles and drops, and the operator, connecting his telephone with B's, as he did with A's, calls to him that A wants to talk with him. He then connects the two wires, 1 and 25, together by means of a loop, the opposite points of which are in the two clamps connected with their wires. This forms a continuous wire between the telephones of A and B, and the operator, having called to A — who has held his telephone to his ear — that B is ready, they go on with their conversation. By pressing either key No. 1 or key No. 2 on the key-board and keeping his ear at the telephone the operator can hear their conversation. He listens for a moment to satisfy himself that their communication is uninterrupted and then takes his finger off the key. When A and B are through they inform the operator by tap of the bell and he takes away the loop connecting their wires, disconnecting them. Though the operation takes some time in describing, it is very quickly done, not occupying more than a minute if the owners of each telephone are prompt in answering his call. The only delay is with them. The operator is always at his post, and can switch two parties together in a few seconds if they answer as soon as called.

Swiv'el Plow. A reversible mold-board of full size is so arranged on its swivel attachment that in connection with the point it makes also a landside plow. See Fig. 2394.

Fig. 2394.



Swivel Plow.

Swiv'el Ta'ble Clamp. One intended for the attachment of jeweler or amateur vises, without injury to the article to which they are attached. With it the vise can be clamped firmly to any kind of table, mantel, or projection.

Sword Mat. (*Nautical.*) A mat worked with a blade like a sword to drive home the roving threads. It is made with shoulders to protect the laniards of lower rigging, boats, gripes, etc.

Sym-pal'mo-graph. An instrument for making Lissajou's sound curves. — "*English Mechanic,*" * xxv. 18.

Syr'inge. See INJECTOR.

Syr'inge Gun. A tube with piston, ejecting water for disabling humming birds without destroying them.

T.

Ta'ble Brush. (*Leather.*) A soft brush used by curriers to sweep shavings from the buffing table.

Taf'fe-tas Ar'mure. (*Weaving.*) One of the four principal characters of weaving. See ARMURE.

This is a simple form of weaving, having but two harnesses, simply interlacing the threads of the warp and weft.

This is the *weave* of broad-cloth, cotton shirtings and sheetings and *moussseline de laines*.

The variations in the goods are cited under FABRIC.

Take Up. (*Weaving.*) 1. The web roller on which the cloth is wound.

2. The device on a sewing machine for taking up the slack of the thread on the upward stroke of the needle.

Take' Up Mo'tion. (*Weaving.*) A device for automatically winding the tissue on to the cloth beam.

See English form, "*Scientific Amer. Supplement,*" * 4091.

Talk'ing Ma-chine'. During more than a century inventors have turned their ingenuity to constructing machines capable of imitating the human voice, though what practical purpose they might serve, if ever so perfect, it is difficult to discover. One of the latest of these efforts is a machine made by M. Faber.

It consists essentially of three parts, — the wind-producing system, the sound making apparatus, and the articulating arrangement. As for the first, nothing particular need be said; it is simply a species of bellows. The second, the sound-producer, the larynx, is an ivory tube so constructed that within certain limits the length may be varied so as to cause a difference in tone produced. Probably it would have been more successful had some more elastic material been adopted. The articulating apparatus includes a part for sounding the vowels, and another for pronouncing the consonants. The former are due to the passage of air through openings of different shapes, made in diaphragms placed successively in the current of air by the action of levers moved by the fingers: in addition, a special cavity, destined to produce nasal sounds, can be put in communication with the former at pleasure by means of a particular lever. The consonants are produced by pieces, the action of which is analogous to that of the lips, the teeth, and the tongue, and the rolling of the *r* is caused by a wheel. All these imitation organs are put in motion by 14 keys very ingeniously disposed in a way to produce the necessary intensity of action and variation in sequence of the parts destined to pronounce a syllable. The number of 14 keys is sufficient, for by certain variations in the touch the intended sound can be regulated as strong or weak at pleasure. As might be expected, the language of the machine is very monotonous, and is by no means perfect, as some sounds produce a much better effect than others; however, in general, the words pronounced are easily understood. They cannot be compared to the changes in the human voice, and whatever improvements the machine may receive, the question still remains, Of what use is it?

Talking Machine, *Faber* . * "*Scientific American*," xlii. 266.

Ta'mise. (*Fabric.*) An all-wool French goods.

Ta'mise Rep. (*Fabric.*) A corded all-wool French goods.

Tam'pon. (*Surgical.*) *a.* A plug to arrest nasal hemorrhage. See EPISTAXIS.

b. An inflatable plug inserted in the trachea to prevent blood from entering the lungs while the surgeon is operating on the throat above the instrument, the lungs being supplied with air through a silver tube.

Trendelenberg's, Fig. 391, Part II., *Tiemann's "Armamentarium Chirurgicum."*

Tam'pon Screw. (*Surgical.*) An instrument with a screw-end to engage and insert or withdraw a tampon or compress to prevent hemorrhage.

Sims', Fig. 468, Part III., *Tiemann's "Armamentarium."*

Tan'dem En'gine. A steam engine in which the two cylinders are placed in line, one in front of the other, tandem fashion.

See COMPOUND TANDEM ENGINE.

Escher Wyss et Cie. . . . * "*Engineer*," xlvi. 23.
Kingdon . . . . . . * "*Scientific Amer. Sup.*," 3848.

Tan'gent Gal'va-nom'e-ter.

The Western Union standard tangent galvanometer, Fig. 2395, is mounted on a circular hard rubber base provided with leveling screws. It consists of a magnetized needle suspended at the center of a rubber ring, containing the coils. The coils are five in number, of the resistances, 0, 1, 9, 40, and 150 ohms (= 200). The first is a stout copper band of inappreciable resistance; the others are of different sized copper wires, carefully insulated.

The five terminals have plug-holes marked respectively 0, 1, 10, 50, and 200. The plugs inserted at the end of the terminal marked 200, puts in circuit all the coils: at the terminal marked 50, all except the 150 ohm coil: and so on till at the zero terminal only the copper band is in circuit.

An aluminum printer is fixed to the needle at right angles, extending across a 5" dial. On one side the dial is divided into degrees, on the other it is graduated, the figures of the scale corresponding to the tangent of the angles of deflection. The needle is suspended by a jewel and points.

In the base of the instrument are three resistance coils, of German silver wire, of 10, 500, and 5,000 ohms, having terminals and plugs.

Fig. 2395.

Tangent Galvanometer.

A tangent galvanometer has been recently introduced by Louis Schwindler. The galvanometer has two coils, — one of thick wire and few convolutions, offering no more than 1 ohm resistance; another of thin copper wire, having a greater number of convolutions, and resistance of 100 ohms. Two sets of resistance coils for use with the above coils, respectively, one of 20 and 200 ohms, the other of 1,000 and 2,000 ohms. A simple reverser allows the readings of the galvanometer to be taken from either side of zero. In order that the strength of the currents passing through the coils may be as nearly as possible proportional to the tangents of the deflections, the magnet has a length of less than one fifth of the diameter of the deflecting coil. The small magnetic needle carries a thin aluminum pointer fixed in the right angle of the needle. In order that the needle after each deflection may come sooner to rest, the aluminum point carries small wind fans of the same metal. When closing the box the needle is taken off its pivot.

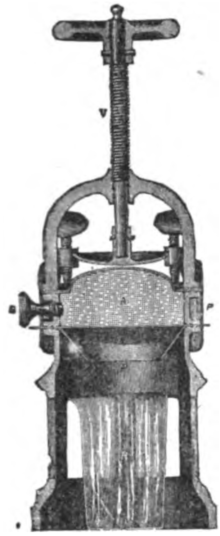
Tank Lo-co-mo'tive. A form of tank locomotive invented by M. N. Forney, of the "*Railroad Gazette.*" It is adapted for narrow gage. The tender end of the frame is carried on a 4-wheel truck; differing in this respect from the plantation locomotive, which has a 2-wheel truck in its larger forms, and is destitute of a truck in the smaller engines, which are supported on 4 wheels only.

The Forney locomotive resembles the usual passenger and freight narrow-gage locomotives modified by connecting the engine and tender in one rigid frame.

Tan'nin-test'ing Ma-chine'. Fig. 2396 represents the "Muntz" apparatus for testing the efficiency of any tanning solution or material. The principle involved consists in forcing a solution containing tannin through a piece of hide. The density of the solution is taken before and after the operation, and a comparison of the densities enables the value of the solution to be readily determined.

The figure shows the internal arrangement. Having taken a small piece of raw hide, and placed it inside, on the base of the apparatus, the india-rubber cover is closed down over it, and secured by the screws in the claws. The liquid to be tested is then poured in on the top of the piece of hide through the small opening, which is fitted with a screw stopper, *B*. This done, pressure is brought to bear by turning the perpendicular main screw *F* at the bottom of which is attached a brass disk, which gradually compresses the india-rubber cover, and forces the liquid to filter through the hide. The screw must be tightened up occasionally so as to maintain the pressure. A glass is placed beneath the machine to receive the liquid, which percolates drop by drop. When sufficient has been obtained to fill a small test glass, the density is taken. To do this the glass should be filled with the first liquid kept in reserve, and the tannometer inserted. In a few minutes it will become steady, and the degree is then noted. The same process must be repeated with the filtered liquid. The difference of degrees between the two densities shows the percentage of tannin in the analyzed substance. This difference is multiplied by 40 if 2½ per cent of stuff is put into water; by 20, if 5 per cent; by 10, if 10 per cent; and by 5, if 20 per cent. For instance, if the tannometer marks for the first liquid 2.8, and for the second 1.3, the difference, 1.5, or 1½°, must be multiplied by 40 if we have taken 2½ per cent., which gives 60 per cent. of tannin; by 20 if we have taken 5 per cent., which gives 30 per cent. of tannin; by 10 if we have taken 10 per cent., which gives 15 per cent. of tannin.

Fig. 2396.



Tannin Tester.

The tannometer referred to is practically a hydrometer, which is supplied with the instrument. With it were detected the valuable properties of *balsamo carpon*, which, when gathered ripe, and the gum taken off free from the fiber of the pod, contains 80 per cent. of tannic acid. It is this gum which weights the leather. Gall nuts are liked by the tanners, but it is now found that the property of gallic acid is to open the pores and allow the other weighting materials to enter the hide. With this small machine, tanners and chemists can test the bark from different trees, some of which are known to yield tannic acid, and are employed for the manufacture of ink and dye, but have never been used for tanning leather. The hide takes from the solution all the properties it requires when the substance is filtered.

Tannin extract factory . "*Scientific American Sup.*," 1608.
Testing appa., *Muntz*. * "*Scientific Amer.*," xxxiv. 355.
Muntz, Br. . . . . * "*Engineer*," xli. 171.
Tannic acid extractor.
Thomson . . . . . * "*Scientific American Sup.*," 144.

Tar'get. 1. A signal used at railroad crossings and switches. See SIGNALS.

2. A shield used for proof of heavy guns.

Shoeburyness, Britain, * Report of Cols. Barnard and Wright, U. S. Engineers, Fabrication of iron for defensive purposes, Supplement, No. 21.
Targets of 100-ton gun * "*Scientific Amer.*," xxxvi. 150.
Tangent galvanometer.
Obach, Br. . . . . * "*Engineering*," xxviii. 351.

Tas'e-om'e-ter. Invented by Steiner, of Vienna, for measuring the strains of structures.

It depends upon the tone given out by a wire or strip when stretched. The wire being attached the variation in length of the bar causes a change in the tone. "*Telegraphic Journal*," vi. 126.

The strain measurer of M. Clevenad, of Paris, is figured in the "*Annales des Ponts et Chaussées*," and is designed to measure directly the strains to which the different parts of any structure are submitted. See STRAIN MEASURER.

See TESTING MACHINE.

Ta-sim'e-ter. A device for measuring very minute variations of temperature.

It is founded on the property, discovered by Edison, that lampblack, when pressed in the form of a button, affects the electric currents passing through the same, and offers a resistance, which diminishes with the pressure, and so sensitive is it that when this pressure varies to the amount of only one millionth part of an inch, the variation in the electric current passing through it will cause a variation in the deflection of the galvanometer needle, and this variation will be in proportion to the pressure. Thus, for instance, if the carbon button is pressed by a strip of vulcanite, and the warm hand is held at a distance of 4″ from it, the expansion by heat of this strip, and the consequent increased pressure, will cause an increase in the conductibility of the carbon, and the electric current which previously passed through and made the galvanometer deflect a certain number of degrees, will cause a greater deflection. The same will take place when a gas flame or a match is ignited in the room, even at a distance of 4′. If a strip of gelatine is used to press the carbon button, its expansion by moisture will be indicated in the same way, when a piece of moistened paper or a wet finger is held at a distance of 4″ or 5″; the heat of a lighted cigar, drying the gelatine, will cause it to contract again, diminished pressure is the result, the current passing through the carbon undergoes greater resistance, and the deflection of the needle will be in the opposite direction.

This instrument is an outgrowth of Edison's experiments with that form of the telephone with which he tried to vary the intensity of electric waves by means of the voice. It promises to be a most important addition to the delicate instruments for measuring very minute variations of temperature.

Thus far the most delicate instrument known to science for determining, for instance, the heat in the different parts of the solar spectrum, has been the thermopile. This instrument is based on Seebech's discovery that when metals of different kinds are jointed together, and the joint is heated, an electric current is produced, passing from one metal to the other. By multiplying the joints and connections of the metals, after the principle of a galvanic battery arranged for very great intensity, very small variations of temperature can be observed by the electric currents generated, and their action upon the magnetic needle of the galvanometer. The great superiority of the tasimeter over the thermopile may be illustrated in a simple manner. If a few inches from the former a hot iron is placed, it will deflect the needle of an ordinary galvanometer say one degree; holding the warm finger 4″ from the tasimeter with the same galvanometer, will swing the needle round some six degrees.

The applications, actual and projected, of the instrument are numerous: —

To warn vessels of the approach of icebergs by exposure to the air or to the water cooled by their vicinity.

To indicate otherwise inappreciable weights, as such laid on the apparatus will affect it.

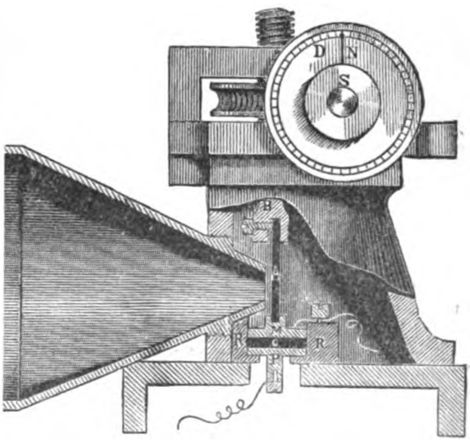
To record pressures of air in motion; affording a delicate and useful addition to the anemometer.

"*Manufacturer & Builder*," x. 149; *Prescott's* "*Speaking Telephone*," etc., * p.

Fig. 2396 shows in perspective the latest form of the Edison tasimeter. See also MICROTASIMETER.

Tasimeter . . . . "*Scientific American*," xxxix. 143.

Fig. 2397.



Tasimeter.

Tast'ing Hole. A hole in a cementing furnace at which trial bars are left to protrude in order to permit examination of the condition of the process.

The same term is applied to holes in other furnaces left for examination of contents.

Taw'ing. Tanning a lamb-skin with the wool on it.

Make a strong soapsuds, using hot water; when it is cold wash the skin in it, carefully squeezing it between the hands to get the dirt out of the wool; then wash the soap out with clean, cold water; next dissolve alum and salt, of each half a pound, in a little hot water, which put into a tub of cold water sufficient to cover the skin, and let it soak in it over night, or 12 hours; now hang the skin over a pole to drain; when well drained spread or stretch carefully on a board to dry. It need not be tacked down if drawn out several times with the hand while drying. When yet a little damp, sprinkle pulverized saltpeter and alum (an ounce each mixed together) on the flesh side, rubbing it in well. It is now to hang in the shade two or three days, the flesh side in, until perfectly dry. When entirely dry, scrape the flesh side with a blunt knife to remove any scraps of flesh. Trim off all projecting points, and rub the flesh side with pumice or rotten stone, and with the hands. Prepared in this way it is white and beautiful, suitable for a door-mat, and also nice for the feet in a sleigh or wagon in cold weather.

Teem'ing. Pouring; as for instance, the weighing of steel ingots during teeming, that is, while running into the mold.

See apparatus of *Ferdinand Moro*, Kladno Iron Works, Austin, * "*Engineering*," xxx. 270.

Tel-au'to-graph. An electrical device for transmitting autographs, or copying designs.

An ingenious application of the same general principles as Morse's telegraphic alphabet. A message is written by the sender in an ink which does not conduct the electric current, and the paper is placed in such a position that a style, or metallic pencil, drawn by machinery across the sheet, covers it with an infinite number of lines, drawn so closely as at first sight to produce the effect of almost continuous coloring, the letters remaining uncolored. Whatever is done at one end of a telegraphic wire can be repeated with ease at the other, and a *facsimile* of the original is inscribed simultaneously, and by the same means, at the receiving station Thus, an autographic message with recognizable signature — or a telegraphic check — may be instantaneously transmitted by any telegraph fitted with the proper apparatus. This system is actually employed on at least one Italian line, and it seems somewhat strange that, considering its extreme simplicity and the great convenience of a recognizable autograph, the use of such a process has not become more general. The possibility of deception and the impossibility of automatic unquestionable record, such as the copying-press gives to letters, greatly restrict the use of the ordinary telegraph by men of business; and both inconveniences are removed, it is said, by the employment of telautography.

Te-lec'tro-scope. An apparatus for reproducing by telegraph the images obtained in the camera obscura. This apparatus is based on the property possessed by selenium of offering a variable and very sensitive electrical resistance according to the different gradations of light.

The apparatus consists of an ordinary camera obscura, containing at the focus an unpolished glass, and any system of autographic-telegraphic transmission; the tracing point of the transmitter intended to traverse the surface of the unpolished glass, will be formed of a small piece of selenium held by two springs acting as pincers, insulated and connected, one with a pile, the other with the line. The point of the selenium will form the circuit. In gliding over the surface, more or less lightened up, of the unpolished glass, this point will communicate, in different degrees, and with great sensitiveness, the vibrations of the light. The receiver will also be a tracing point of blacklead or pencil for drawing very finely, connected with a very thin plate of soft iron, held almost as in the Bell telephone, and vibrating before an electro-magnet, governed by the irregular current emitted in the line. This pencil, supporting a sheet of paper arranged so as to receive the impression of the image produced in the camera obscura, will translate the vibrations of the metallic plate by a more or less pronounced pressure on that sheet of paper.

Tel'e-graph. The following is the chronology of the telegraph.

TELEGRAPHS BY ELECTRICITY.

1774. — Georges Louis Lesage, Geneva, set up the first telegraph line, which consisted of 24 insulated wires for the alphabet, each terminating in a pith-ball electroscope, duly lettered, for indicating by its excitation the succession of letters in the message, the transmitting operator using a manual conductor from an electrical machine.

1787. — Mons. Lomond, Paris employed a single brass wire in connection with pith-ball electroscopes, making use of an alphabet of motions.

1794. — M. Reiser, Geneva, used 36 insulated wires for letters and numerals, in connection with a like number of narrow strips of tin foil pasted on glass; the letters and figures were cut in the foil and made visible by the passage of the electric spark.

1795. — Tiberius Cavallo, England, sent explosive and other electric signals through fine insulated copper wire, using Leyden jars, and sending "sparks at different intervals according to a settled plan."

1798. — D. F. Salva, Spain, worked an electric telegraph through the unprecedented distance of 26 miles, using a single wire, and the sparks of a Leyden jar for signals.

1816. — Francis Ronalds, England, constructed an experimental telegraph line, of a single insulated wire 8 miles long, operated by an electrical machine, or small Leyden jar. His elementary signal was the divergence of the pith-balls of a Canton's electrometer, produced by the communication of a statical charge to the wire. Lettered dials, rotated synchronously at each end of the line, served, in connection with the pith-balls, to indicate the letter designated by the sender. This dial system was the precursor of Wheatstone's dial telegraph in 1839; House's letter printing telegraph in 1846; and Hughes's printing telegraph in 1855.

1828. — Harrison Gray Dyar, America, constructed a telegraph on Long Island, supporting his wires by glass insulators fixed on trees and poles; the electric signals printed themselves upon litmus paper, the spacing of the marks indicating the letters and other signs. Just as Dyar and his partner Brown were seeking capital to set up a line between New York and Philadelphia, a black-mailing agent, failing to extort the concession of a large share in the enterprise, obtained a writ against the two partners on a charge of conspiracy to carry a secret communication between the cities! The case was never brought to trial, but the enterprise was blocked.

According to Steinheil, these various experiments put it beyond a doubt that frictional electricity might be made a successful means of telegraphic intercourse.

TELEGRAPHS BY GALVANISM.

1808. — The first to apply to telegraphy the galvanic battery introduced by Volta, in 1800, was Dr. Samuel Thomas Von Soemmering, of Munich. He employed the energy of a powerful voltaic pile to bring about the decomposition of water by means of 35 gold pins immersed in an oblong glass trough. Each of these electrodes was in connection with one of the 35 wires forming the line. The bubbles evolved at these electrodes were received in lettered and figured tubes, and the messages were thus spelled out. In 1810 Soemmering telegraphed through two miles of wire.

1816. — Dr. John Redman Coxe, of Philadelphia, suggested a system substantially the same as Soemmering's (of which he appeared to be ignorant). He also proposed to accomplish the same result by decomposing metallic salts, as was afterwards done.

1843. — Mr. Robert Smith, Scotland, devised a galvano-chemical telegraph carrying out practically the suggestion of Dr. Coxe. At first he used a separate wire for each letter, the message being printed on a strip of paper wet with a solution of ferrocyanide of potassium. Subsequently Mr. Smith reduced his line to a single circuit of two wires, and worked his system through 1,800 yards of fence wire (1846).

1846. — Mr. Alexander Bain, Scotland, patented in England a galvano-chemical telegraph, different in mechanical details, but similar in its chemical record to the system of Smith.

1849. — Prof. Samuel F. B. Morse, New York, patented in this country a telegraph similar to Smith's.

TELEGRAPHS BY GALVANO-MAGNETISM.

1820. — Hans Christian Oersted, Copenhagen, rediscovered the directive influence of a galvanic conductor on a magnetic needle (Romagnosi's observations of the same in 1802 having attracted no attention). The same year (1820) Professor Schweigger, of Halle, made the first real galvanometer; and shortly after Ampère, in Paris, proved experimentally the feasibility of an electro-magnetic telegraph, in which the galvanometer should take the place of the electrometer employed by Lesage.

1823. — Baron Paul L. Schilling, of Cronstadt, Russia, practically applied Ampère's suggestion. In his apparatus signals were produced by five galvanometer needles, provided with independent circuits.

1824. — Peter Barlow, England, experimenting with considerable lengths of wire, to test the practicability of Ampère's suggestion, was convinced that it was impracticable, owing to the rapid diminution of effect (due to increased resistance), by lengthening the conducting wire. Other inconclusive experiments in the same direction were made by Fechter in 1829, and Ritchie in 1830.

1833. — Prof. Carl Friedrich Gauss and Wilhelm Edward Weber constructed at Gottingen a galvanometer telegraph of a single circuit of uninsulated wire a mile and a half long. The alphabet of signs was made up of right and left deflections of the needle, observed by reflections from a small mirror. Gauss was the first to employ magneto-electricity in telegraphs. Weber added to the signaling device a delicate apparatus for setting off a clock alarm.

1836. — Prof. C. A. Steinheil, of Munich, undertook, at the request of Gauss, the development of the arrangement above described, and constructed a similar galvanometer telegraph line two miles in length, introducing considerable improvements. The next year Steinheil discovered that the ground might be made a part of the circuit, thus dispensing with a second wire for the return circuit.

1837. — Mr. William Fothergill Cooke and Prof. Charles Wheatstone patented in England a galvanometer or needle telegraph very similar to the earlier one of Schilling, employing six wires and five indicating needles. An experimental line a mile and a quarter long was worked with partial success July 25; and one thirteen miles long was established in 1838.

While these experiments with the needle were going on the electro-magnet was being developed and applied.

1820. — The germ of the electro-magnet was discovered by Arago, who observed that the electric current would develop magnetic power in strips of iron and steel.

1824. — William Sturgeon, England, produced the true electro-magnet with its intermittent control of an armature.

The electro-magnet of Sturgeon was improved by Professor Henry in 1828; and in 1829 he exhibited a larger magnet of the same character, tightly wound with 35′ of silk covered wire. A pair of small galvanic plates, which could be dipped into a tumbler of diluted acid, was soldered to the ends of the wire, and the whole mounted on a stand. This was the first magnetic spool or bobbin. This invention was further improved the same year, and in 1830 Professor Henry, assisted by Dr. Philip Ten Eyck, constructed an electro-magnet which lifted 750 pounds. In 1831 he made one weighing 82¼ pounds, which sustained over a ton. In the meantime Professor Henry practically worked out the differing functions of quantity and intensity magnets, and experimentally established the conditions required for magnetizing iron at great distances through long conducting wires. This first made the electro-magnet available for telegraphic purposes.

1831. — The transmission of signals through a mile of copper bell wire interposed in a circuit between a small Cruikshank's battery and an intensity magnet — a practical telegraph — was practiced by Professor Henry.

"This memorable experimental telegraphic arrangement involved three very significant and important novelties. In the first place, it was the first electro-magnetic telegraph employing an 'intensity' magnet capable of being excited at very great distances from a suitable 'intensity' battery. . .

"In the second place, it was the first electro-magnetic telegraph employing the armature as a signaling device, or employing the *attractive* power of the intermittent magnet, as distinguished from the directive action of the galvanic circuit. That is to say, it was, strictly speaking, the first magnetic telegraph.

"In the third place, it was the first *acoustic* electro-magnetic telegraph."

Further on Mr. Taylor pertinently remarks that it is suggestive to consider how different would have been the popular estimate of Professor Henry's labors if he had been worldly-wise enough to secure an early patent on these three indisputably original and most pregnant features of telegraphy.

1837. — Prof. Samuel F. B. Morse devised a magneto-electric telegraph capable of transmitting signals through a circuit of 40′, but failed for longer distances from the circumstance that he used a quantity current. His friend, Dr. Gale, made for him an intensity battery, and added a hundred or more turns to the coil of wire around the poles of the magnet. With these necessary (and radical) improvements the apparatus was made to work through ten miles of wire. In applying for a caveat for his invention, October 6, 1837, Professor Morse specified six distinct parts, not one of which enters into the established "Morse" telegraph of to-day. Mr. Taylor shows that Professor Morse's real contribution to telegraphy consists first in the adaptation of the armature of a Henry electro-magnet to the purpose of a recording instrument; and second, in connection therewith, the improvement on the Gauss and Steinheil dual-sign alphabets, made by employing the single line dot and dash alphabet.

In his general summary of the history of the origin and development of the electro-magnetic telegraph, Mr. Taylor sets down the leading preparatory investigations and discoveries as these five:

1. The discovery of galvanic electricity by Galvani, 1786–1790.
2. The galvanic or voltaic battery by Volta, 1800.
3. The directive influence of the galvanic current on a magnetic needle by Romagnosi, 1802, and by Oersted, 1820.
4. The galvanometer by Schweigger, 1820 (the parent of the needle system).
5. The electro-magnet by Arago and Sturgeon, 1820-1825 (the parent of the magnet system).

The second half dozen capital steps in the evolution of telegraphy were: —

1. Henry's most vital discovery, in 1829 and 1830, of the intensity magnet and its intimate relation to the intensity battery.
2. Gauss's improvement, in 1833 (or probably Schilling's, considerably earlier), of reducing the electric conductors to a single circuit by the ingenious application of a dual sign, so combined as to produce a true alphabet. (The anticipations of this idea by Lomond in 1787, Cavallo in 1795, and Dyar in 1825, are not regarded as practically influential in the progress of telegraphy.)
3. Weber's discovery, in 1833, that the conducting wires of an electric telegraph could be carried through the air without insulation, except at the points of support.
4. As a valuable adjunct to telegraphy, Daniell's invention of a constant galvanic battery in 1836.
5. Steinheil's discovery, in 1837, that a single conducting wire is sufficient for telegraphic purposes.
6. Morse's adaptation of the armature of a Henry electro-magnet as a recording instrument, 1837, and the single line dot and dash alphabet in 1838.

The earlier needle type of electro-magnetic telegraph has found its special application in ocean lines, no element of the Morse system entering into the operation of submarine cables.

The more recent telegraphic developments do not fall within the scope of Mr. Taylor's review. A few other dates, as given by Prescott, may appropriately serve to complete this chronology.

1861. — Reiss discovered that a vibrating diaphragm could be actuated by the voice so as to cause the pitch and rhythm of vocal sounds to be transmitted to a distance and reproduced by electro-magnetism.

1872. — Stearns perfected a duplex system, whereby two communications could be simultaneously transmitted over one wire.

1874. — Edison's quadruplex system was invented.

1874. — Gray invented a method of electrical transmission, by means of which the intensity of tones as well as their pitch and rhythm could be reproduced at a distance; and subsequently conceived the idea of controlling the formation of electric waves by means of the vibrations of a diaphragm capable of responding to all the tones of the human voice.

1876. — Telephone invented. — Bell invented an improvement in the apparatus for the transmission and reproduction of articulate speech, in which magneto-electric currents were superposed upon a voltaic circuit, and actuated an iron diaphragm attached to a soft iron magnet. During the same year Dolbear conceived the idea of using permanent magnets in place of the electro-magnets and battery previously employed, and of using the same instrument for both sending and receiving.

1877. — Edison's carbon telephone was brought out.

To these may be added Edison's electro-motograph or electro-chemical telephone, 1877.

1878. — Duplexing of ocean telegraph.

1879. — Cowper's writing telegraph.

1880. — Field's successful substitution of dynamo-electricity for galvanic batteries in telegraphing.

1800. — Volta, Italian, discovery of galvanism.
Galvani, Italian, discovery of galvanism.

1809. — Soemmering, suggestion of application of galvanism to telegraph.
Oersted, Dane, galvanometer.
Ampère, French, astatic needle.

1825. — Ohm, German, law of strength of current.

1833. — Gauss.
Weber.
Becquerel, constant battery.
Daniell, constant battery.
Steinheil, discovery of earth circuit.

Commander Cameron of the British navy says that the Morse system of telegraphy, as far as it depends on the length of sounds, has long been in use in Africa. He has found tribes that, by stationing drummers at intervals, carry intelligence for miles with great rapidity, the beats of the drum being made in accordance with a previous arrangement of signals.

A message of 69 words, forwarded by the governor of Victoria, announcing the opening of the Melbourne Exhibition, was dispatched from Melbourne at 1 P. M., and reached London at 3.43 A. M., on the same day, or 9 hours 17 minutes before the hour of its dispatch. Allowing, however, for the difference of time between the two cities, it occupied only 23 minutes in transit. The route of the message was over the lines of the Victorian and South Australian colonies, the cables of the Eastern Extension, Australasia, and China Telegraph Company, the lines of the Indian government, the cables of the Eastern Telegraph Company, and the lines of the Egyptian and French governments, and the rapidity of its transmission shows the harmony with which these various administrations work together. The total distance traversed was 13,398 miles.

The annual report of the president of the Western Union Telegraph Company for the year ending June 30, 1880, furnishes many figures of interest to others than the stockholders of the company. The latter, however, appear to have no reason to complain, the net profits of the company for the year footing up over $6,000,000, the capital stock of the company being about $41,000,000. The net profits for the fourteen years from 1866 to 1880 exceed $45,000,000. The telegraph business of the year is represented by 29,215,509 messages, $12,782,894.53 receipts, $6,948,956.74 expenses, and $5,833,937.79 profits. The company has in operation 85,645 miles of line, 233,534 miles of wire, and occupies 9,077 offices. The new offices established and equipped during the year number 548. The number of messages sent was over 4,000,000 more than the year before. The increase in mileage of wire was 22,000 miles; the increase in miles of pole lines was 2,658. The ratio of expenses was 54.3 per cent. of the receipts, against expenses of 56.2 per cent. the previous year, and of 63.9 per cent. the year preceding that, and the cost per message reduced to the average of 22.3 cents, against 23.1 cents the previous year, 25 cents the year preceding that, and 29.8 cents the year ending in 1877.

The wires of long circuits in continental Europe are 5 mm. diameter, weighing about 540 lbs. per English mile.

Smaller lines have wire of 4 mm., = to Am. No. 9, about 320 lbs. per mile.

Branch lines have wire of 3 mm., = 200 lbs. per mile.

In England large and important lines use No. 4 gage, = 800 lbs. per mile.

The majority of American lines has No. 9 gage, = 320 lbs. per mile. A portion of the remainder is No. 8, = 380 lbs. per mile. 3 per cent. is No. 6, = 540 lbs.; and some No. 10, = 270 lbs.

The Cumming periphery-contact telegraph key, it is claimed, has no jar or sticking points, and has a close needle point contact. Two disks are placed at right angles to each other, and the connection between the two is only a needle-point of surface. The adjustability of the electrodes is such that if connection should be arrested, both wheels can be changed in an instant by turning each slightly on its axis to a new bright surface. The electrodes connect firmly, so that the trunnion can be screwed tight without affecting the correct working of the key. The system of wheels and axles forms an elastic bed, that, taken in connection with the dot contact and close adjustment, makes it possible to work the key all day without any lost motion to fatigue the hand or try the nerves.

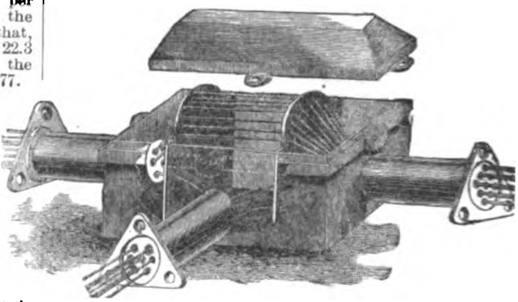
Commander Perrier read a paper at the last meeting of the Geographical Society of Paris, on the determination of the longitude of Algiers by telegraphy. The exact longitude is 2′ 50.21″ east from Paris, the probable error being only 0.01″. The time required for the transmission of the electricity from Paris to Marseilles was found to be only 2-100 of a second; the distance between these two cities being 863 kilometers, it shows that the velocity of the electricity was not less than 46,000 kilometers per second. Similar experiments tried on the submarine cable between Algiers and Marseilles proved that the time required to travel was 23-100 of a second: for a distance of 926 kilometers this shows a velocity of only 4,000 kilometers. But the battery used for signaling in the aërial line was composed of 100 elements, and only ten elements were used in the sub-Mediterranean cable.

For history of and record of improvements, see —

Telegraphy, history of		"*Manufacturer & Builder*," p. 62, 1873: x. 110.
Musical, *La Cour* . .	*	"*Scientific American*," xxxv. 136.
Progress of. *C. W. Siemens* . .		"*Scientific American Sup.*," 1813.
Ocean telegraphy, paper on, *Field*		"*Scientific American*," xl. 195.
Longitude by telegraph		"*Scientific American Sup.*," 1866.
Multiplex printing telegraph, *Baudot*, Fr. .	*	"*Engineering*," xxvi. 227.
Multiplex telegraph. *Meyer-Baudot* . . .		"*Telegraphic Journal*," vi. 502.
Meyer	*	"*Engineering*," xxiv. 6.
Telegraphing without wires		"*Scientific Amer.*," xxxviii. 97. "*Scientific American Sup.*," 908.
Telegraph, underground		"*Scientific Amer.*," xxxvi. 311.
System, *Meyers* . .	*	*Lines*' "*Rept. Vienna Exp.*," 1873.
Writing, *Dolbear* . .	*	"*Scientific American*," xl. 376.
New Zealand . . .		"*Scientific American Sup.*," 3.
Apparatus, ocean . .		"*Scientific American Sup.*," 145.
Pneumatic, *Guattari* .	*	"*Scientific American Sup.*," 555.
Cable, appr., *Tomassi*	*	"*Telegraphic Journal*," vi. 47.
Cables, Atlantic, "*Engineering*" . .		"*Van Nostr. Mag.*," xxiii. 502.
Relative durability .		"*Telegraphic Journal*," iv. 56.
Cable ship "Faraday"	*	"*Engineer*," xli. 295.
Electro-harmonic, *Gray*		"*Scientific American*," xxxv. 258.
Key, *Byrns*	*	"*Scientific American Sup.*," 807.
Double current, *Trimmer* . . .	*	"*Scientific American Sup.*," 1478.
Instrument, *Bramão*	*	"*Telegraphic Journal*," vii. 114.
Sound	*	"*Scientific American*," xxxv. 391
Military, *Trouve* . .	*	"*Scientific American*," xxxv. 23.

Tel′e-graph Wire. In one form of underground telegraph system the naked copper wires are drawn through glass tubes, which are firmly held in position in the iron pipe by paraffine wax. For lateral connections, as well as convenience in laying, traps are used, into which the pipes are screwed, the wires passing over non-conducting bridges, as

Fig. 2398.



Trap for Underground Telegraph Wire.

shown in Fig. 2398, thus allowing any wire to be taken out and replaced without interfering with the working of the others. The pipes are connected by a coupling, which, after being bolted together, is completely sealed; the traps being closed and sealed in like manner.

By this system there is claimed to be no crossing of wires, no difficulty from atmospheric changes, no cutting of wires in cases of riot, no imperiling of life and property by the breaking down of poles and wires by snow storms or fires (causing interruption of telegraphic communication); but a perfectly reliable telegraphic connection under all circumstances.

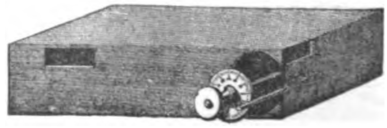
Te-lem′a-chon. A name applied by Wallace, of Ansonia, Conn., to his apparatus for transferring power from the Naugatuck river to his factory, a quarter of a mile off. A dynamo-electric machine transforms mechanical power into electricity, and an electric motor reverses the operation and turns the current into power. Loss stated at 20 per cent.

Te-lem′e-ter. A device for determining rapidly and accurately distances on the earth's surface.

Various mechanical devices for these purposes have been invented, but none hitherto similar to that illustrated, devised by Lieutenant Gaumet, French army, which is adapted for carriage in the pocket. A perspective view of the instrument is given in Fig. 2399. Fig. 2400 shows the interior. Two mirrors are disposed on a metallic plate so that an angle of 45° is made between them. One mirror is fixed; the other is mounted on a movable alidade, so that the above angle can be varied from 41° to 49°. A micrometric screw of .04″ travel per turn has a disk on its head, which is divided circumferentially into 100 parts. This screw moves in double nuts on the metallic plate. The disk travels in front of a divided rule, each division of which equals .04″. A spring causes constant contact between the arm of the alidade and the extremity of the micrometric screw.

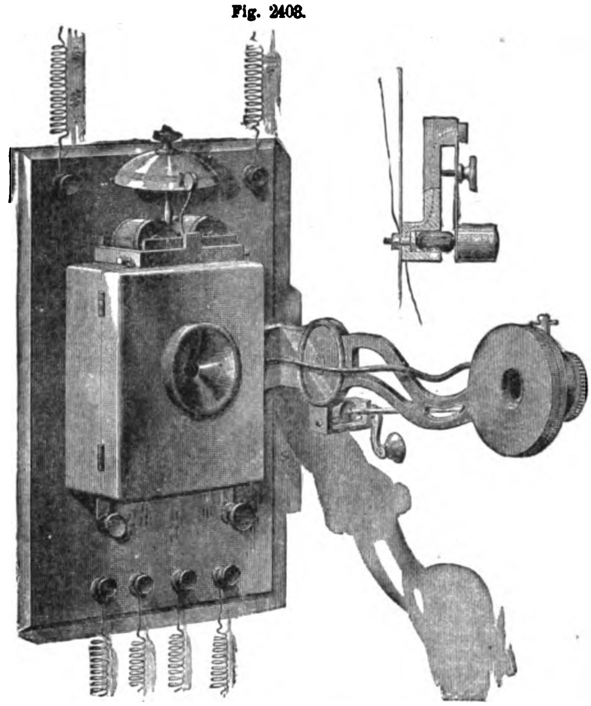
All the above parts are contained in a rectangular box, as shown in Fig. 2399, having at its rear an opening for the eye, and on the right side a similar aperture through which the

Fig. 2399.



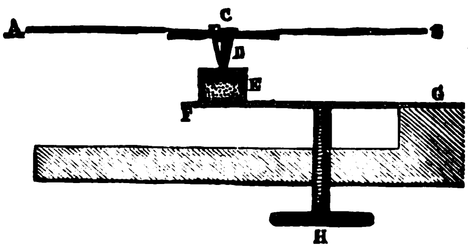
Telemeter.

Fig. 2403.



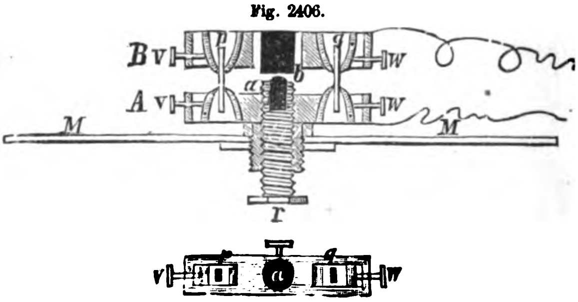
Edison's Telephone.

Fig. 2405.



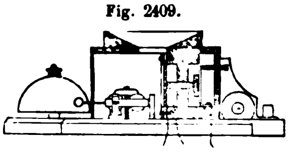
Regi's Telephone.

Fig. 2406.



Luedtge's Telephone.

Fig. 2409.

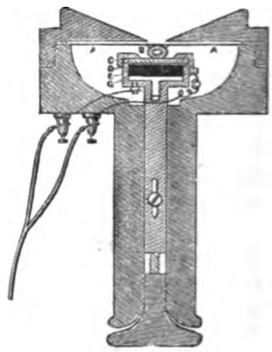


Herz's Telephone.

Fig. 2402.

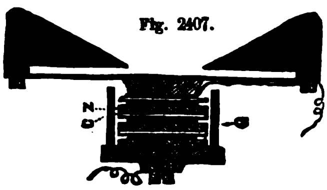
Bell's Telephone.

Fig. 2404.



Edison's Carbon Telephone.

Fig. 2407.



Edison's Pile Telephone.

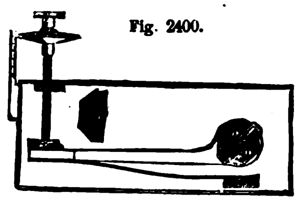
Fig. 2408.

Hubbard's Telephone.

rays pass to the mirrors. The principle on which the device is constructed is a simple application of that of double reflection. When a luminous ray is reflected successively by two mirrors placed in a plane perpendicular to the intersection of the mirrors, the angle formed by the incident and reflected ray is double the angle of the mirrors.

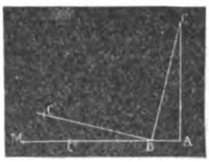
In order to measure the distance by the instrument three operations are necessary. These will be understood from Fig. 2401, and are as follows: 1, to determine the right angle *C A M*; 2, measure a base *A B*; 3, measure an angle at *A C B*. *A C* being the distance to be determined. The observer posts himself at *A*, the point *C* being on his right. The reflected image of this point then appears directly above the direct image of the fixed station *M*, which is regarded in direction perpendicular to *A C*. (The angle *C A M* is right whenever the two mirrors make an angle of 45°.) The observer now, by means of a tape provided with the instrument, measures off a distance along the line *A M* of *A B* = 60′. He then proceeds to *B* and regards anew the signal point *M*, between which and *C* there will no longer be a coincidence, the latter appearing to the right, say at *C″*. To reëstablish the coincidence the movable mirror is turned to an angle equal to ½ *C″ B M*, which equals ½ *A C B*. The angle of rotation of the mirror is in the instrument measured by its tangent by the aid of the micrometric screw. This gives a very close approximation. When the coincidence above referred to is obtained the number of turns made by the screw is read from the scale, and this equals the measure of the tangent of the angle of rotation of the mirror. This angle of rotation is half the angle *A C B*. The relation, therefore, between the distance from the pivot of the movable mirror to the axis of the micrometric screw and double the number of divisions equals the ratio between the unknown distance and the base measure. Therefore, *D* being the distance to measure; *b*, the base taken, say 60′; *l*, the distance of the pivot as above, which in the instrument is 2.2″, and *n* the number of divisions, we have

Fig. 2400.



Telemeter.

Fig. 2401.



Plan reflected in the Telemeter.

$$\frac{D}{b} = \frac{1}{2.n} \quad \text{or } D = b \frac{2.2}{n}.$$

Whence we obtain for each instrument a constant which, divided by the number on the scale, at once gives the distance sought. On every instrument a table prepared from the above formula is fixed so that the observer merely has to glance thereat to determine the distance without calculation.

This invention is in principle the same as that patented in the United States, March 16, 1875, by Mr. William F. Hausch, of Chicago, Ill.

Tel′e-phone. An acoustic telegraph.

A modification of the electric telegraph, whereby sounds, and especially articulate sounds are conveyed to a distance

The telephone of Prof. Alex. Graham Bell, Plate XLVIII., Fig. 2402, consists of an insulated permanent magnet, in form of a cylindrical rod, which is enveloped with a wire coil that communicates at one extremity with the ground and by its other extremity with a similar coil around a like magnet at the distant station whose unattached end communicates in like manner with the ground. Opposite the outer end of each magnet is stretched a thin metallic diaphragm (usually ferrotype sheets) to which a mouth-piece is attached. Sounds projected into the mouthpiece vibrate the diaphragm, and by so doing increase and diminish the polarity of the magnet. This acting inductively on the inclosing coil transmits electrical impulses through the connecting wire to the distant coil, which in turn operates to magnetize and demagnetize its inclosed bar, which finally sets up vibrations on the adjacent diaphragm, similar to that in the sending station, thus converting the electrical impulses back into sound.

The *telephone system* depends for its efficiency upon three distinct elements: the telephone, the microphone transmitter, and the exchange table and system.

The telephone generally used consists essentially of a thin metallic diaphragm, suitably mounted in a sound-receiving chamber with a mouth-piece, and a short bar of magnetised iron secured adjustably in the handle of the instrument at right angles to the diaphragm, nearly, but not quite in contact therewith. A coil of insulated wire surrounds the magnetized bar at its diaphragm end, and is connected with the line wire and with the ground respectively.

Speech or other sounds projected into the mouth-piece cause vibrations of the diaphragm which produce fluctuations in the magnetism of the bar. Induced currents of electricity are thereby brought into play in the coil surrounding the magnet, which, being transmitted by the line wire to the terminus, cause precisely similar vibrations in the diaphragm of the receiving instrument, and thus, by an exact reverse of the previous process, produce sound waves.

Thus by the conversion, so to speak, of sound waves into electrical waves, the transmission of the latter, and finally their reconversion into sound waves, the sounds given to the receiving instrument are reproduced at remote distances with astonishing accuracy; but the favorable results produced are much enhanced by the use of a microphone known as the *transmitter*, which is now used as the sending instrument.

The transmitter is a modification of the principle of the telephone proper, in which a diaphragm mounted in an insulating rubber marginal support vibrates against a spring-supported platinum point interposed between the diaphragm and a disk of compressed carbon. The platinum point and the carbon disk are electrically connected through an insulated coil, surrounded by a secondary coil interposed between the line wire and the ground connection. The object of this invention is to produce secondary pulsations of greater intensity, which, being transmitted by the line wire, practically solve the question of distance in the transmission of sound.

Telephone exchange. Each subscriber to a local telephone system is connected by a line wire to a central office or *exchange*, where, for convenience, the subscribers are grouped to the number, say of fifty, the wires of each group concentrating at a particular desk in charge of an operator clerk, and distinguished by a particular color. At the exchange terminus of each wire is a magnet mounted on a frame, which, when the line is out of use, holds a bright colored disk in sight. These magnets being arranged on shelves in front of the operator, each will drop its disk whenever its patron "calls" the exchange, thus indicating the individual giving the signal.

Each desk has a similar group of magnets and signals connected with the wires belonging to its group of patrons, and, in addition, a number of *plug-sockets* with wires connecting them with the other tables. These plug-sockets are arranged in groups of ten, and each group has its distinguishing color, and is connected with the groups of the same color on each of the other tables; thus each table has as many groups of sockets and connecting wires as there are tables in the exchange. By this means each operator may connect either of the wires distinguished by his appointed color with any other table, and, thus intermediately with any other line wire to such other patron as the original caller may indicate telephonically to the central exchange.

Fig. 2403, Plate XLVIII., represents Edison's new telephone. The chalk cylinder is inclosed in a vulcanite box at the end of the movable arm. The cylinder, when once moistened, remains in that condition an indefinite time, as the box is practically air-tight. The small shaft that runs parallel with the iron arm extends through the side of the box and carries the chalk cylinder. Upon the opposite end there is a small pinion moved by a worm, the crank of which is turned by the finger. The diaphragm of the receiving instrument is covered by the front of the box, except a small central portion sufficient for the exit of the sound. The arm that supports the receiving instrument is jointed so that it can be raised vertically out of the way when the telephone is not in use. The transmitter is contained in the rectangular box; its mouth-piece projecting slightly, and the diaphragm, which is of mica, is supported by a metallic frame and springs inside the box cover. The transmitter is so constructed that a vulcanite arm is secured to the center of the mica diaphragm by a small bolt that is connected to one pole of the battery by a piece of metallic foil or very thin copper wire. The head of the bolt is platinum faced and deeply sunk in the vulcanite arm, the same cavity containing also a piece of carbon pencil, such as is used for electric candles. This carbon fits the cavity loosely, and is rounded at both ends. Its outer end is pressed by a platinum-faced spring, secured to the outer end of the vulcanite arm. The spring carries at its free end, opposite the carbon, a brass weight, and its pressure upon the latter is regulated by the small set screw. A wire or piece of copper foil, connecting with the spring, completes the circuit, which includes the primary of an induction coil contained by the rectangular box. The secondary wire of the induction coil is connected with the telephonic line and a tertiary coil that envelopes the secondary is connected with the rubber and chalk cylinder.

Fig. 2404, Plate XLVIII., represents the "Edison" carbon telephone. He made the discovery that when properly prepared, carbon possesses the remarkable property of changing its resistance with pressure, and that the ratios of these changes correspond exactly with the pressure. On this principle he constructed his telephone. The carbon disk is represented near the diaphragm, which is placed between platinum plates and connected with the battery circuit. A small piece of rubber tubing is attached to the center of the metallic diaphragm, and presses lightly against an ivory piece that is placed directly over one of the platinum plates. When, therefore, any motion is given to the diaphragm, it is immediately followed by a corresponding pressure on the carbon, and by a change of resistance in the latter.

The "Regi" instrument, Fig. 2405, Plate XLVIII., has the special advantage that when once adjusted it continues to operate without readjustment. The peculiarity of the new instrument is in transmitting wave-sounds through a diaphragm that rests upon a conducting substance made of a mixture of silver, reduced to an impalpable powder, and carbon, also very finely pulverized; the above devices being mounted on the end of a slender spring.

In principle the Regi telephone is similar to "Edison's" carbon telephone, and also to the "Hughes," which was based on Edison's.

Professor Gray received a patent for a combination of a telephone with the ordinary Morse instrument, so that the telegrapher may communicate over the same line both by the Morse signals and also by the voice. By use of the quadruplex instrument on such a line four messages may be transmitted by signals in the usual manner, while conversation may at the same time be carried on over the same wire, all without any interference of the different signals or systems.

Gray claims to have first invented and reduced to practice—

1. The transmission of composite tones of varying quality through a closed circuit by the superposition of one set of electric waves upon another.

2. The reproduction of such vibrations by means of a continuously charged receiving magnet.

3. The combination of a magnet with a diaphragm of magnetic metal arranged in close proximity thereto, and adapted to act either as a transmitter or receiver of articulate or any other sound.

"Dr. Luedtge's microphone," Fig. 2406, Plate XLVIII., patented January 12, 1878, some time before the microphone notes of Hughes and Edison were published, has been improved so that the disagreeable sounds that are heard on some other microphones have been avoided, and words spoken into the transmitter are reproduced so clearly and so loud that it can be heard best somewhat removed from the receiver, which is an ordinary "Bell" telephone. With too near an approach a healthy ear might be injured.

Words have been plainly transmitted by this apparatus through a distance of 186 miles.

If a Bell telephone and a Luedtge microphone are brought in connection, a clear, deep, and impressive tone, something like the tone of a fog-horn that can be heard for quite a distance, is perceived at the transmitting as well as at the receiving station.

The essential part of the instrument is the connection between the two electric conducting bodies (preferably of iron, platinum, or carbon). One of the pieces is level at the contact surface, but the other is convex. The electric current passes through this contact, and the variations in the electrical resistance at this point while speaking cause the vibrations of the membrane in the receiving telephone. A peculiarity of the construction is that both of the contact pieces are united to a support fastened to the middle of the membrane, so that both vibrate with the membrane.

Fig. 2497, Plate XLVIII., represents Edison's voltaic pile telephone. A piece of cork, *K*, is fastened to the diaphragm, and presses upon a strip of platinum which is attached to a plate of copper. The latter is one of the terminals of an ordinary galvanic pile. The other terminal plate presses against the metallic frame of the instrument. When the pile is included in a closed telephone circuit it furnishes a continuous current. The strength of this current depends upon the internal resistance of the pile and its polarization, and these are varied by vibrating the diaphragm. The pile is composed of alternate plates of zinc and copper, *Z C*, and a bibulous medium, *G*, between the pairs of plates.

In the Hubbard telephone, as seen in Fig. 2408, Plate XLVIII., the inventor has made use of the Jamin laminated U-magnets to secure great magnetic power with little weight. The ends of the magnet are cut off diagonally, and the poles are each surrounded with a helix of fine insulated copper wire connected as in an electro-magnet. Two of these magnets are attached to an elliptical hoop, which surrounds the head and supports the diaphragms and ear-pieces. Each diaphragm carries a light triangular armature, which fits the poles of the magnets and nearly touches them. The telephones are connected with each other and with the line. The operation is similar to the Bell telephone. The instrument shown in the engraving is arranged as a receiver to be used with any of the ordinary transmitters, but it may be arranged as a transmitter.

Fig. 2409, Plate XLVIII., represents the telephonic instruments of Dr. Cornelius Herz.

The apparatus represented in the figure is specially designed for lines most affected by induction, which renders communication impossible with ordinary telephones.

This plan utilizes two principles discovered by Dr. Herz: the alternation of the current in the line, and employing condensers as receivers. The instrument constitutes a station, completely inclosing, under a compact and appropriate form, all the parts necessary for the call and for communication.

The diaphragm is horizontal, but a funnel placed in front of the box collects the sound and concentrates it upon the diaphragm, and the instrument will transmit words spoken fifty centimeters from it.

Four pairs of microphonic contacts are placed upon an oscillating platform, under the diaphragm and connected with it by a rigid rod, communicating to it all the vibrations of the diaphragm. These contacts are of a special composition, and communicate with the battery and with the line.

In this apparatus it is not necessary to use the induction coil, but it is necessary that the number of elements of the battery in the line be proportioned to the distance of the two stations; for example, between Paris and Orleans it was necessary to use thirty elements of Daniell at each station, in order to obtain the maximum intensity.

In a modification the alternation of the current is accomplished in a different manner, and the induction coil is used in order to diminish the number of elements necessary in a long line.

Originally this instrument was formed of a vibrating plate, having at each side a contact point touching the diaphragm lightly, and the vibrations increased or diminished the pressure alternately upon each one of these contacts, but this form being inconvenient, M. Herz preferred that which is now used, which gives the same results.

The vibrating plate is of conducting material. Below, and touching it lightly, is a cylinder, which rests upon a disk, the two being made of the same material as the plate. The disk rests, in its turn, upon a thin metal spring, which is made adjustable by means of a screw, so as to vary the contact between the three pieces.

The plate and the disk are connected with one of the poles of a battery of four elements, which is grounded at the center. Finally, the cylinder is connected with one of the extremities of the primary wire of the induction coil, the other end being grounded. The secondary wire of the coil passes out from one side to the line, and from the other side to the ground.

An electro-thermic telephone, described by W. H. Preece in a paper before the Royal Society, consists of a telephone receiver whose action is due to the linear expansion of a thin wire under tension when placed in a microphonic circuit.

It has been discovered that each damaged or imperfect joint in a telephonic wire becomes a microphone, taking up the sounds that occur in its vicinity for transmission to the receiver.

The microphone, in fact, is itself two or more conductors, connected together, electrically, by an imperfect joint.

Mr. Geo. Hopkins, of Brooklyn, N. Y., during a thunder storm, connected the gas and water-pipes of his dwelling with an ordinary Bell telephone, and discovered that the electric discharges were plainly indicated by either a sharp crack or by a succession of taps. This occurred when the discharge was so distant that the thunder was inaudible. There was a marked difference in the discharges; some that appeared single to the eye were really multiple. Often the discharges would consist of a series, beginning and ending with discharges larger than the rest, thus: —— . . . . . ——, sometimes it would be thus: —— . . . . ., sometimes the reverse, and often a single crack.

Experiments with the telephone as an indicator of the approach of distant thunder storms seem to prove that the telephonic dispatch was simultaneous with the rays of light, as exhibited by the flash of the lightning, even when the storm was so distant that the sound waves were not appreciable to the ear via the atmosphere. A significant fact, if sound waves with a conductor with a minimum friction can keep pace with rays of light.

The nearest cable station from Alexandria during its bombardment, in 1882, was at Malta, distant about 1,000 miles from the scene of the battle. A press dispatch says that when a telephone was attached to the Malta end of the cable the firing of the guns at Alexandria could be distinctly heard, though no oral communication was possible over that length of cable.

See "*Mech. Dict.*," 2514.

Telephone.	"*Scientific American Sup.*," 765.
	* "*Engineer*," xliv. 37, 239.
	"*Scientific American*," xxxv. 168.
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Applied to torpedoes . "*Telegraphic Journal*," vi. 368.
Blake, researches . . "*Jour. Soc. Tel. Eng.*," vii. 247
Dr. Clarence Blake . * "*Scientific American Sup.*," 2352.
Bell. . . . . * "*Engineering*," xxii. 518; xxvii. 498.
* "*Eng. & Min. Jour.*," xxvi. 346.
* "*Jour. Soc. Tel. Eng.*," v. 500, 519, 525; vi. 385.
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Experiments . . . "*Scientific American Sup.*," 1864.
Breguet . . . . * "*Scientific American Sup.*," 2004.
* "*Telegraphic Journal*," vi. 158.
Brown Ayres . . . * "*Scientific American Sup.*," 2087.
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Curious facts, *Chaening* "*Scientific American Sup.*," 1720.
Dental attachment for, *Fiske* . . . . . * "*Scientific American*," xliii. 82.
Disk . . . . . . * "*Telegraphic Journal*," vi. 113.
"Double crown" . . * "*Scientific American Sup.*," 2481.
Edison . . . . . * "*Manufact. & Builder*," xi. 252.
* "*Engineering*," xxv. 497. *
* "*Scientific American*," xli. 198.
* "*Telegraphic Journal*," vi. 158.
Edison's carbon . . * "*Scientific American Sup.*," 2024.
Edison-Phelps . . . * "*Min. & Sc. Press*," xxxvi. 305.
Electro-thermic. *Hopkins* . . . . * "*Scientific American*," xliii. 37.
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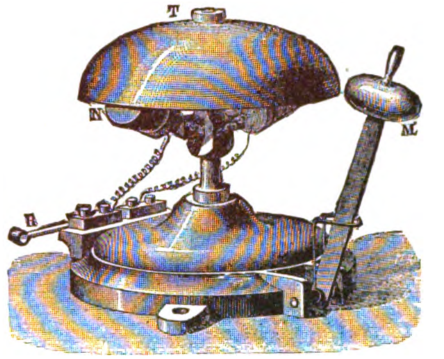
Fig. 2410.



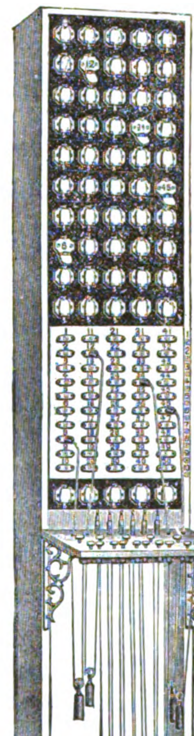
Telephone Call.

Tel′e-phone Call.

The Lorenz telephone call, Fig. 2410, is an alarm or call-bell, in which the magnet *N S* is placed coincident with a diameter of the steel gong *T*. When by means of a hammer *M*, pushed by a spring, the gong is struck in a direction across that of the magnet the vibrations have their maximum amplitude in front of the poles, and induction currents relatively strong are generated in the coils placed on the poles of the magnet. These currents are sent to the corresponding station, and are there received in the Bell telephone, slightly modified, the bobbins being more powerful than in ordinary telephones, and a resonator being also added to them. The latter is a long cone of white iron, truncated at its top, the small end being inserted close to the telephone diaphragm.

"*Telegraphic Journal*," * vi. 439.

Fig. 2411.



Telephone Switch-board.

Tel′e-phone Ex′change Ap′pa-ra′tus. Fig. 2410 is the Western Telephone Exchange switch board. It consists of fifty annunciators for subscribers' wires; fifty spring-jack switches for connecting and disconnecting line wires and annunciators; five annunciators for receiving the clearing-out signals. A shelf with five pairs of cords and plugs, and five sets of keys.

Tel′e-phone Harp. An instrument for making telephonic musical effects more audible for large audiences.

Gower, Br. . . "*Jour. Soc. Teleg. Engineers*," vii. 259.

Tel′e-phon′o-graph. An invention of Edison, a combination of the telephone and phonograph, for making a phonic record of a message conveyed from a distance.

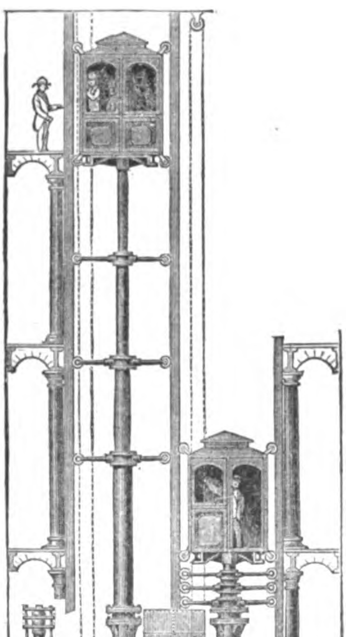
"*Engineer*" . . . . * xlvi. 425, Fig. 27.

Tel′e-phote. An instrument or apparatus for conveying messages or images by transmission of light.

This broad definition may include the heliotrope, but nothing narrower, it appears, will include the various ideas and inventions of Bell, Perry, Ayrton, Edison, Adams, Day, Willoughby, Smith, Sabine, Kerr, Middleton, Michin, and others, who are reported to be working at the problem.
See sketch in "*Engineering*," xxix. 361.

Tel′e-scop′ic El′e-va-tor. Fig. 2412 shows a telescopic hydraulic elevator for lifting passengers or freight to the upper floors of a building.

Fig. 2412.



Telescopic Elevator.

Tel′e-scop′ic Tank Car. One in which the circular sections of the tank are of gradually decreasing diameter toward the ends, lapped within each other.

In contradistinction to the *straight tank* car, in which the sections are alternately inside and outside.

Tel′e-scope Sight. (*Fire-arms.*) A telescope mounted on a fire-arm. It is generally adjustable, in altitude for distance; in azimuth for wind correction.

See patents of J. M. Trowbridge, March 8, 1864, No. 41,874; C. Slotserbek, October 8, 1878, No. 208,765.

Tell′-tale. (*Gas.*) An attachment to a station meter to indicate any irregularity of the production of gas during the 24 hours, the cards being renewed daily.

Tell′-tale Com′pass. A tell-tale mariner's compass, recently patented in England by Mr. H. A. Severn, is intended to serve captains of vessels as a check upon the man at the wheel during their absence, and to insure greater attention on the part of the helmsman.

It consists of an ordinary compass card, to the center of whose upper surface is attached a metallic bar, through the agency of which an electric circuit is closed, and a bell is sounded as soon as the vessel is off her course either way beyond a given amount of latitude. To effect this there are two index hands, which may be set at will at any distance on either side of the metal bar. These hands carry at their ends thick platinum wires, bent downward, so that they are touched by the metallic bar on the compass card as soon as the vessel is out of her course beyond the given limit. These wires are connected to one pole of a Leclanché battery, while the point carrying the card is connected with the other. The compass can also be used in the ordinary manner.

Tem′pered Glass. (*Glass.*) A process invented by M. de la Bastie, which consists in heating a piece or object of glass to such a heat as to approach malleability, but not hot enough to lose its shape, and then plunging it into a bath of fatty and resinous matter, which is heated to liquidity and maintained at a heat of from 300° to 600° F., according to the quality of the glass.

The difference of temperature between the malleable state of glass, say 1400° F., and that of the bath constitutes the "temper."

The glass is much strengthened against injury by a blow, but becomes fractured by being cut with a diamond. It resists great changes of temperature. It is much more elastic also.

It can be depolished and cut by the wheel. See also Compressed Glass.

Tempered Glass, *Bauree* "*Technologiste*," xxxvii. 182-194.
On, *Leger* . . . . "*Technologiste*," xl. 68.

Tem′per-ing. Chisels for dressing French burr stones may be tempered by heating to a dark cherry red, and quenching in the following solution: To three gallons of water add three ounces each of spirit of niter, spirit of hartshorn, white vitriol, sal ammoniac, and alum, and six ounces of common salt, with a double handful of hoof parings.

Fig. 2413.

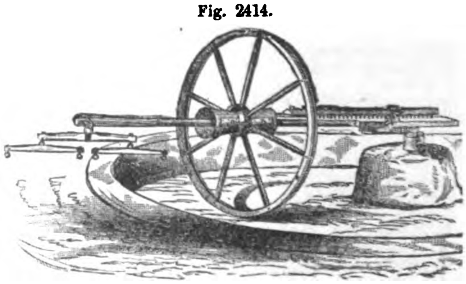
Tempering Gas Heater.

Tem′per-ing Gas Heat′er. A gas heater, Fig. 2413, with directing and concentrating flanges for directing the heat.

Tem′per-ing Wheel. Fig. 2414 represents Allen's clay tempering wheel. It is used in the preparation of clay for making bricks, and for mixing mortar in large quantities; the substance to be worked being placed in a circular pit, as shown in the engraving, of 16′ to 30′ diameter.

It is made with wrought iron or with cast iron arms or spokes, and of any length of shaft required.

Fig. 2414.



Tempering Wheel.

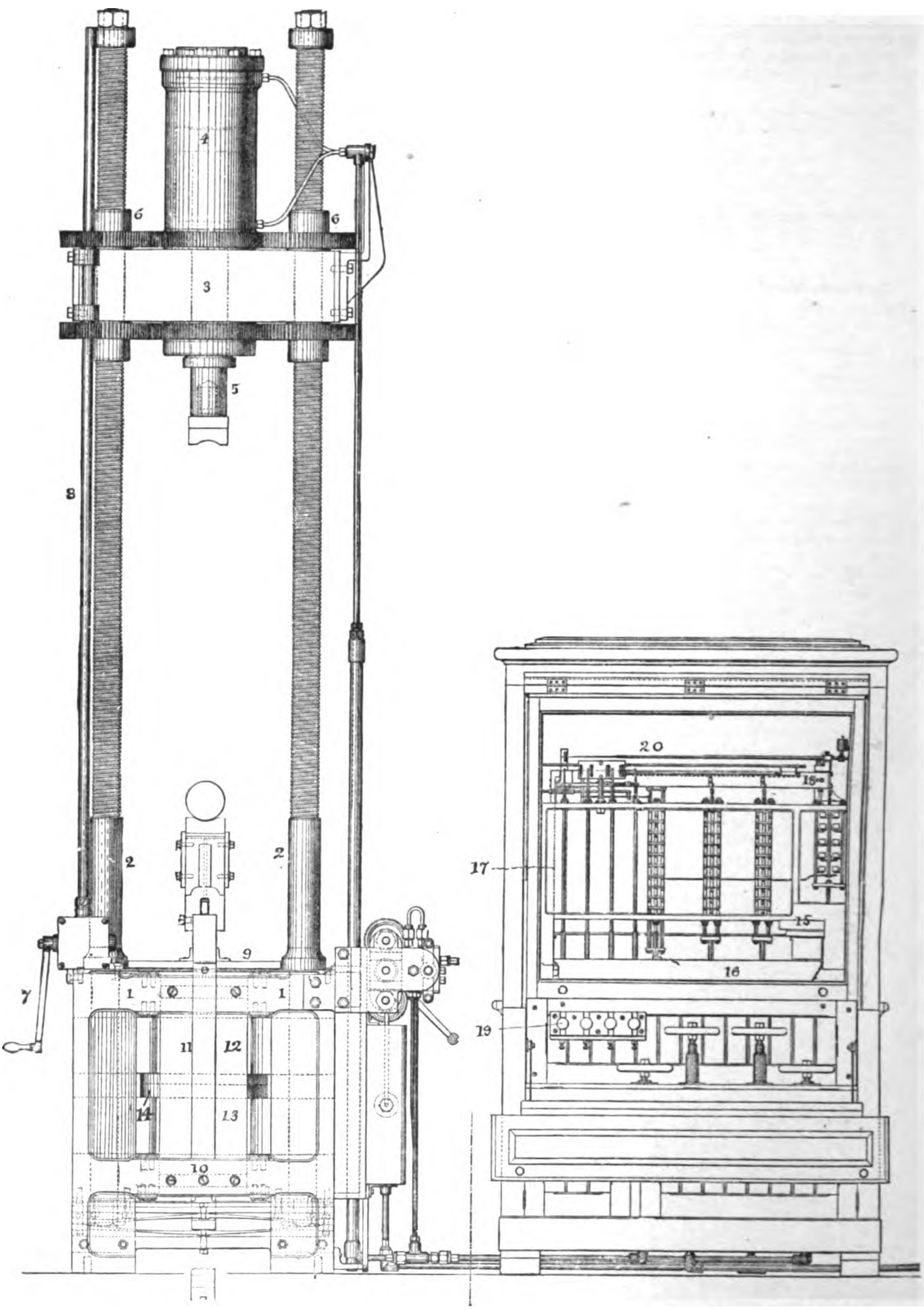


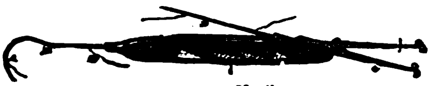
PLATE XLIX. EMERY'S TESTING MACHINE See page 887.

The heaviest piece weighs 830 lbs. The cubic measurement of the whole is about 40′.

Ten-ac′u-lum For′ceps. (*Surgical.*) An instrument for withdrawing and detaining the parietes of an artery to facilitate tying.

Ten-ac′u-lum Nee′dle. (*Surgical.*) A curved surgical needle, Fig. 2415, the invention of Dr. C. J. Cleborne.

Fig. 2415.



Tenaculum Needle.

Ten′der Por′ce-lain. (*Ceramics.*) A soft body porcelain made in Europe.

a. The kaolin body porcelain of England is composed of—

Calcined bone-dust	47
Kaolin	34
Feldspar	19
	100

The phosphate of lime gives a translucent character, but the ware is tender and baked at a low heat.

b. Pâte tendre is a vitreous porcelain, formerly made at Sèvres, before the Böttger recipe for hard porcelain was introduced at Sèvres in 1765. *Vieux Sèvres* was abandoned in 1804.

Ten′sion Ap′pa-ra′tus. Fig. 2416 represents Dalton's apparatus, used by him, for the determination of the tension of the vapor of ether, and is interesting as being the instrument by which he arrived at one of his most important experimental laws, — the law of tensions. Almost all the apparatus of Dalton is of a somewhat rude description; this gives it the more interest, knowing as we do the immense results he obtained with their aid. The one under notice is no exception to this, being made by him of wood, the central figures and lines being written on paper, which is pasted on. It is about 3′ long.

Fig. 2416.

Tension Apparatus.

Ten′sion Rol′ler. A pulley, drum, or roller resting against a belt to cause it to adhere to the driving pulley. A *tightening pulley.*

Fig. 2417.

Dark Tent.

Tent. Fig. 2417 shows a dark tent for use in developing the plates in outdoor photography. The box carrying the tent and forming part of same contains a reservoir and developing tray, and is mounted on a light tripod. One of the many improvements in out-door photography by the Scovill Manufacturing Co., of New York.

Test′ing Ma-chine′. A machine for ascertaining the strength of an object for trial.

A familiar class of machines of this character are *dynamometers*, which are, however, principally adapted to ascertain the power or strength exerted; while those usually termed *testing machines* are intended to ascertain the strength of materials.

There is no absolutely clear line to be drawn between these classes of machines. It is a question of adaptation and application.

The ordinary form of testing machine for ascertaining the strength of metals is founded upon the Roman *statera*, the lever balance, with special arrangements incident to its new function. Such are shown on pp. 2536–2539, "*Mech. Dict.*"

Ordance Department machine, Fig. 6323.
Prof. Thurston's machine, Fig. 6324.
Colt's armory machine, Fig. 6325.
Fairbanks's machine, Figs. 6326, 6327.
Kirkaldy's (English) machine, Fig. 6328.

A number of machines, usually of a smaller size than these which deal with steel rods of inch square section, for instance, are made for various other tests, and these may be found in this volume under the following heads: —

Belt-tension apparatus.	Oil tester.
Cable testing machine.	Paper tester.
Cement tester.	Petroleum tester.
Cloth tester.	Pipe testing machine.
Coal testing apparatus.	Spring tester.
Dynagraph.	Strain measurer.
Dynamometer.	Tannin tester.
Fiber tester.	Taseometer.
Gas testing apparatus.	Test gage.
Lubricant tester.	Wire tester.
Milk testing tube.	Yarn tester.

It should be added that a large number of instruments are also *testers*. As, for instance —

The *photometer* is the tester of the illuminating quality of gas, candles, etc.

The *pulsometer* or *sphygmometer*, of the rate and force of the pulse.

Without adding other instances, please refer to specific index, under the caption MEASURING, CALCULATING, TESTING, AND RECORDING INSTRUMENTS.

In the Emery system of testing machines, scales, gages, and dynamometers, power is transmitted from the load to the indicating device, by means of liquid acting on diaphragms, so as to avoid friction and give the result with the utmost accuracy.

Plate XLIX. represents a fifty-ton testing machine made under this system. It is constructed with a bed, 1, to which are firmly fixed stationary straining screws 2. Adjustably mounted on these is a straining beam, 3, carrying a straining press, 4, in which is a double acting piston, with piston-rod, 5. Geared nuts, 6, operated by a crank, 7, through the medium of a splined shaft, 8, move the straining beam 3 up or down to adjust its position for long or short specimens and to give light strains if desired. Heavy strains, and usually light ones, of either tension, or compression or transverse loads are given to the specimen by the hydraulic press piston, 5. The strain is transmitted directly from the specimen to a yoke consisting of a platform, 9, a beam, 10, and connecting plates, 11, which yoke is fixed in position by flexible plates and transmits pressure in the axis of the machine to a pair of coupled load beams, 12 and 13, between which rests a hydraulic support, 14. With strains of tension, 13 is the free platform and 12 the bed of the scale. For compression or transverse loads, 13 is the bed of the scale and 12 the free platform, the strain being transmitted from the specimen to the support 14 in either direction according to the direction of the strain. The pressure on the liquid in the hydraulic support 14 is conveyed to a small chamber, 15, in the weigh case. From this small chamber the pressure is communicated through a fixed fulcrum plate to the levers 16, 15, and from it through a yoke, 17, to a lever, 18, to which are attached a series of poise-rods, each carrying 10 weights which are operated by levers 19, 18. The weights have values of 10, 100, 1,000, and 10,000 each, depending on which poise-rod they are applied to. An indicator, 20, 19, shows when the scale is balanced. The ratio of movement of the indicator to the platform is 400,000 to 1 in this machine, so that a millionth of an inch movement of the platform gives .40 of an inch at the indicator. The drawing shows the transverse apparatus in position with a specimen ready to be loaded.

A testing machine of four hundred tons capacity built by Mr. Emery for the United States government has been in practical use for seven years without repairs of any sort and its efficiency and delicacy are as great as when first erected.

In regard to this machine the late eminent engineer, Alexander L. Holley, said: —

"The excellence of the machine in every respect is more than satisfactory, and its accuracy is at first sight astonishing, although an investigation of its principles must show that if the weighing apparatus will weigh at all, it must do so with perfect accuracy, because all its movements are absolutely without friction.

"The proof experiments were numerous, and the effects of recoil after sudden ruptures at maximum loads, were watched with great care, but without much anxiety, because the weighing parts affected are by no means delicate in structure and their motion is almost infinitely small. Among the tests were the following: —

"A forged link of hard wrought iron, 5″ in diameter between the eyes, was slowly strained in tension, and broke off with a loud report at 722,800 pounds. The diameter before breaking at the point of fracture was 5.04″; after breaking 4.98″.

"In order to see if the weighing parts had been disturbed by the recoil, which was obviously near the greatest recoil the machine will ever suffer, a horse-hair was next tested; it was 7-1000ths of an inch in diameter; it stretched 30 per cent. and broke at 1 pound. Other horse-hairs varied in tenacity between 1 and 2 pounds. A 5″ round bar, turned down to 3⅛″ in diameter along the center, was pulled apart at 430,200 pounds tension. Then some more horse-hairs were tested; also copper wires 19½-1000ths of an inch in diameter, which averaged 25 pounds tenacity.

"Specimens were subjected to 1,000,000 pounds compression although the contract calls for but 800,000 pounds. After these proofs, delicate structures such as eggs and nuts were tested in compression, and violin strings in tension. It is unnecessary to multiply instances. It seems safe to conclude that bars and structures up to 400 tons can now be tested with perfect accuracy, and that there is no reason to fear the deterioration of the weighing apparatus.

The machine consists of a double-acting straining cylinder and ram on a carriage at one end, and a movable weighing apparatus at the other end. The two are connected by a pair of 8½″ screws, 48′ long. Nuts driven by shafting move the straining cylinder to different places on the screws, so as to test long and short specimens. The weighing apparatus has been described as a reversed hydrostatic press, having diaphragms instead of pistons. The load is transferred by means of a liquid (alcohol or glycerine) by a series of large diaphragms to a series of small ones, and finally to a system of scale-beams. Thus a weight of 800,000 pounds acting through an inconceivably small space, finally moves a finely graduated indicator at the rate of 1-100th of an inch per pound. It is allowed to move through a space of 2″ and is kept balanced by weights mechanically placed quickly on or off the scale-beam. One pound, in moving the indicator 1-100th of an inch, moves the platform against which the load presses, 1-42,000,000th of an inch. The whole arrangement of the scale-beams, the adding and removing of weights, and the fast or slow but always steady application of pressure are ingenious and convenient in the highest degree. By means of universal joints, the pressure pipes are always connected to the straining cylinder, etc., whatever the position. The steam pump and the accumulator have cylinders and weights respectively for high and low pressures, and the machine receives pressure without pulsation, from the accumulator only, when testing

"The finished metal in the machine weighs 175,000 pounds and includes pieces of 14,000 pounds down to those of which 250,000 would weigh 1 pound. The hydrostatic weighing platform of the machine was tested to 1,500,000 pounds, but so perfectly frictionless is it that a horse-hair under a breaking strain of one pound had to move 24,000 pounds of metal. The workmanship is also remarkable. The 8½″ screws, 48′ long, were fitted to gages within 1-1000th of an inch in diameter throughout their length, and similar accuracy was maintained in other parts."

The boiler plate testing machine of E. & J. Fairbanks & Co., used by the U. S. steamboat inspectors, has a capacity of 75,000 lbs.

The weighing apparatus is a regular platform scale, and may be tested with standard weights to prove its accuracy. The strain is applied to the specimen of boiler plate by means of two screws and worm gears worked by a large gear-wheel and a small pinion. The main beam *A* of the scale carries a poise or weight *B*, which moves on rollers and may be run out to 75,000 lbs. The light beam *C* has a finer graduation on it, running up to 6,000 lbs. The poise *D*, on this beam, is moved automatically by an arrangement of clock-work, *E*, attached to the end of the beam.

The platform of the scale *K* rests on four knife-edges in the main levers *F*, one at each corner of the scale. These levers connect with the double lever *G*, through which the strain is transmitted to the lever *H*, and then through the lever *J* to the steelyard rod of the scale and by that to the beam *A*.

The two columns *L L*, with the cross-head and upper clamp *M*, rest on the platform of the scale. The lower clamp *N* is secured to the cross-head *P*, which is worked up or down by the screws *R R*, turned by worm gears *S S*, on their lower ends, which receive their motion from worms on the shaft carrying the gear-wheel *T*.

To make a test, the specimen *V* of iron to be tested is secured in the clamps *M N*, by steel wedges *W W*. When this is done the specimen is the only connection between the screws and gearing and the platform of the scale.

To begin the test the pinion *U* is shipped out of gear, and the gearing and screws are turned by the handle *Y* until a slight strain is applied to the specimen, when the pinion *U* is shipped into gear. As the strain on the specimen increases the beam of the scale rises, causing the automatic poise *D* to move along on the beam until it reaches the point equal to the strain applied to the specimen, when the beam drops and the poise instantly stops. This operation is continued until the specimen is broken, when the point at which the poise stands will indicate the exact number of pounds which were required to break the specimen.

The testing machine of M. Thomasset (French), Fig. 2417½, avoids the blows incident to the piston of the hydraulic pump when moved by a lever, and has a piston moved by a screw, preventing any jar.

The pressure in the pump is obtained by a hand-wheel on whose shaft is a worm gearing into a cog-wheel on the shaft of the screw whose lower end carries the piston. The pressure in the pump cylinder is transmitted by a pipe to the horizontal cylinder in which is the piston whose rod exerts the tractive force upon the piece under experiment. The other end of the test-piece is held by a clasp connected with the short arm of a heavy lever, the horizontal arm of which rests at its end upon the diaphragm of a cylinder, the water in which transmits the pressure to a column of mercury in the manometer standing alongside

The machine requires but little change for making tests in compression. For flexion the piece is supported between two edges, and a third one at the end of the ram is brought against the middle of the piece.

The following references may be consulted: —

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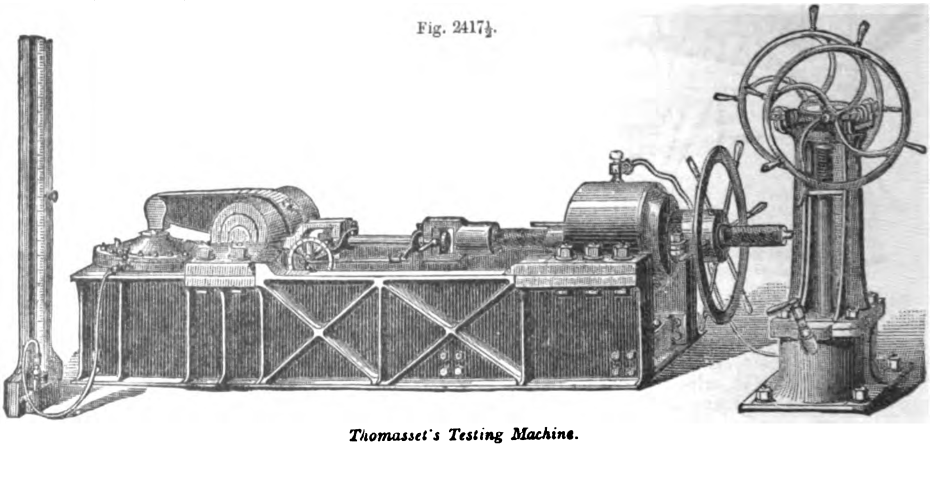
Watertown Arsenal, *Emery*	xxvii. 267.
Chauvin & Marie-Darbel	* xxvi. 184.
Greenwood & Batley	* xxviii. 244.
Mulhouse (100 ton)	* xxix. 494.

Fig. 2417½.



Thomasset's Testing Machine.

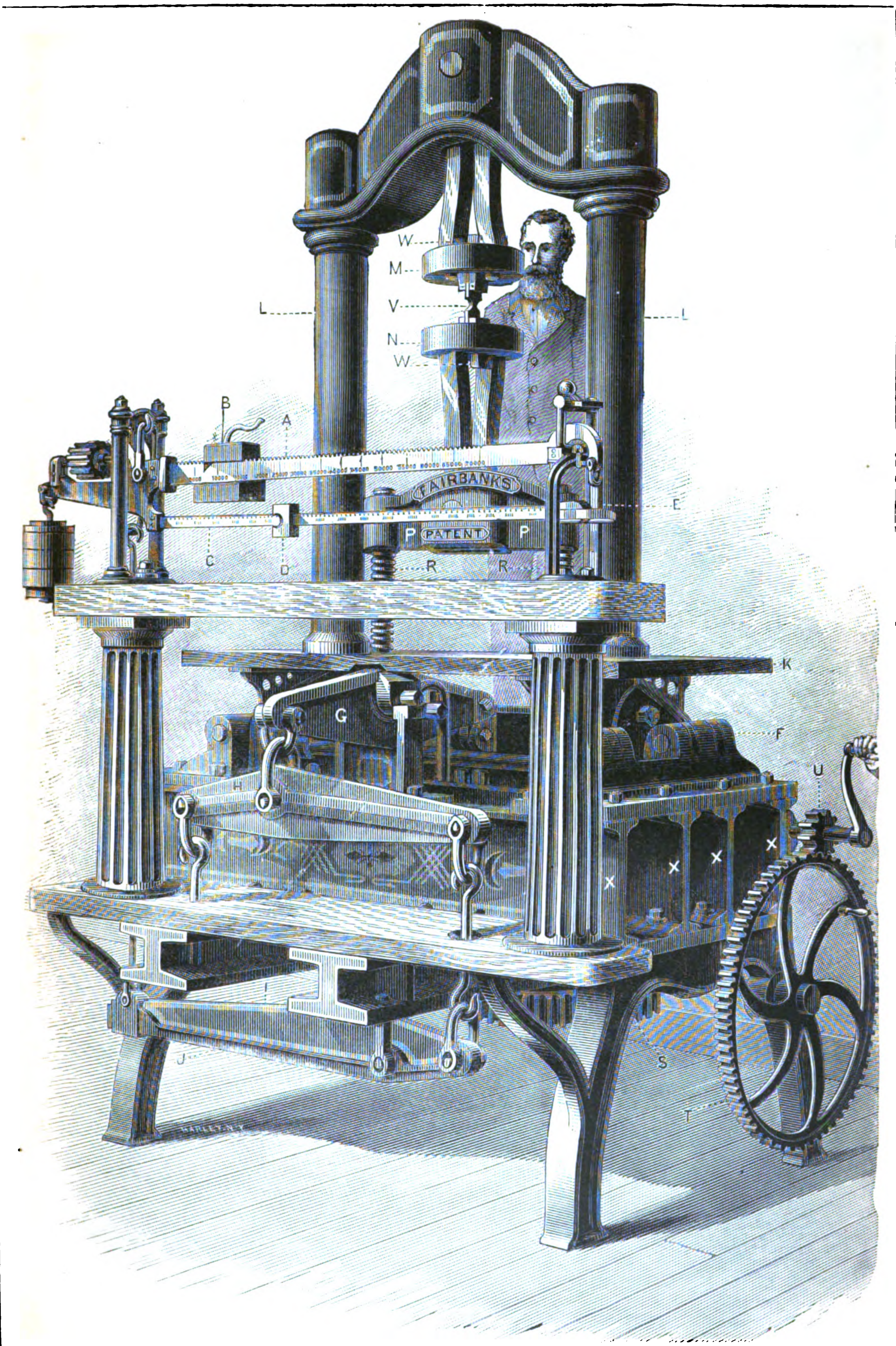


PLATE L. FAIRBANKS' TESTING MACHINE. *See page* 888.

Water pipe . . . . * xxviii. 178, 215.
Lubricants, *Thurston* . . . . . * xxiii. 176.
Ingram & Stapfel . . . . . . * xxiii. 28, 33.
Eastern Ry. of France . . . . * xxvii. 284.
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Lubricants . . . . . xxxiii. 7; * xxxv. 177.
(Electric) . . . . . xxxviii. 351.

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Riehle . . . . . . * xviii., Dec. 14, p. 1; xix., May 10, p. 18.
Riehle (hydraulic) . . * xx., July 19, p. 9; Aug. 30, p. 1; * xxvi., July 29, p. 9; Dec. 16, p. 1.
Allison (hydraulic) . * xx., Dec. 6, p. 3.
Chauvin & Marie Darbel * xvii., July 18, p. 1.
Watertown, *Emery* . xxiii., Feb. 20, p. 9; Feb. 27, p. 17; xxiv., Dec. 25, p. 15.
Specimens and grips . * xxiii., April 3, p. 9.
Gill . . . . * xxiii, May 22, p. 1.
Grout, Engl. . . . * xxiii., April 3, p. 3.
Kennedy, Eng. . . . * xxiv., Dec. 4, p. 1.
On metal testing machine xxxv., June 24, p. 3.
Chain cable . . . . xx., Aug. 16, p. 14; Sept. 20, p. 15.
" Little Giant " . . * xxi., June 27, pp. 9, 14; xxv., June 17, p. 9.
U. S. boiler plate tests . xxvi., July 29, p. 12; Aug. 26, p. 9.
Wire, *Riehle* . . . . * xxii., Nov. 21, p. 1.
Ritter . . . . . . xxii., Nov. 14, p. 20.
Cloth, *Riehle* . . . . * xxiii., June 12, p. 5.
Lubricant, *Regray*, Fr. . xxii., Nov. 21, p. 15.

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Bailey . . . . * xxxviii. 130.
Fairbanks . . . . * xlii. 262.
Chaurin & Marie-Darbel . . * xxxix. 210.
Thurston . . . . * xxxvi. 342; xxxviii. 130.
Kerosene, *Mead* . . . . . * xxxiv. 402.
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Pease . . . . xliii. 323.
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Lubricants, *Deprez & Napoli* . * xxxvi. 214.
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Yarn, *Brown & Sharpe* . . . * xxxv. 275.
Tissues . . . . xxxviii. 74.
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French . . . . 987.
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Fibers, tests for . . . . . 1430.
Cement, *Michaelis* . . . . . * 3748.
Cement . . . . * 2335.
Oils, chrono-thermo, for . . * 181.
Adulteration, *Ingram & Stapfer* * 1073.
Metal, *Riehlé* . . . . . . * 498.
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Cloth, *Fairbanks* . . . . . * xi. 178.
Cables, E. R. Bridge . . . . xii. 13.
Cement, E. R. Bridge . . . * xi. 108.
Fairbanks . . . . xii. 280.
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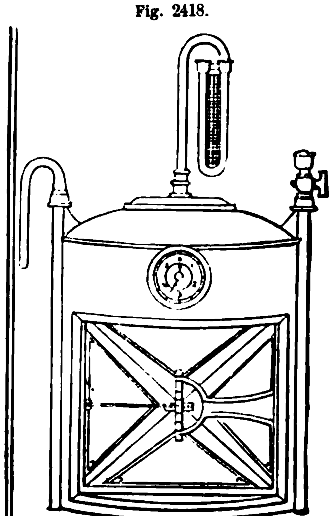
Metals . . . . . . * xli. 264.
Lever, Landore Works * xlii. 21.
Daniel Adams & Co. * xlviii. 412.
Tannin, *Muntz* . . . * xli. 171.

See also DYNAMOMETER.

Test Me'ter. Fig. 2418 shows an experimental or test meter for burners, etc. To insure a uniform and steady light it is made with three diaphragms, and is glazed in front and on top to show its

Fig. 2418.



Test Meter for Gas Burners.

various internal working parts. The dial is so divided as to show hourly rate of consumption by observations of one minute.

The-od'o-lite. A *distance telescope* (theodolite), with a self-registering scale of distances, has lately been invented in Sweden by Mr. Ljungström. The difference between this instrument and others of this class, is principally that the instrument itself effects all the calculations which otherwise are necessary in consequence of the inclined angles, and also that the distances sought are immediately marked on the plane-table. The line of sight upon a leveling-staff having been taken by the telescope which is fixed on a ruler that lies on the plane-table, and can swing round on a fixed needle to a piece as large as the part read off on the leveling-staff, is marked on a movable scale on the instrument, upon which a knob being touched, the point of a needle marks the distance on the paper. The calculating operations are effected by the inclined movement of the telescope, which, by means of a curved line, places the scale at such angles to the vertical plane of the line of sight that the sine for these angles constitute the square cosine for the inclined angle of the telescope, and this sine is then projected towards the movable needle.

Ther-a-peu'tic Ma-chin'e-ry. Fig. 2419, is Dr. Zanders' instrument for treating the muscles of the ankle.

It consists of a sole-plate, to which the foot is secured by means of two sliding stops working on a screw, and adjusted by a small lever. This sole-plate is mounted on a bent axle, the lower end of which is pivoted on to the frame of the machine, and the upper end is connected with a sliding-bar that passes through the spindle of a fly-wheel on the top of the frame. When this wheel is caused to revolve, the axle and sole-plate revolve with it, with an angularity of movement more or less marked according to the distance of the upper bearing of the axle from the center of the wheel spindle. The person operated upon sits in a chair in front of the instrument with his foot secured to the sole-plate as described.

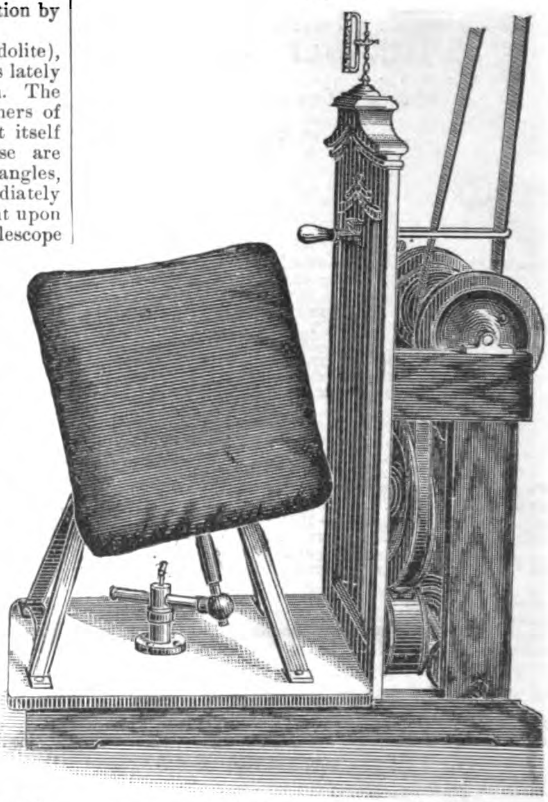
Fig. 2420 represents Dr. Zanders' machine, consisting of a saddle mounted on a shaft, the lower end of the shaft working in a socket on a sliding bar to regulate the motion. The patient, sitting astride of the saddle, is subjected to the influence of a more or less pronounced rolling movement, which brings the muscles of the trunk into action.

Fig. 2419.

Apparatus for Strengthening the Ankles.

Fig. 2421 represents Dr. Zanders' compound machine for acting on the muscles of the legs, and for friction or percussion on any part of the body. The former consists of a horizontal padded cushion, hinged at one extremity and resting on cams at the other, to which a very rapid rotary motion is imparted in such a way that the cushion is thrown into a state of intense vibration. The restorative action of this part of the machine is very remarkable. The other part of the apparatus consists of a vertical spindle sliding in long bearings, and capable of being locked at any height by the set screws shown. A very rapid reciprocating motion is imparted to this spindle by means of the small connecting rod shown on the left-hand side of the engraving. The pad at the top of the spindle is caused to move to and fro with about 600 strokes per minute. This

Fig. 2420.

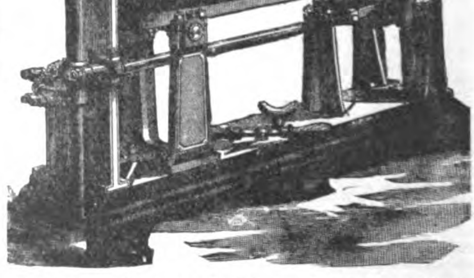


Apparatus for Developing the Muscles of the Body.

apparatus is especially intended for application to the back and shoulder, and different shaped pads are employed according to circumstances.

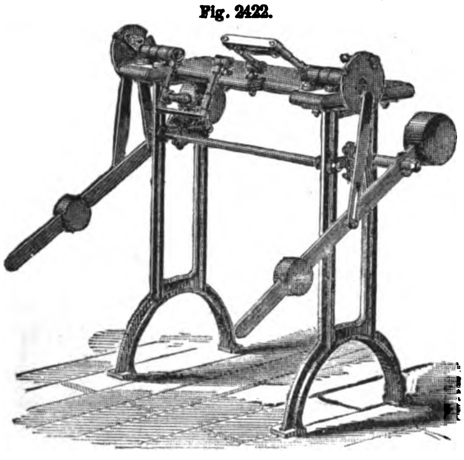
Fig. 2422 represents Dr. Zanders' machine designed for strengthening the wrists. With the fore part of the arm laid flat upon the table of the machine the patient grasps the two

Fig. 2421.



Apparatus for Developing the Muscles of the Legs and Body.

Fig. 2422.



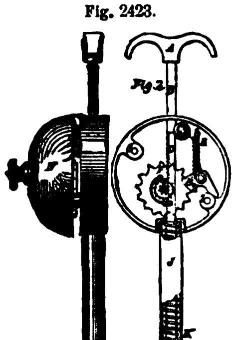
Wrist Strengthening Apparatus.

handles, and slowly raises them, repeating the operation as long as necessary. These handles are not connected with each other, but are hinged on the inner side to the table, and on the outer are connected to a shaft, on the end of which is a short crank, a pin at the end of which fits into one or other of the notches shown around the periphery of the disk, to which are coupled two rods carrying a transverse weighted bar. The effort required to turn this bar upon its center varies with the position of the balance weights.

Ther'mal A-larm'.

Fig. 2423 is an engraving of a very useful instrument designed and constructed by Mr. Stephen Alley, of Glasgow, Scotland, for giving a prompt indication of a hot bearing.

Fig. 2423.



Thermal Alarm for Hot Boxes.

The apparatus consists simply of a brass tube, *J*, which is placed in a hole bored in the cap of the bearing to receive it, the bottom of the tube touching the shaft. At one side, near the bottom, the tube *J* is partly cut away so as to admit of the ready insertion of a cylindrical plug, *L*, formed of a hard grease, or of a composition which will melt at the temperature at which it is desired that the alarm should be given. To insert the plug *L*, the handle *A* is pulled so as to draw up the spindle *B*, and thus, by compressing the spring *K*, make room between the bottom of the spindle and the bottom of the tube for the plug to be inserted. If the bearing becomes heated, the plug *L* begins to melt, and escapes drop by drop through the hole *M*. As this melting takes place, the spring *K* forces down the spindle *B*, and in so doing gives motion by the rack *D* to the pinion *G*, and thence by the ratchet *O* to the striking wheel *F*. This wheel, as it revolves, operates upon the pallet *H*, and alternately draws back and releases the hammer *C*, which, when released, is made to strike the interior of the bell *N* by the action of the spring *F*.

The instrument gives a number of clear and distinct signals as the composition melts, and can scarcely fail to call the attention of the engineer. It is, moreover, a very simple apparatus, and there is nothing about it likely to get out of order.

Ther'mo-cau'te-ry Ap'pa-ra'tus. (*Surgical.*)

An instrument with hollow platinum cautery, which, having been heated to blackness in a spirit lamp, receives a blast of benzine vapor from a spray bellows which heats the cautery to redness, and maintains the heat by an occasional pressure of the air-bulb.

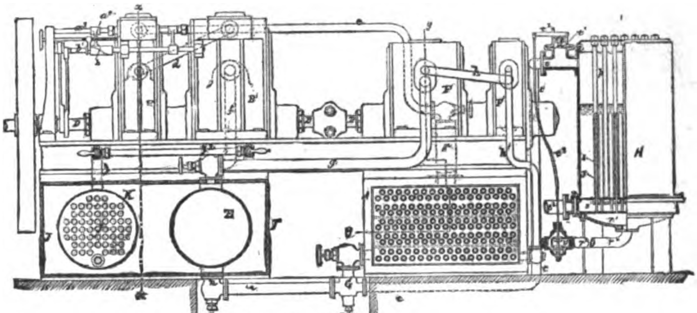
Paquelin's Fig. 482, Part I., *Tiemann's "Armamentarium Chirurgicum."*

Ther'mo-dy-nam'ic En'gine.

Fig. 2424 represents Gamgee's engine, the "Zeromotor." A motor engine with conditions of a closed circuit with a liquid boiling at a low temperature relatively to water transformed into vapor, the molecular energy of which is converted into the mass or molar motion of the piston, so that its initial condition is restored. In this way, in a heat engine, the temperature is extended within which the heat is utilized downward in the direction of the absolute zero instead of upward above the temperature of surrounding objects.

The agent intended to be used is anhydrous ammonia, the boiling point of which at atmospheric pressure approaches closely to 34.4° centigrade. At 0° centigrade its vapor tension is 3,183.84 millimeters, or about four atmospheres, while at 10° it attains to 4,574.03 millimeters or six atmospheres. When the mean temperature attains 20° centigrade no less a pressure is exerted than 6,387.78 millimeters, or nine atmospheres; and at 30° centigrade, or tropical heat, it reaches over 8,000 millimeters, or over 10½ atmospheres in tension. Since at blood-heat 200 lbs. to the square inch is available, it is evident that the usual temperature of ocean or river water is most desirable in practice, and best, it is thought, when below 20° centigrade. The latent heat of ammonia (900° as against 960° for water) is used in developing energy, so as to reduce the amount of rejected heat to a minimum, and obtain a maximum rate of liquefaction.

Fig. 2424.



Thermo-dynamic Engine.

The engine shown in the figure is a double-cylinder rotary engine, *B* being the first or high-pressure cylinder, and *B'* the second or low-pressure cylinder, into which the first cylinder exhausts through pipe *d*. As seen in section, the gas or vapor enters the cylinder *B* through the valve *a* and sliding division-port *a'*, which runs in contact with the eccentric rotary piston *C* in the usual way. The admission-valve is operated from the rocking valve-rod a^3 in the usual way, said rod having an arm, a^2, which bears against the rotating adjustable cut-off cam *b*, whose shaft *b'* is rotated through the medium of eccentrics and connecting-rods from the main shaft *D* in the ordinary manner. The exhaust-port of the first cylinder is shown at *d'* in communication with the exhaust-pipe *d*, which leads to the gas or vapor admitting valve of the second cylinder *B'*. The latter, with its accessories, is similar, except in size, to the first cylinder *B*, the shaft *D* being common to both, and the two cylinders are combined together for operation in the same way as the two cylinders of an ordinary compound or double-cylinder rotary engine.

The pipe *e* conducts the liquefiable gas or vapor to the primary cylinder *B* from the dome A^1 of the part *A*, which, for convenience' sake, will be termed the "boiler."

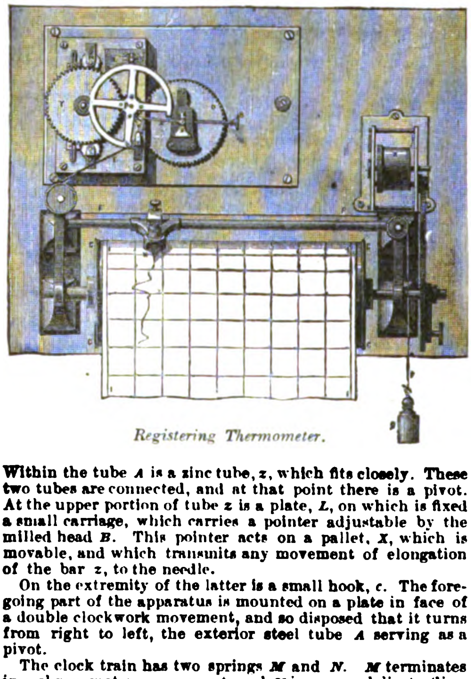
The exhaust-pipe *f* from the second cylinder *B'*, leads into the closed exhaust-vessel *E*. This vessel receives, through the exhaust-pipe *f*, the liquefied vapor and gas from the second cylinder.

From the upper part of the exhaust-vessel leads a pipe, *g*, to the larger cylinder *F* of a compound or double cylinder rotary pump, *F F'*, driven by the rotary shaft *D*. The smaller or high-pressure cylinder *F'*, with its accessories, is the counterpart of the other, and has its induction-port in communication with the eduction-port of the larger cylinder through the intermediary of pipe *h*. The eduction-port of the smaller cylinder *F'*, communicates through pipe *h'*, with the space in boiler *A*, which receives the liquid from which the motor gas or vapor is to be generated.

Ther-mom'e-ter. Fig. 2425 is a representation of Redier' new registering thermometer which operates through the dilatation in a straight line of two metals, zinc and steel.

If a multiplying mechanism be mounted on a steel bar, 39'' long, and connected with a zinc bar of the same length, the difference of the two expansions per 212° Fah. will be about .08''. This difference is used in the present apparatus to register changes in temperature. The thermometer proper consists of an exterior steel tube, *A*, which carries a toothed wheel, *D*, on which multiplying mechanism is mounted.

Fig. 2425.



Registering Thermometer.

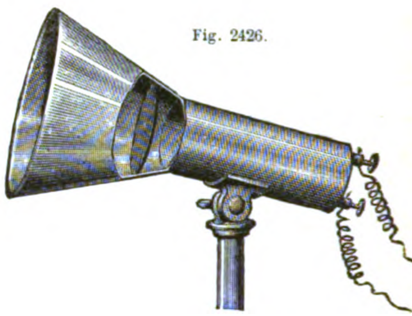
Within the tube *A* is a zinc tube, *z*, which fits closely. These two tubes are connected, and at that point there is a pivot. At the upper portion of tube *z* is a plate, *L*, on which is fixed a small carriage, which carries a pointer adjustable by the milled head *B*. This pointer acts on a pallet, *X*, which is movable, and which transmits any movement of elongation of the bar *z*, to the needle.

On the extremity of the latter is a small hook, *c*. The foregoing part of the apparatus is mounted on a plate in face of a double clockwork movement, and so disposed that it turns from right to left, the exterior steel tube *A* serving as a pivot.

The clock train has two springs *M* and *N*. *M* terminates in a chronometer escapement, and *N* in a very delicate flier, which turns with great rapidity. These two movements are interconnected by the differential train *R R S*. The satellite *S* entrains the axis *A* which on one side carries the pulley *P* on which is wound a cord which moves the pencil, and on the other a pinion, *E*, which engages with the wheel *D* of the thermometer. These two gears are so constructed that the velocity of motor *M* being 1, that of motor *N* will be 2.

We may now trace the operation under a constant temperature. The hook *c* of the needle *A* stops the small fly-wheel. The escapement *E* of the motor *M*, which works constantly, turns the large wheel *D* from right to left. The needle *A* follows the movement and disengages the flier *V* and spring *N*. The latter now being freed, and its velocity being .2, while that of the escapement is .1, tends to turn the wheel *D* from right to left until the needle *A* again catches by its hook, when the same operation is repeated. As the pulley *P* makes the same movement as the wheel, the pencil will trace on paper, if the temperature remains constant, a right line, apparently continuous, but in reality formed of a series of very small zigzags. This movement of constant oscillation is of great importance as regards the sensitiveness of the instrument, as it suppresses the effect of friction at starting and renders the instrument always ready to show instantly the least change of position of the needle. If the temperature augments, the flier *V* remains hooked for a longer or shorter period, proportional to the change of temperature, and as the increase, while turning the wheel *D* from left to right to unhook the flier, also causes the turning of the pulley *P*, the latter will rotate over an angle proportionate to that which the change of temperature causes the needle to pass over. The inverse effect is produced when the temperature falls. The pencil *K*, Fig. 2425, moves on a cylinder, *C*, on which the paper *H* is rolled. The chronometer *R* regulates the movement of this cylinder at a velocity of 0.16'' per hour.

Fig. 2426.



Thermo-telephone.

Ther'mo-phone. (*Electricity.*) An instrument in which sonorous vibrations are produced by the expansion of bodies under the influence of heat. One that produces sound by thermo-action through conversion of forces, or in other words, in rapid expansion and contraction of its circuit by sudden changes of temperature.

Wiesendanger	* "*Teleg. Journal,*" vi. 410.
	* "*Engineer,*" xlvi. 335.
Hughes	* "*Engineer,*" xlv. 344, Fig. 8.

Ther'mo-scope. When chloride of cobalt is dissolved in a definite quantity of strong wine spirit, or alcohol slightly diluted with water, a solution is obtained the color of which varies in a curious manner with the temperature of the surrounding air. Exposed to cold air it develops a bright pink color, which, as the temperature of the air increases, passes through various shades of color, until at last, when the liquid becomes quite warm, it assumes a strong blue or violet blue hue. These color changes are primarily due to the fact that in the cold alcoholic solution the salt appropriates a portion of the water, and when heated, it parts with this water of crystallization or hydration. When the proportions of the chloride of cobalt, alcohol, and water are properly adjusted, and the liquid is sealed in a narrow glass tube, it becomes quite sensitive to change of temperature, and the varied changes of tint when compared with a standardized color scale may serve, within certain limits, as a rough index of the temperature of surrounding bodies, thus constituting the little instrument a thermoscope, if not entitling it to the name chromothermometer, which has been given it. The statements to the effect that changes of color are due to the action of light and electricity or atmospheric humidity, etc., are of course erroneous.

To prepare the solution, dissolve a few crystals of chloride of cobalt (pure) in two or three drachms of warm water, and to this add strong alcohol until, when exposed to a temperature of about 70° Fah., the liquid presents a slaty color, — intermediate between the pink and blue. The proportions will then stand at about twenty grains of the salt to the fluid ounce of alcohol. If too blue, more alcohol or a drop of water may be added to the solution; if it inclines too strongly to the pink a few more grains of the salt.

The solution may be poured into a long, narrow test tube, leaving the upper part of the tube unoccupied, so that it may be subsequently drawn out, and sealed hermetically by means of the blowpipe.

The remarkable properties possessed by some of the solutions of this salt certainly suggest the possibility of applying it to something of greater practical utility than the curious toys in which it has thus far been chiefly employed.

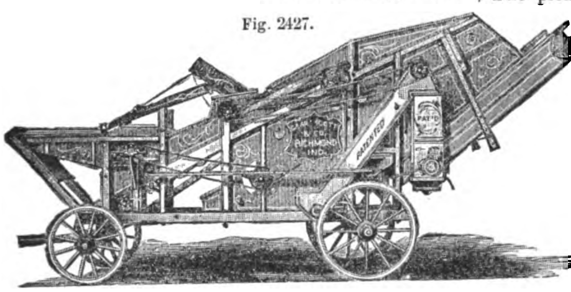
Ther′mo-tel′e-phone. (*Electric.*) Fig. 2426 is a thermo-telephone.

It consists of a thermopile having placed in its collecting funnel a hard rubber disk, as shown in the engraving. A sound made in front of this disk is heard in a receiving telephone connected with the thermopile.

The *rationale* of this is at once apparent when a strip of hard rubber is placed against the lips and bent, so that the strip will be alternately concave and convex. The difference in temperature is very perceptible, the convex surface being cold and the concave surface warm, and, however rapid the vibrations which render the surfaces alternately convex and concave, the result is the same.

Thom′son Bat′te-ry. (*Electricity.*) A modification of Menotti's battery, in which a copper tray

Fig. 2427.



Separator.

replaces the copper plate, and contains the sulphate of copper crystals, and the superstratum of wet sawdust upon which rests the zinc element.

The resistance of the battery is very low.

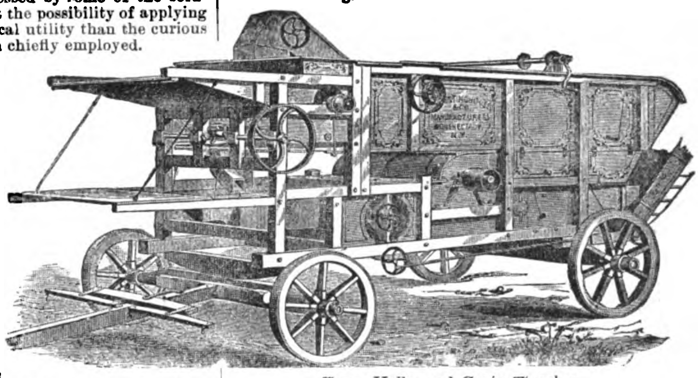
Niaudet, American translation, * 130.

Thrash′er. The Gaar separator, Fig. 2427, is an apron machine whose cylinder has from eight to twelve bars as may be desired, and is full curve spiked. The center heads are placed in the cylinders to increase their strength and the power of their momentum, so that they are not readily checked. All the eight and ten-horse machines, both geared and belt, have outside bearings and pivot boxes on the cylinder shafts. A concave adjuster enables the operator to raise or lower the whole concave any required distance while the machine is in motion.

The grain carrier is shaken its whole length by agitators, facilitating the separation of the grain from the straw. Either screw or drag elevators, as desired. All the geared machines have three hitch gear. The tail chain or straw carrier is shaken its entire length by revolving knockers. The shoe is shaken by a half cross belt, dispensing with the fan cog-wheels and shaker shaft. The cylinders have pivot boxes and steel set screws for adjusting the cylinder endwise.

In the Westinghouse combined clover and grain thrasher, Fig. 2428, the process of separation commences at the thrasher. The cylinder delivers the straw to the vibrating separator, where it is first agitated and loosened by a revolving picker, and a farther division of the seed or grain ensues. After passing the picker, the straw is moved back

Fig. 2428.



Clover Huller and Grain Thrasher.

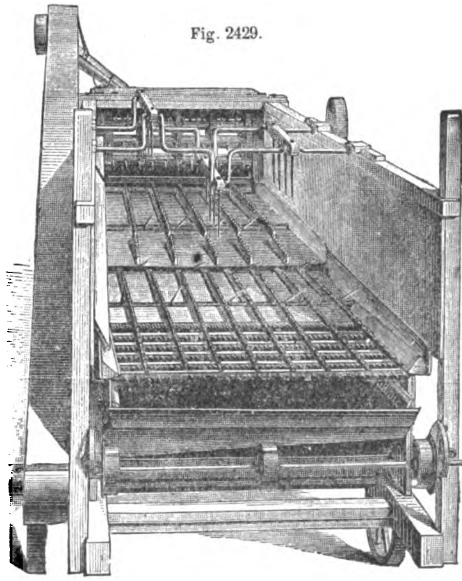
and over a series of shaking forks, which loosen it and permit the grain to reach the open platform, and escape to the grain carrier and fan. The picker, in addition to its help in separating, prevents the straw, with its accompanying seed or grain, from shooting back from the cylinder. The shoe has a short longitudinal action so as not to cause much vibratory motion to the machine.

There is an apparatus for elevating the clean grain or seed as it is discharged from the machine, and emptying either into the measures or bags, making a register of each measure as it is filled.

Thrash′ing Ma-chine′. Fig. 2429 represents an interior view of the Bonanza machine.

It is a vibrator, with large riddle surface, and strong frame, with few wearing points. It has a system of pickers that are useful, especially in damp grain. The front wheels

Fig. 2429.

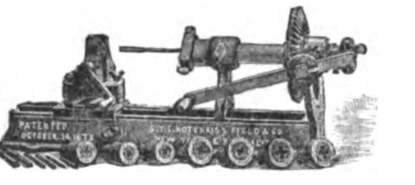


Interior of Separator.

cut under, making it easy to handle. It has many points of separation, and the tables are low.

Thread-cut'ting Ma-chine'. Fig. 2430 represents a self-centering machine for cutting threads in bolts, etc.

Fig. 2430.

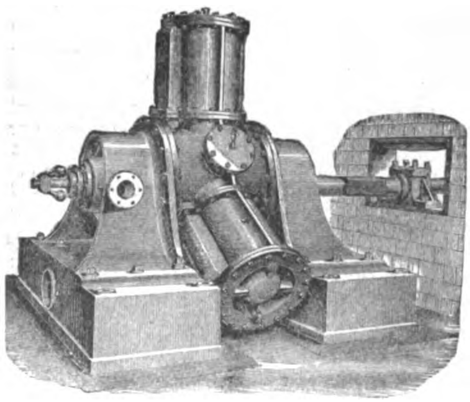


Thread Cutter.

Three-cyl'in-der En'gine. Fig. 2431 represents the Brotherhood engine.

The special advantages secured by the invention are as follows: The engine will start with the crank in any position, there being no "dead center," and a perfectly uniform motion of the shaft is obtained without the use of a fly-wheel; the connecting rods being always in compression, there is no blow on the crank-pin at either end of the stroke, no matter how loose the fit may be or at what speed the engine may be running. The working parts are entirely inclosed and protected from injury; the lubrication is easily effected;

Fig. 2431.



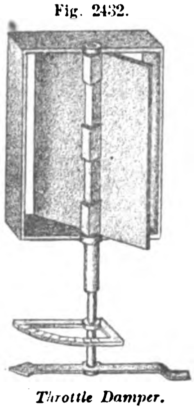
Three-cylinder Engine.

in the steam engine the rotary slide-valve is arranged to cut off at any required degree of expansion, and a governor and reversing gear is readily applied to the steam engine, while the hydraulic engine is made reversible by the addition of Ellington's patent controlling valve.

The high speed at which this engine may be worked, besides developing immense power in proportion to the size of the engine, permits of its being coupled directly to capstans, rotary pumps, fans, circular saws, screw propellers, centrifugal machines, etc.

The pistons are very deep and guide themselves in the cylinders. The connecting rods are of chilled cast iron in the hydraulic engine and of wrought iron well case-hardened in the steam engine, their crank-pin ends working on a hard gun-metal sleeve fitted to the crank-pin, and their piston-ends working in hard gun-metal sockets in the pistons. The crank shaft is of steel, and the crank, where necessary, is counterbalanced. The slide valve is rotary in the hydraulic and the steam engine, and is balanced, special means being adopted to insure uniform wear.

Fig. 2432.



Throttle Damper.

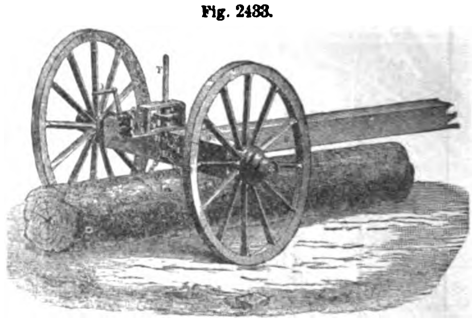
Throt'tle Dam'per. Fig. 2432 is a throttle damper, with arrow and quadrant, for regulating the passage of the flue and registering the same.

Throw'ing Wheel. (*Ceramics.*) The potter's lathe.

The accompanying engraving (Plate LI.) shows the interior of one of the workshops at Sèvres. On the right are shown the throwing wheels, and farther along are men at work molding small objects. On the left is an artist dressing (*grattage*) a green molded object with a scraper. On the throwing wheels, also, are dressed the green objects previously molded there, the operation being known as *tournassage*. See PORCELAIN MOLDING.

Tim'ber Cart. Fig. 2433 is a high wheeled cart for drawing timber. The timber, after the cart is driven over it, is raised to the axle by crank-gearing and tackle.

Fig. 2433.



Timber Cart.

Time Globe. Fig. 2434 shows the time globe.

Mr. L. P. Juvet, of Glen's Falls, N. Y., exhibited at the Centennial a novelty in horological manufacture, which was examined by all scientists with interest, and honored with unqualified praise from all skilled in horology. The time globe, as this invention is happily designated, is a horological apparatus by which the hour at any given place is designated and also the corresponding time anywhere and everywhere on the face of the earth. It consists of a terrestial globe, encircled at the equator by a zone dial, inscribed with

Fig. 2434.

Time Globe.

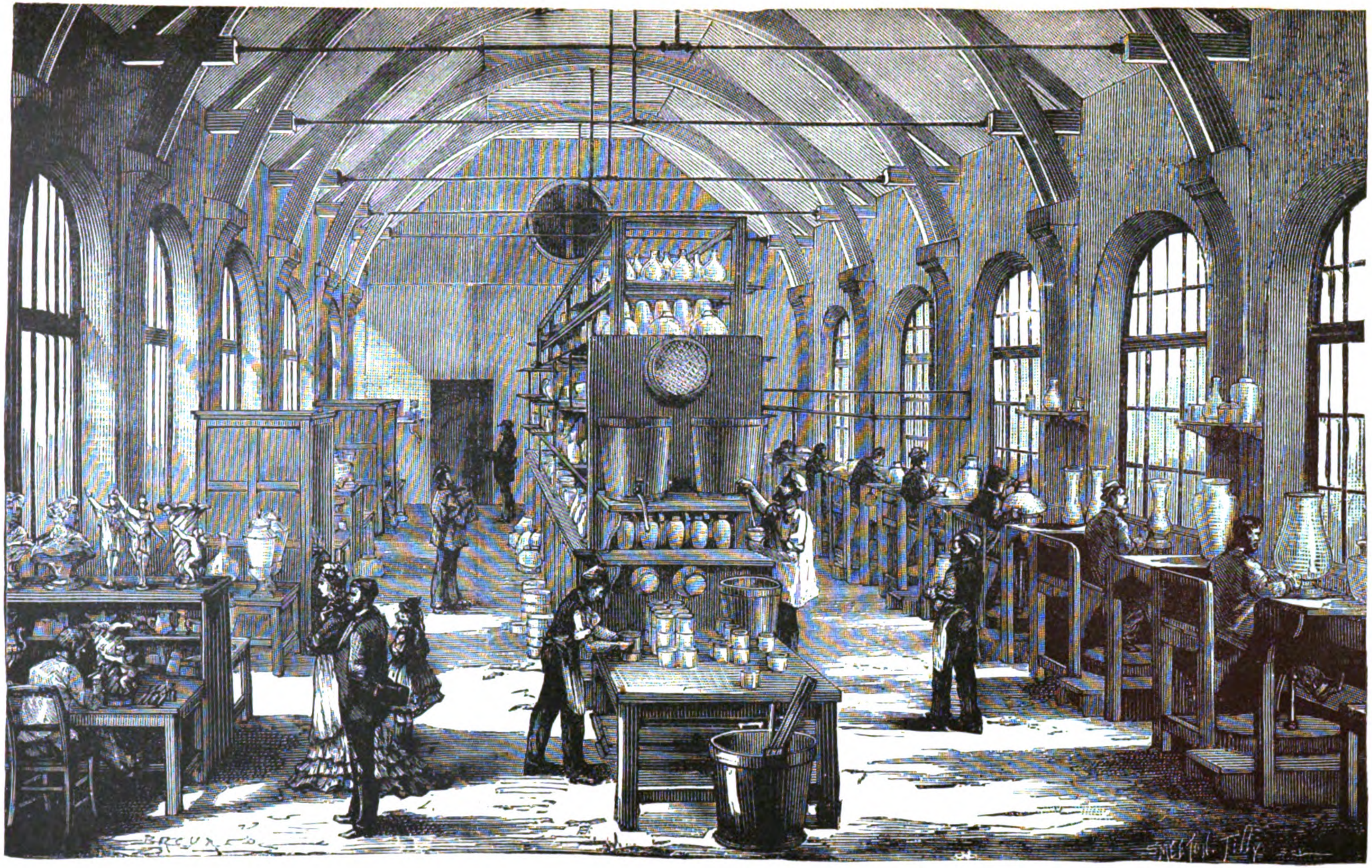


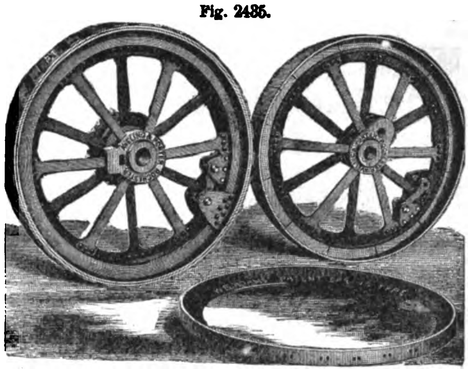
PLATE LI. PORCELAIN MOLDING ROOM. See page 894.

the twenty-four hours of the day and the fractions thereof, while an ordinary clock dial encircles the north pole. The zone dial is stationary, while the terrestial globe revolves on its axis once in twenty-four hours, exactly as the earth does. To set the apparatus in operation for any locality the hands of the clock dial are removed and replaced in position so as to accord with the time indicated by the longitude of that place on the zone dial at the equator. Care must be taken to set the globe in proper sidereal position by the compass, and also that the proper hour of day or night as designated by the zone dial indicates the actual time of day or night, as the case may be. This is easily determined by letting sunshine fall on the globe, and seeing which part is in light and which in shadow. Then set the hands of the clock dial to the actual time of the location, and the terrestial globe revolves on its axis so that the longitude of the location is opposite the same instant on the zone dial. Now the time globe is set, and a glance at the zone dial shows the time opposite every meridian of longitude, and consequently of every place on the surface of the earth. The hands of the clock dial revolve to the right, while the globe revolves to the left, consequently the relative difference in designation of time is maintained, and every meridian of longitude points out its mean time on the zone dial so long as the movement is regulated and kept in proper working order. The movement, which is self-winding in the terrestial globe, is made of two plates, in the center of which stands the main-spring and barrel, with its arbor extending through the globe at the south pole, outside of the meridian ring, where its end is provided with a knot or thumb-piece by means of which the clock is wound up. The shaft of the first wheel extends through the plate and receives a triple wheel intended to transfer to the minute, hour, and globe wheels their proper motions. The axis of these wheels is secured to the upper plate of the works by a flange with pins and screws, extends through the globe at the north pole to the meridian ring, where it is firmly secured by a set screw, and forms with the arbor the axis upon which the globe revolves.

Tire.

Fig. 2485 represents Adams's spring tires for locomotive wheels. To an inner tire of strong spring iron are riveted

Fig. 2485.



Tire for Locomotive Wheel.

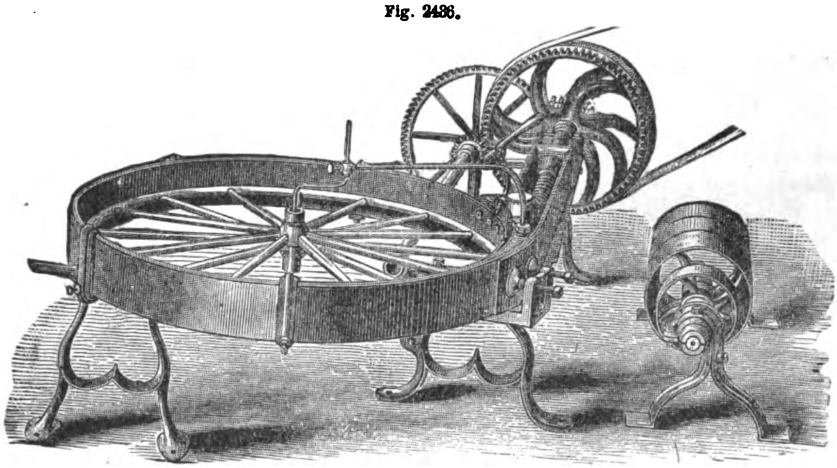
the wrought-iron spokes, while the outer iron consists of a hoop of suitable thickness, stiffened by angle-iron rings running around its edges, and faced with diagonal plates for giving the wheel increased adhesion, as well as for carrying the angle-iron paddles occasionally made use of on soft ground.

Solid blocks of india-rubber between the tires serve the purpose of a spring to the engine without interference with its gearing. The outer and inner tire of each wheel are coupled by a drag link to prevent friction on the rubber blocks.

Tire Set'ter.

The West tire setter, Fig. 2436, is arranged with a strap made up of several thicknesses of thin steel, and capable of being "set up" by a powerful screw, worked by a belt. A

Fig. 2436.



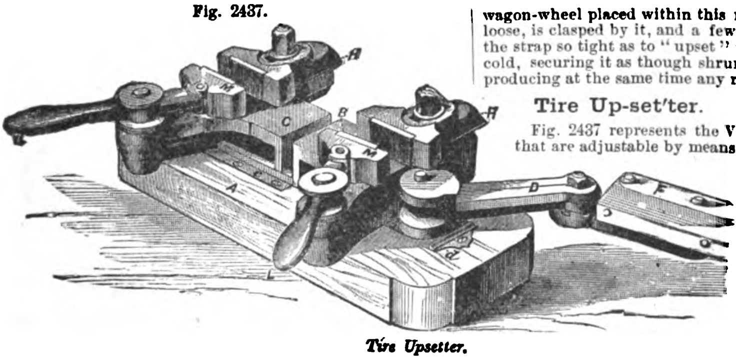
Tire Setter.

wagon-wheel placed within this ring, with its tire perfectly loose, is clasped by it, and a few turns of the screw draws the strap so tight as to "upset" the tire, although perfectly cold, securing it as though shrunken in the usual way, and producing at the same time any required dish of the wheel.

Tire Up-set'ter.

Fig. 2437 represents the Vulcan machine; has levers that are adjustable by means of a joint. They allow of grasping and holding various shapes of iron, from ½″ to 3½″ wide.

Fig. 2437.



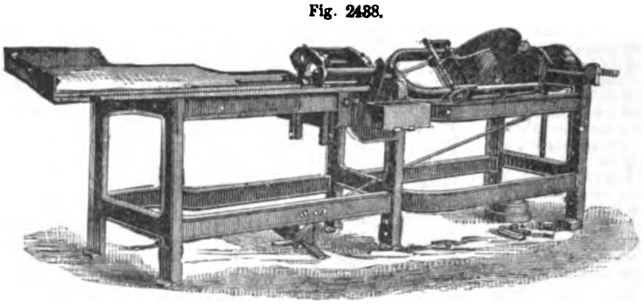
Tire Upsetter.

To-bac'co Spin'ning Ma-chine'.

Fig. 2438 shows the Robinson tobacco spinning machine.

A machine to spin small twist, constructed to run

Fig. 2438.



Tobacco Spinner.

at great speed, light, and without strain, making a fine cord. The rollers pass the twist between them, so as only to require winding up by the bobbin; this is done by a slight self-acting friction which is of a uniform tension and under the immediate control of the spinner. The machines are made to suit different sizes of twist, from 8-16″ to ¾″ and for any sort of tobacco. The quantity which can be spun per day varies from 75 lbs. to 250 lbs., according to size, etc. They will work either long or short-filler, there is no strain on the twist, and shorts can be spun if desired. The tobacco when spun passes on to the bobbin, which when full is very easily replaced by an empty one.

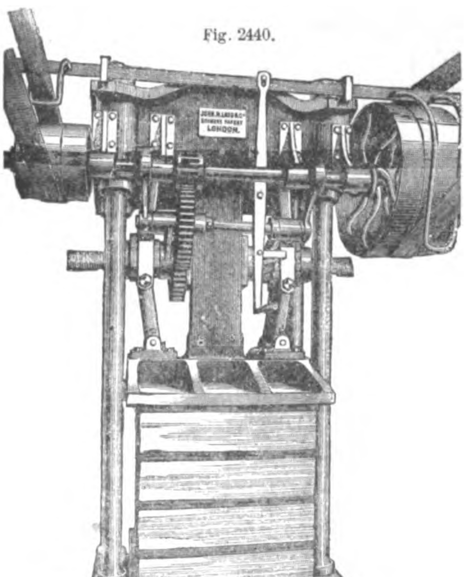
Tog'gle Iron. A harpoon, Fig. 2439, with latch that prevents retraction.

Fig. 2439.

Toggle Iron.

Tog'gle Press. A press in which the power is obtained by the action of one or more toggle joints. See p. 2586, "*Mech. Dict.*"

Fig. 2440.

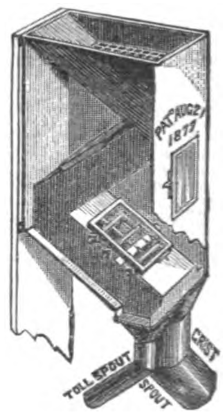


Toggle Press.

Fig. 2440 represents the Boomer & Boschert. The principle by which its accumulative power is acquired is the combination of four levers acting upon toggle joints, either to approach or to diverge, according to the direction of such rotation, with uniform motion. The power is controlled by a standard fastened to the follower sliding through the head block between the arms, maintaining the follower on a level, and preventing an endwise movement of the screw. The gross load is transmitted through the toggle joints to the top frame or head block connected with the base by the wrought-iron pillars. The power accumulates at each revolution of the screw, the follower decreasing in motion in precisely the same ratio as the power increases, so that at last the accumulated power is almost irresistible. The development of the pressure and the increase of the resistance being so nearly equal, it requires but little motive power to work it. Thus one man can work a press of 150 tons, and for the press up to 600 tons it requires but from one to two horse-power.

Tol'ler. (*Grist Mill.*) The Tom Thumb toller, Fig. 2441, is an automatic divider of the toll from the grist.

Fig. 2441.



Toller.

Tom'kin Post. (*Grain Mill.*) The post supporting the pivot end of the bridge-tree.

Tom Thumb Bat'te-ry. (*Electricity.*) A small and simple battery made of a couple of plates of zinc and lead placed in a tray with a solution of sulphate of copper, and furnished with binding posts for connections.

"*Scientific Amer. Sup.*" 2489.

Tongue Hold'er. (*Dental.*) Fig. 2442 represents Dr. Flagg's tongue

Fig. 2442.

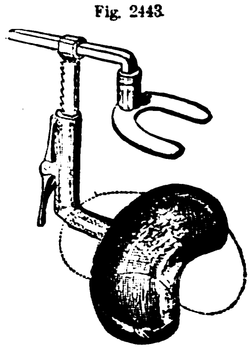
Tongue Holder.

holder for restraining the tongue from interference while the teeth are being operated upon by the dentist. See TONGUE DEPRESSOR, p. 2590, "*Mech. Dict.*"

Tongue Hold'er and Duct Compres'sor. Fig. 2443 represents Dr. Smith's tongue regulator and duct restrainer. By the use of this instrument the tongue is clamped down and held in position as desired.

The sublingual and submaxillary ducts are closed by placing upon them pads of bibulous tissue paper before applying the compress; a pad of paper or a napkin

Fig. 2443.



Tongue Holder and Duct Compressor.

should be placed on the tongue before adjusting the instrument in position for use.

To'nite. Dry nitrated gun cotton. Density 1.50, about the same as dynamite, and occupies in a blast-hole ⅜ the space of compressed gun cotton. Sold as a dense dry cartridge.

"*London Mining Journal*," 1878. See also "*Engineer*," 1878.

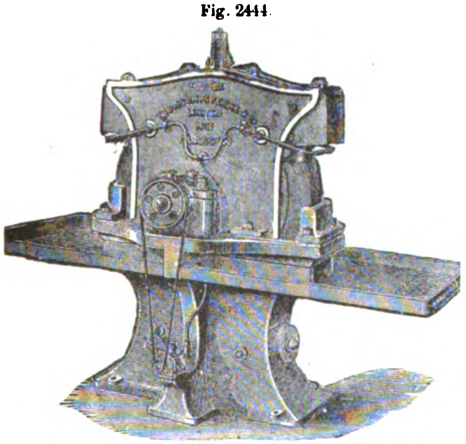
As made at Fernham, England, it consists of finely divided or macerated gun cotton compounded with about the same weight of nitrate of baryta. The gun cotton itself is mainly common cotton waste steeped in nitric acid, and on the excess being forced out by a hydraulic press or otherwise, it is left some time for digestion in vessels of clay. While moist, it is macerated between crushing rollers and then washed. The *rationale* of the latter process is a secret.

As stated above, tonite consists of this macerated gun cotton intimately mixed up between edge-runners with about the same weight of nitrate of baryta. It is pressed into candle-shaped cartridges, with a receiver at one end for the reception of a fulminate of mercury detonator.

Tool Grind'er. A machine for sharpening and polishing tools.

Fig. 2444 is an emery grinder for heavy tools, made by Thomson, Sterne & Co., of Glasgow, Scotland, and is shown with a simple rest for the tools, but is also supplied with special slide-rests for grinding tools in holders. The water is thrown upon the emery-wheel by perforated pipes, which are shown branching to each side from a pipe which rises alongside of the bearing from a small rotary pump driven by a cord from the wheel-shaft.

Fig. 2444.



Thomson, Sterne & Co.'s Tool Grinder.

Tool Mark'ing.

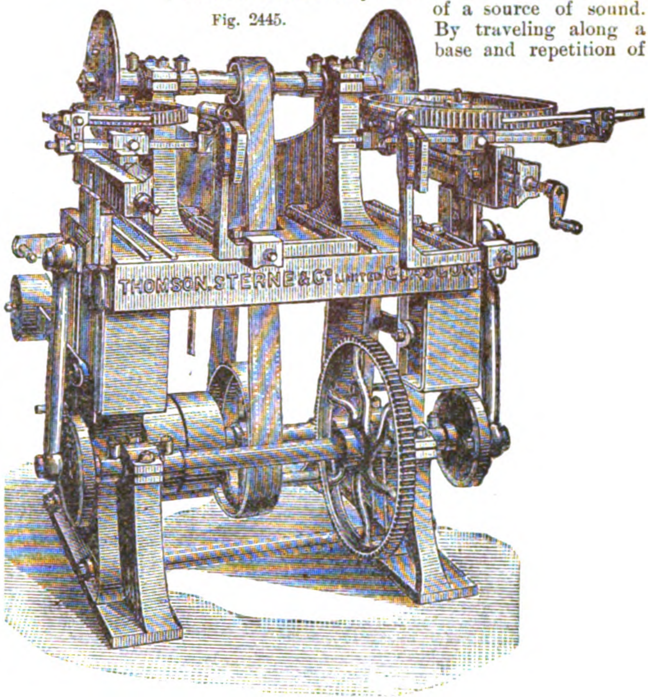
To inscribe your name on steel tools cover the part to be marked with a thin coating of tallow or beeswax. Then with a sharp instrument write the name in the tallow, cutting clearly into it. Then fill in the letters with nitric acid. Let it remain from one to ten minutes. Then dip in water and rub off, and you will have the mark etched.

Tooth Clean'er. A machine for dressing up the teeth of cog wheels.

Fig. 2445 represents Thomson's wheel tool-cleaning machine for dressing between the teeth of spur-wheels. Two wheels can be operated on at once by two emery wheels fixed on each end of the spindle, driven by the counter-shaft.

To'po-phone. An instrument invented by Prof. Alfred M. Mayer to determine the direction of a source of sound. By traveling along a base and repetition of

Fig. 2445.



Tooth Cleaner.

observation it may also, by calculation, be an indicator of distance of the source of sound.

Described by the inventor in the "*American Journal of Otology*" for October, 1879.

The instrument has been made in two forms: the stationary and portable.

In the former case, when used on board a vessel to ascertain the direction of a fog-horn or bell, the apparatus has a vertical rod passing through the roof of the deck-cabin, on the upper end of which is attached a horizontal bar carrying two adjustable resonators. Below these is a pointer, set at right angles with the horizontal bar. Rubber tubes pass through the roof of the cabin and connect the resonator with a pair of ear-tubes. A handle attached to the vertical rod serves to turn it either way, the direction being indicated by the pointer. The resonators are by this means adjusted so that they are brought simultaneously upon the wave surface; that is to say, the horizontal bar is a chord in the spherical wave surface, of which the fog-horn, for instance, is the center; the pointer then represents a radius, or, in other words, coincides in alignment with a line drawn from the place where the sound is produced through the plane of observation.

By sailing the ship at a measured distance at an observed angle from the radius line thus found, a second radius line may in like manner be found, and the distance between the two points of observation is the base-line of a triangle, of which the two convergent radii are the sides. From these data the distance of the fog-horn is readily computed.

The true line of direction is evinced by the clearness of the note imparted, any lateral deviation from the line giving rise to opposition and consequent neutralization of the respective sounds. The connecting tubes being of the same length, when the resonators receive the sound at the same exact instant, the sound pulses, acting together, are reënforced to the ear.

On trial it was found that the direction of sound could be ascertained within one point, say 10°.

The description of the action of the stationary form applies, *mutates mutandi*, to the portable form.

"*Iron Age*" . . . . xxv., March 4, p. 5.
"*Manufacturer & Builder*" . . xii. 79; * 253.

Tor-pe'do. Torpedoes have been divided into *defensive* and *offensive*, and the former into *electrical* and *mechanical*.

I. DEFENSIVE:

1. The *electrical* includes those fired by the closing of a circuit, either by a party on the look-out or by contact of the vessel. They are defined as: *a.* "Electro-contact torpedoes"; *b.* "Torpedoes fired by observation."

a. The electro-contact torpedo is placed so that a vessel running against it will set in motion the electrical apparatus; but it can be rendered harmless as against a friendly vessel by an observer on shore, and as instantly restored to activity by the same agency.

A torpedo fired by contact can be much smaller in its charge than one fired by observation, as the proximity of the latter to the enemy can only be approximately determined, and it must be sufficiently powerful to be fatal to vessels within a considerable area.

b. In the torpedo fired by observation, charges of powder from 500 to 2,000 lbs. are used, to be fired when the vessel is over the spot where such is sunken, to be determined by means of collimators or telescopic observing areas.

The electric torpedo is not itself explosive, and a blow or a fall is harmless, except as it may injure the envelope and cause a leak.

It is preferably lighted by the platinum wire fuse, which is simple, safe, and certain, and can be tested electrically, both before and after it is placed in the torpedo, without the fear of explosion.

The charge may be gunpowder, gun cotton, dynamite, etc. The British prefer gun cotton; America and Sweden have experimented largely with dynamite; Prussia, during the war with France, 1870, 1871, used dualine, another nitro-glycerine preparation; Austria used gun cotton.

2. The *mechanical* includes those exploded by concussion.

ANCHORED TORPEDOES. — The *shell* torpedo is used for the defense of obstructions in rivers and harbors. It is bolted in an inclined position to a frame which is sunk upon the obstructions and loaded with stone.

The *arm* torpedo is of the buoyant anchored class. As the bottom or side of a ship comes in contact with one of the three arms which radiate like spokes at angles of 120° with each other, the hammer is unshipped, and the spring drives it upon the caps, which explode the charge.

The *percussion* torpedo has a loose lid which is displaced by the contact of the bottom or side of a vessel, and, falling off the torpedo magazine, pulls upon some wires which spring the hammers and explode the charge. This was one of the earliest in use during the late war, and continued to be employed to the last. It is understood to have done more execution than any other during the war.

The *submarine* torpedo consists of a water-tight tank of common powder, anchored by two chains below the surface of the water and exploded by electricity, contact, clock-work, or what not. The term is general rather than descriptive, in contradistinction to terrestrial or military torpedoes, and perhaps to those exposed on the ends of spars. See SPAR TORPEDO.

Into the center of the tank pass the terminals of two insulated copper wires, a fine platinum wire passing through a small cartridge of fine rifle powder in the middle of the charge.

Mechanical torpedoes of various forms are described on pp. 2599, 2600, "*Mech. Dict.*"

a. Drifting.	*c.* Boom or spar, Figs. 6554–6556.
b. Anchored.	*d.* Maneuvered.

II. OFFENSIVE:

These may be divided into—

1. The *fish* torpedo, of which Whitehead's (see Plate LII.) is the principal example.
2. Drifting torpedoes.
3. The sea torpedo.
4. Torpedo boats.

1. The fish torpedo has a steel or iron fish-like case; the front fitted with a percussion fuse communicating with the charge. The stern of the Whitehead torpedo has machinery for working a screw by compressed air, which is in a reservoir amidships. It is launched from shore or from a ship, and pursues its course under water.

The Lay torpedo (see Plate LII.), p. 2599, "*Mech. Dict.*," uses condensed carbonic acid gas. A cable containing the electric wires pays out as the torpedo proceeds; two of these are for governing the machinery and the third for exploding the charge.

Col. Lay's torpedoes are still extensively used in Europe, especially in Russia, and his star torpedoes in the Russian navy; and two of his torpedo boats are owned by the United States government. This boat, as recently improved, can be controlled at a distance of more than a mile and a half.

The Ericsson torpedo is launched from a vessel, and has an india-rubber tube which pays out and conveys compressed air, which furnishes the motive power. Fig. 6558, "*Mech. Dict.*," described on page 2599.

2. Drifting torpedoes have cases of various kinds, and are abandoned to drift in a current or with the tide.

3. The sea torpedo is used in action, and is a case maneuvered by lines from the yards of the vessel.

4. Torpedo boats are of several kinds (see p. 2601, "*Mech. Dict.*"), and either carry the torpedo on a spar or a projection from the stern, or are arranged for launching fish torpedoes.

The *turtle* torpedo is so named from its resemblance to that animal, and is placed to prevent raking or grappling for a moored boom torpedo, being connected with the latter by a rope 130′ or 140′ long.

The Whitehead fish torpedo is a spindle of revolution, made of iron and steel, about 14′ long, and having a diameter of 14″, and carries a charge of 20 lbs. of dynamite. It is driven by a propeller and a compressed-air engine, the air being contained in a reservoir. A rudder regulates the depth and the direction, being adjustable so as to direct it along any curve required. The after half has projecting longitudinal ribs, which are extended aft to the ring which surrounds the propeller, and afford rests for the torpedo in launching. The bow, which contains the explosive, may be separated from the body of the torpedo and be stowed in a magazine. The extreme point forward has an arrow-head to stick into the side of a wooden vessel.

The results attained have been speeds of from 10½ to 7¼ knots per hour for distances of from 720′ to 4,500′; but more lately one has been made to run 600′ at the rate of 17 knots, or a mile at the rate of 10 knots. This trial was witnessed by some U. S. officers at Fiume, and is reported in the "*Army and Navy Journal*" of November 28, 1874. It is described in the "*Army and Navy Journal*" as cigar-shaped, made of ¼″ inch steel, and 19′ long, 15″ in diameter. It has a six-bladed screw with expanding pitch, and four T-iron angle pieces running three fifths of its length. A pistol at the bow is exploded by concussion, and in addition there are three triggers projecting from the bow, which may explode the charge by contact with a vessel. This torpedo had no apparent steering apparatus, traveling only in the direction given to it at starting by the adjustment of the rudder. The pressure in the reservoir is 1,000 pounds per square foot.

The action of current is taken into consideration in launching, as well as the rate of motion of a vessel at which it may be launched. It can be launched by projection from a tube by compressed air, or by hand by simply starting.

Mr. H. F. Hicks has designed a gun that is used, like that of Ericsson, to propel torpedoes under water, but the motive power is steam instead of gunpowder. The gun has a number of steam chambers connected with the bore, so as to use steam pressure successively and act on the principle of accelerated velocity, on the plan of Haskel's gun.

Myron Coloney, of St. Louis, has a system of floating torpedoes, with magnets secured to them (see Plate LII.). The magnets are intended to securely attach the torpedoes to iron vessels before exploding.

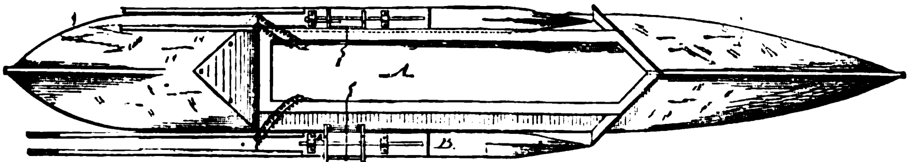
The torpedo invented by Asa Weeks (see Plate LII.) is believed to be the most powerful and destructive rocket torpedo yet produced. The torpedo proper is a triangular float, having two side wings extending astern, where they are provided with keels or cut-waters. The wings serve to maintain the balance of the torpedo, as it grows lighter from the combustion of the rocket composition, and the cut-waters serve as guiding rudders. The bursting charge of dynamite is in the front compartment of the torpedo, and is exploded by a percussion primer on contact with an obstacle, or is blown up by fire from the rocket charge after the expiration of a suitable interval.

The torpedo is slung at the davits of a steam launch made expressly for the purpose. The prow of the torpedo rises a little above the general surface line to prevent the tendency to run under when striking a wave. The rocket is carried in cylindrical chambers, and the powder is cored out eccentrically to the inclosing casing. This arrangement of the powder secures a nearly uniform combustion. The combustion chambers are surrounded by some refractory substance to prevent injury to the float and danger to the bursting charge. The rocket charge is ignited preferably by an electric ignitor, and the torpedo detaches itself from the davits, being hung thereto by a loop and pin. The rocket runs on the surface of the water, and can be made to travel at the rate of 100′ per second for 1,500′. The cost of a rocket carrying 50 lbs. of dynamite has been reduced below $500.

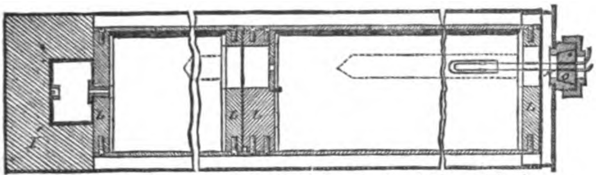
This torpedo has been adopted by the United States government after full investigation of its merits.

Mr. Weeks is the inventor of a star torpedo operated from the deck of a fast steam launch. He has also a floating or drifting torpedo that is detached from the float when it encounters an obstruction and explodes after sinking a few feet. It is intended to be set adrift in rivers and tideways where the current sets in the direction of a hostile fleet.

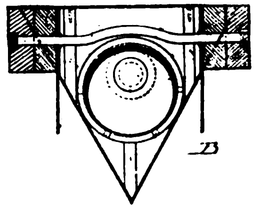
Col. Mallory's rocket torpedo has an ingenious arrangement of the rocket charge to secure uniform combustion. The charge of slow powder is made up into a large number of small cartridges, placed in holes radiating from a central chamber in a cylinder of fire clay. The cartridges all burn at once, and as only the end of each cartridge is presented to the flame the extent of the burning surface remains the



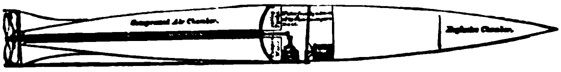
Weeks' Rocket Torpedo.



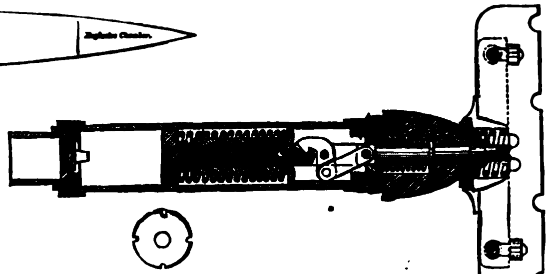
Weeks' Rocket Torpedo. (Sectional Longitudinal View of Rocket and Explosive Chambers.)



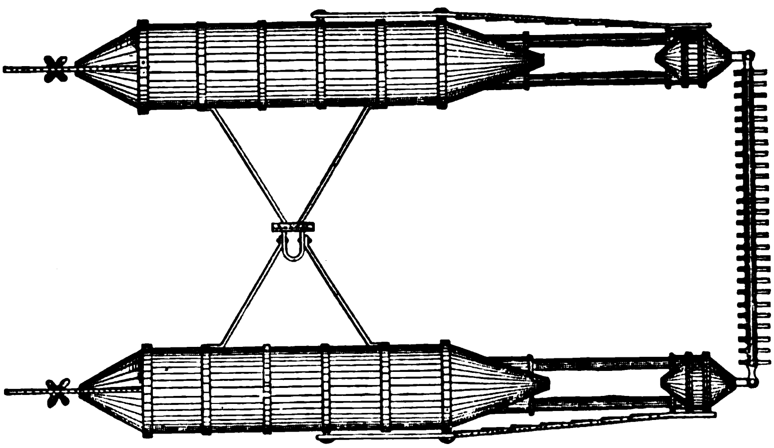
Weeks' Rocket Torpedo. (Sectional Transverse View.)



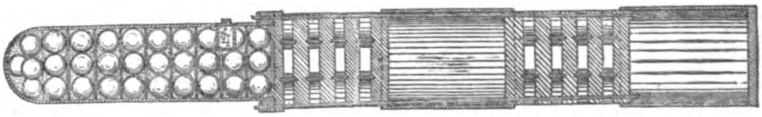
Whitehead Torpedo.



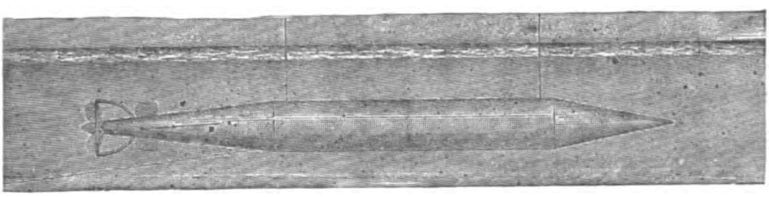
Week's Device for Exploding Torpedo on Contact with Netting.



Coloney Torpedo.



Coloney Projectile Torpedo.



Lay Torpedo.

same, and the decrease in weight by burning is regular. The air is permitted to escape at a determined rate from the air vessel that surrounds the torpedo, and so the loss in flotation equalizes the loss in weight due to combustion, the torpedo thus being advanced in a predetermined depth under the surface of the water.

The torpedo-boat invented by Bushnell, of Conn., in 1777, proved the feasibility of this style of warfare by blowing up a British tender in the harbor of New London, and but for the awkwardness of the person in the boat, would have blown up the "Eagle," a British sixty-four gun ship in New York harbor. This same person, in the same year, set a squadron of kegs afloat in the Delaware river, arranged to explode upon coming in contact with anything. They were set adrift too high up, so that they approached in the daytime. One boat was blown up. The British from the shore fired on them, which gave rise to the famous Battle of the Kegs, of which so much sport was made by our revolutionary writers.

The usual arrangement of booms, spars, and nettings for resisting he attacks of torpedo boats having been found ineffectual in the British navy, a magneto-electric light, contrived by Mr. Wilde, of Manchester, for the purpose of detecting the approach of a torpedo boat at night, has been tested. The carbon points and lens are arranged in a box which has vertical and horizontal adjustments permitting the beam of light to be rapidly directed to any point of the horizon and upon any object within the limit of its vertical range. Two steam pinnaces fitted with torpedo arrangement were employed to make a sham attack upon the "Comet," which was provided with one of these machines, but were in each instance discovered before approaching within a mile, the direction of the proposed attack being previously unknown.

(*Fishing.*) Torpedoes exploded under water are employed on the southern coast of the United States for catching fish. The same plan is used by poachers for salmon and trout in Scotland and in trout ponds of New Jersey. The torpedo is exploded by a portable battery.

Cartridges or torpedoes of dynamite, nitro glycerine, etc., are sometimes exploded in schools of fish, and destroy great numbers.

The Austrian torpedoes are well described and illustrated in Barnard & Wright's report, Engineers' Dept. U. S. Army, on the "*Fabrication of Iron for Defensive Purposes*," Washington, 1871.

Anchored, electric, fuses.

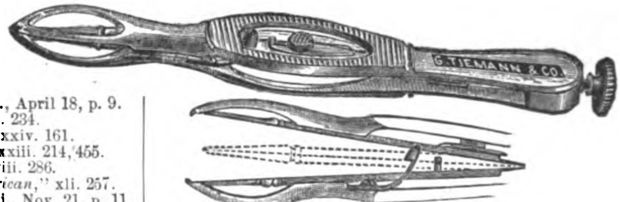
Harvey torpedo,* p. 195, Appendix X. Barnard & Wright's Report, U. S. Engineers, 1871.

Torpedoes of various kinds, electric, contact, navigating, floating, moored, etc. * *Manufacturer & Builder*," ix. 181.

Torpedo.
* "*Sc. Amer.*," xxxvi. 295, 327, 402; xxxviii. 82
* "*Sc. Am. Sup.*," 337, 388, 479.
American.
* "*Iron Age*," xix., June 28, p. 24.
And boats . . . . "*Iron Age*," xxi., April 18, p. 9.
Armor . . . . . . * "*Engineer*," xlv. 234.
Batteries for . . . . * "*Engineering*," xxiv. 161.
Electro-mechanical . * "*Engineering*," xxiii. 214, 455.
Ericsson . . . . . * "*Engineer*," xlviii. 286.
* "*Scientific American*," xli. 257.
"*Iron Age*," xxii., Nov. 21, p. 11.
Fuses, joints, etc. . . * "*Engineering*," xxiv. 219.
Lay . . . . * "*Iron Age*," xxv., June 10, p. 1.
* "*Engineer*," xlix. 244.
* "*Scientific American*," xli. 249.
Harvey . . . . . * "*Engineering*," xxiv. 391.
* "*Scientific American Sup.*," 1792.
Locomotive, *Whitehead*, etc. . . . . "*Van Nostrand's Mag.*," xvi. 158.
Mathieson's mechanic. * "*Engineering*," xxiii. 406.
McEvoy, mechanical * "*Engineering*," xxiii. 407.
Mechanical primer for, *Abel*, Br. . . . . * "*Engineering*," xxiv. 83.
On . . . . * "*Engineering*," xxi. 15, 22, 96, 153, 184, 224, 404, 475, 549.
Porter . . . . . * "*Scientific American*," xxxvi. 159.
Signaling and firing apparatus . . . . . * "*Engineering*," xxii. 303.
Series of admirable papers . . . . . * "*Engineering*," xxiii.
Spar . . . . . . * "*Engineering*," xxv. 14, 127.
Spar locomotive . . * "*Engineering*," xxv. 210.
Testing table . . . * "*Engineering*," xxii. 367.
Warfare . . . . . "*Scientific American Sup.*," 1087.
* "*Scientific American*," xxxvii. 39.
Whitehead . . . . * "*Scientific American Sup.*," 781.
Balloon torpedo. . . . * "*Scientific American*," xxxviii. 287.

Torpedo boat . . . . * "*Scientific American*," xli. 379.
"Alarm" . . . . . "*Van Nostrand's Mag.*," xv. 477.
"*Scientific American*," xxxiv 89.
Spar, *Yarrow*, Br. . . * "*Engineering*," xliv. 419.
Steel, for Whitehead torpedo . . . . . * "*Scientific American Sup.*," 1837.
Ericsson . . . . . "*Manuf. & Builder*," x. 229.
Fish, Br. . . . . . "*Iron Age*," xxi., May 23, p. 15.
Garrett, Br. . . . . "*Van Nostrand's Mag.*," xix. 381.
"*Iron Age*," xxii., Oct. 17, p. 9.
Herreshoff . . . . "*Scientific American*," xl. 105.
"*Engineering*," xxvii. 32.
Lay . . . . "*Iron Age*," xvii., May 4, p. 3.
"*Telegraphic Journal*," iv. 161.
Mortensen . . . . * "*Scientific American*," xl. 119.
Russian . . . . . * "*Scientific American Sup.*," 1314.
Thorneycroft . . . * "*Engineering*," xxx. 237.
"*Van Nostrand's Mag.*," xvii. 92.
Ten Eyck . . . . * "*Scientific American*," xl. 50.
"Destroyer," *Ericsson* . . . . . . * "*Engineer*," xlvi. 340.
"Lightning," *Thorneycroft* . . . . * "*Engineer*," xliii. 337.
Boat engine, compound, *Thorneycroft*, Br. . * "*Engineering*," xxx. 243.
Ericsson . . . . . * "*Scientific American*," xl. 68.
Boat and engine, Russian * "*Engineering*," xxvi. 327.
* "*Scientific American Sup.*," 2462.
Defense . . . . . . * "*Scientific American Sup.*," 1616.
Defense, Br. . . . . * "*Engineering*," xxiv. 279.
Experiments, Engl. . . * "*Scientific American Sup.*," 1908.
Thorneycroft (Cherbourg) . . . . . * "*Scientific American*," xxxvi. 239, 246.
On ship's hull . . . * "*Scientific American Sup.*," 1880.
Circuit closer, *Atkinson* * "*Engineering*," xxvi. 443.
Charge cases . . . . * "*Engineering*," xxii. 68.
Launch "Acheron," Australia . . . . * "*Engineering*," xxviii. 52, 99.
Danube . . . . . "*Iron Age*," xx., July 26, p. 18.
Herreshoff, Br. . . . * "*Engineering*," xxvii. 98.
Thorneycroft . . . * "*Engineering*," xxiii. 449.
And generator, *Herreshoff* . . . . . . * "*Scientific American*," xl. 210.
On . . . . * "*Engineering*," xxiii. 383.
"*Engineering*" . . "*Van Nostr.'s Mag.*," xvii. 125.
Nettings, "Thunderer" * "*Scientific Amer.*," xxxvii. 3, 5.
Ram, Br. . . . . . "*Iron Age*," xix., April 19, p. 24.
Ship "Alarm," U. S. . * "*Engineering*," xxiii. 283.
"Zieten," Ger. . . . "*Engineering*," xxi. 211.
Station, U. S., work at . "*Scientific American*," xl. 71.
Torsion of shafts, testing apparatus, Br. . . * "*Engineering*," xli. 336.

Fig. 2446.



Torsion Forceps.

Tor'sion For'ceps. (*Surgical.*) An instrument (see Fig. 2446) for twisting the end of an artery as a substitute for ligation.

Shown at Figs. 98 *b*, 100, 102 *b*, 163, Part I., *Tiemann's* "*Armamentarium Chirurgicum.*"

Tor'ti-col-lis Brace. A brace for overcoming distortions of the neck.

Tough'ened Glass. La Bastie's toughening process consists in heating the glass, nearly to malleability, but not hot enough to lose its shape, say 1400°, and plunging it instantly, in this state, into a bath of fatty and resinous matter at a temperature of from 300° to 600°. This glass will withstand sudden changes of temperature without damage, as the pouring of molten lead into a tumbler. The strength of the glass is said to be increased many times. Lamp chimneys and other articles thus made are very durable. See Glass, Tempered, *supra*.

In the Siemens' glass works at Dresden there is now manufactured a product which has the same properties as La Bastie's tempered glass, the strength being communicated by the pressure of metallic rolls. Plates can be made by this method of much larger dimensions than by La Bastie's. They have a beautiful look, and can be ornamented with the most complicated designs, at a less cost than ordinary glass. When broken, it shows a fibrous structure, while La Bastie's is crystalline. For equal thickness the resistance of a plate of compressed glass is from seven to ten times as great as that of an ordinary plate.

Tour'ists' Pho-to-graph'ic Cab'i-net. An apparatus is made which works without a silver bath, the silver nitrate having been already united to the haloid salts in the collodion, and a *washed emulsion* is supplied in a bottle.

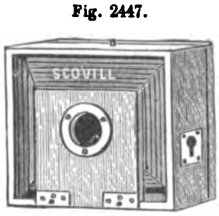
The bottle being shaken and allowed to stand 10 minutes, the emulsion is poured on the glass plate. The glass is previously washed by tripoli in alcohol, followed by French chalk. In 2 minutes the film is set and may be exposed in the camera; or if kept in reserve, dried over a hot tin or spontaneously, in 20 minutes. Non-actinic light, of course, is used in these operations, a portable ruby glass lantern being furnished.

After exposure the film is washed and picture developed by a mixture of pyrogallic acid and ammonia, restrained in action by a suitable quantity of potassium bromide. It is then washed, fixed, and washed again.

The film can be removed to a piece of prepared paper, and when dry can be put in a book, and reimposed at any time for printing. A set of 6 glass plates is furnishing enough, and a blank book may contain the films of a prolonged tour.

Tour'ists' Pock'et Cam'e-ra. Fig. 2447 is the pocket camera of the Scovill Manufacturing Co. of New York, intended for tourists' use. It measures, when folded up, but $5\frac{3}{4}'' \times 6\frac{1}{2}'' \times 2''$, with no projecting parts.

Fig. 2447.

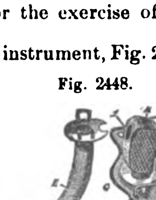


Tourist's Pocket Camera.

Tow'er, Re-volv'-ing. Theodore R. Timby, of Worcester, Mass., in 1841, filed a model and caveat in the U. S. Patent office for a revolving tower or fort, to be revolved by engines within the same; for use on land or water. He was granted a patent in 1862. A tank having been formed at the desired location, with the addition of water supply and exit pipes, the first communicating with a supply tank, and the latter with a drain, the water supply is regulated as desired through these pipes. A metallic battery is floated in this tank, revolving round a central pillar, on which it is lifted or lowered by the adjustment of the water supply in which it floats. Openings in the embankment that surrounds the tank and tower give the necessary opportunity for the exercise of the guns or mortars.

Tra'che-o-tome. Hauk's instrument, Fig. 2448, is to obviate the danger from blood entering the trachea during an operation.

Fig. 2448.



Tracheotome.

It consists of a curved, hollow, sharp-pointed trocar, with handle (also hollow) attached,—the whole about $3\frac{1}{2}''$ in length. It is made to exactly fit the larger of the set of tracheotomy tubes.

Tra'cing Cop'y-ing. A photographic process called the blue process, in which a tracing is used to print from instead of the glass negative.

For the sensitizing solution take $1\frac{1}{4}$ oz. citrate of iron and ammonia, and 8 oz. clean water; and also $1\frac{1}{4}$ oz. red prussiate of potash, and 8 oz. clean water; dissolve these separately, and mix them, keeping the solution in a yellow glass bottle or carefully protected from the light.

The paper may be gone over once with the sponge quite moist with the solution, and the second time with the sponge squeezed very dry. The sheet should then be laid away to dry in a dark place, as in a drawer, and must be shielded from the light until it is to be used. When dry the paper is of a full yellow or bronze color; after the exposure to the light the surface becomes a darker bronze, and the lines of the tracing appear as still darker on the surface. Upon washing the paper the characteristic blue tint appears, with the lines of the tracing in vivid contrast.

Any good, hard paper may be employed (from a leaf from a press copy-book up to Bristol board) which will bear the necessary wetting.

Lay the paper, sensitized side up, on a smooth blanket, and place the tracing on this with a plate of clear glass over all, heavy enough to press the tracing close down to the paper.

Expose the whole to a clear sunlight for six to ten minutes. If a clear skylight only can be had, the exposure must be continued for thirty or forty-five minutes, and under a cloudy sky, sixty to ninety minutes may be needed.

Remove the prepared paper and drench it freely for one or two minutes in clean water, and hang it to dry.

Track In'di-ca'tor. (*Railway.*) An instrument devised to ascertain the condition of the track, indicating irregularities, low joints, etc. One used on the Pennsylvania Railway is designed by R. Pitcairn, locomotive superintendent of the Pittsburg Division.

It is described and illustrated in "*Engineering*," * xxv. 119, 122. See also DYNAGRAPH.

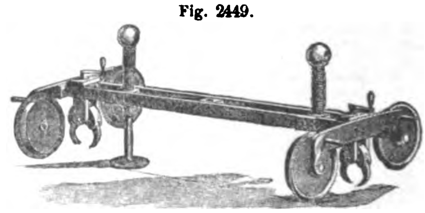
Track'-lay-ing Ma-chine'. A construction machine carrying rails and ties, with devices for delivering them off the front of the train to the laying force. The train is advanced as the work progresses.

It consists in a succession of rollers set in movable frames attached at will to the sides of several flat cars in a train, elevated so as to afford an inclined plane from rear to front. Upon these the ties on one side and the rails on the other are easily rolled or laid by men upon the cars, when they move along over the rollers to the front, and are delivered to the tie and track layers as fast as they can use them.

Track Lift'er. For lifting railroad tracks in ballasting and leveling.

A truck frame with four ordinary flanged wheels running on the rails, has a strong central cross-bar, bearing a spirit-level and scale, by which any degree of inclination is indicated. Through this central bar two powerful screws play in suitable swiveled nuts, and have each a pivoted base plate to thrust against the ground, and a suitable lever at the top.

Fig. 2449.



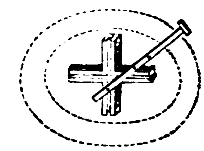
Track Lifter.

Trac'tion En'gine. A form of locomotive engine adapted to travel on ordinary roads. Used to haul threshing machines, and other heavy objects from point to point, and in threshing and furnishing power for different purposes.

Fig. 2451 represents Owen, Lane, & Dyer's engine, geared and speeded for $2\frac{1}{2}$ to 4 miles an hour; will draw a 10- or 12-horse power thrasher with ease; runs in either direction; carries fuel and water for 4 hours' run; will pull up or down a grade of 1 in 12.

See "*Mech. Dict.*," p. 2608.

Fig. 2450.

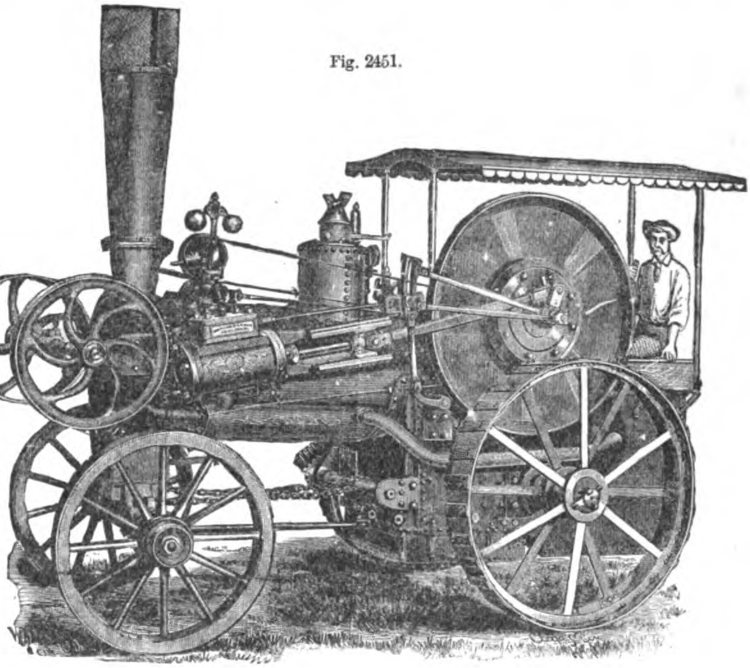


Tram.

Tram. A device for describing an ellipse.

When oval moldings are required two pins are placed in two holes of the handle to the center-mold, and made to move in the rectangular grooves of the cross represented in

Fig. 2451.



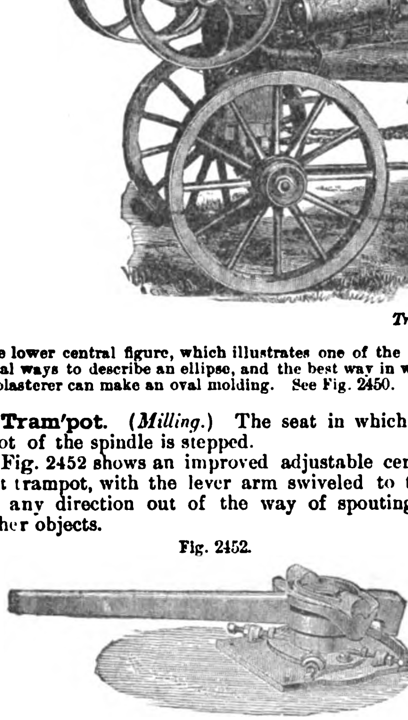
Traction Engine.

the lower central figure, which illustrates one of the practical ways to describe an ellipse, and the best way in which a plasterer can make an oval molding. See Fig. 2450.

Tram'pot. (*Milling.*) The seat in which the foot of the spindle is stepped.

Fig. 2452 shows an improved adjustable center-lift trampot, with the lever arm swiveled to turn in any direction out of the way of spouting or other objects.

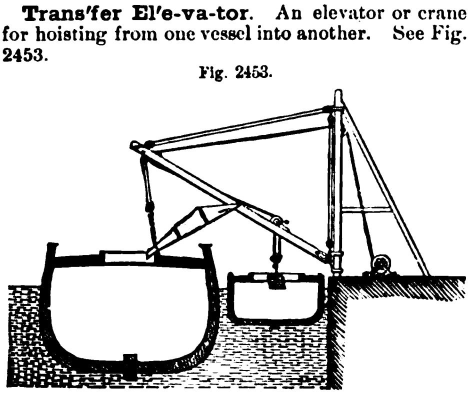
Fig. 2452.



Trampot.

Trans'fer El'e-va-tor. An elevator or crane for hoisting from one vessel into another. See Fig. 2453.

Fig. 2453.



Transfer Elevator.

Trans-la'tor. 1. (*Generally.*) An instrument whereby one form of energy is converted into another. For instance: the *power* of a prime motor, say a steam engine, is *translated* by means of a magneto-electric engine into electricity.

2. (*Specifically.*) A British term for a *repeater.*

Trans-mit'ter. (*Electricity.*) 1. In former practice, the sending forward of a message by an operator at a receiving station was called *transmitting.*

This function is now performed in telegraphy by a *repeater,* sometimes called in Britain a *translator.*

2. The sending instrument in telephonic circuit.

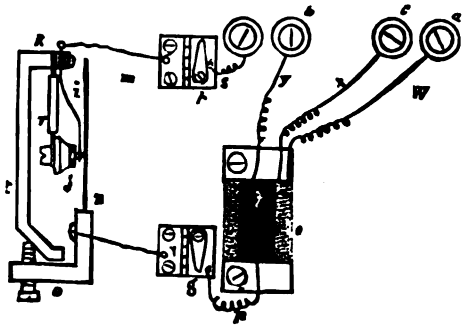
(*a.*) In Bell's *transmitter* (see Fig. 2402, Plate XLVIII.) the message is sent by the variable induced currents set up in a coil surrounding a permanent magnet, to and from which the diaphragm plays.

(*b.*) In the Edison carbon transmitter the diaphragm impinges upon a carbon button through which a battery current is led to line. The vibrations of the diaphragm and the consequent varying pressure upon the carbon affect the conductivity of the latter, and consequently give rise to undulations in the current, corresponding in amplitude and force to the sound vibrations of the spoken message.

(*c.*) In the Blake transmitter, Fig. 2454, a battery current is led through the primary helix of an induction coil, the secondary coil of which is included in the line circuit.

The battery wire comes to the binding post *b*. The circuit goes to primary coil *f*, composed of a few layers of coarse wire, thence by curl *p* to hinge *g*, thence by wire *l* to back frame *v*, thence through screw *o* and adjusting bar *t* to spring *r*, on the end of which is a weighted carbon button, *j*, thence through carbon button and platinum bead to spring *i*, which is insulated at *k*, thence by wire *m* to the hinge *h*, thence by curl *s* to binding post *a*, thence to battery, thus forming a short local circuit, including a battery, a primary coil, and a delicate carbon and platinum contact. The insulated diaphragm *n* bears against the platinum bead, and any movement of the diaphragm, by the voice or otherwise, alters the degree of pressure between the platinum bead and carbon button. Any alteration of pressure alters the conductivity at this point, and thus varies the intensity of the current which the battery is sending through the primary coil *f*. Under the jarring effect of the voice the contact at *j* is constantly altering, and thus giving a series of impulses to the current passing through the primary coil.

Fig. 2454.



Blake Transmitter.

This battery circle is entirely local, and does not go to line.

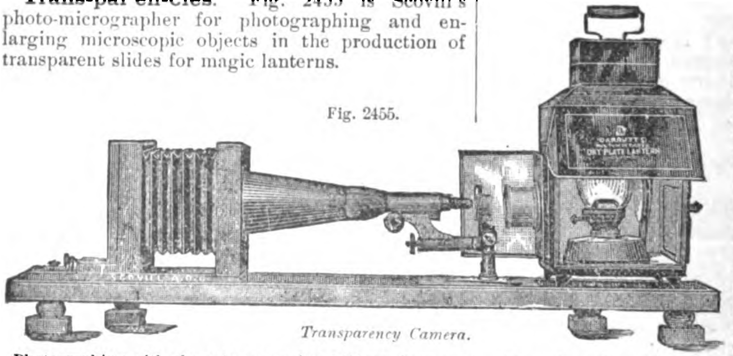
The line wire with telephone and other apparatus in circuit, goes to binding post *d*, thence by curl to secondary coil *e*, composed of many layers of fine wire wound outside of the primary coil *f*, thence by curl to binding post *c*, thence to ground or continued line.

The telephone or line circuit contains, as far as the transmitter is concerned, only the secondary coil. When a current passes through the primary coil wire it induces a strong current in the secondary coil wire, and thus sends the impulse to the line.

Telephonic, *Redmond* .	* "*Engineer*," xxvi. 184.
	* "*English Mechanic*," xxvii. 653.
Blake	* "*Scientific American*," xli. 274.
	"*Scientific American Sup.*," 3989.
Hopkins	* "*Scientific American*," xlii. 292.
Duplex and quadruplex	"*Iron Age*," xxv., March 4, p. 19.

Trans-par'en-cies. Fig. 2455 is Scovill's photo-micrographer for photographing and enlarging microscopic objects in the production of transparent slides for magic lanterns.

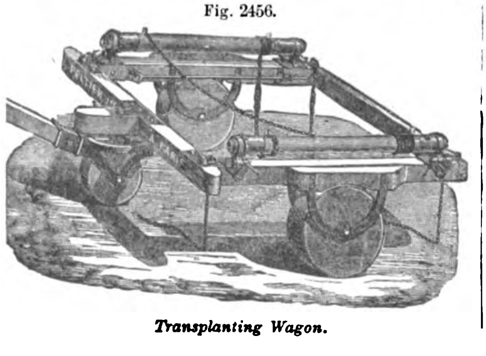
Fig. 2455.



Transparency Camera.

Photographing with the microscope has hitherto been accomplished by the aid of elaborate and costly apparatus, and been applied chiefly to making illustrations for scientific magazines. The process used, that of wet collodion in connection with sunlight, involved the procurement of an expensive heliostat to produce a steady illumination, for with any less powerful light the exposure would necessarily be so prolonged that the coating of the plate would dry and become useless. Now all this is changed, for with the modern improvements in photography which are the result of the introduction of gelatine dry plates, the photographing of microscopic objects becomes easy of accomplishment.

Fig. 2456.

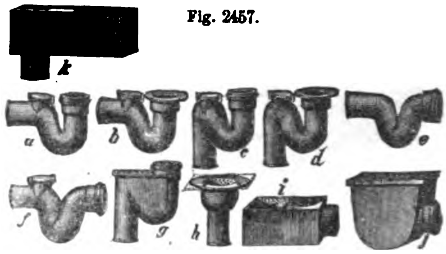


Transplanting Wagon.

Trans-plant'ing Wag'on. Fig. 2456 shows a three-wheeled truck, the frame of which uncouples and surrounds the tree. The chains are crossed under the roots and the tree hoisted out of its hole by means of levers in the holes in the rollers, and transported to the place of planting, where the truck straddles the hole, and the tree is let down.

Trap. A sink or depression in a pipe which allows the liquid contents to fill it permanently at one point and prevent passage of air.

Fig. 2457.



Traps.

a. P-trap.
b. P-trap, with flange for hopper.
c. S-trap.
d. Flanged S-trap.
e. Running or belly trap.
f. Same with hand-hole.
g. Conductor trap.
h. Bell trap.
i. Yard trap.
j. Round bottom drain trap.
k. Stable trap.

Trav'el-ing Crane. A derrick on an elevated track for shifting to different parts of the building. In Fig. 2458 the winch is operated by bevel gearing from the shafts at the side of the building. The transverse shafts have an endwise movement to disengage them from the gearing on the shaft along the side of the room, in shifting the carriage lengthwise of the room.

Trav'ers-ing Saw'ing En'gine. Fig. 2459 shows the Brotherhood three cylinder traversing metal-sawing engine. The whole machine traverses longitudinally in cutting the material to be operated on. The power is obtained from a hydraulic cylinder, and the speed of traverse is regulated by a slide valve. Steam may be used.

Trav'ers-ing Saw'ing Ma-chine'. One in which the saw travels instead of the work operated on.

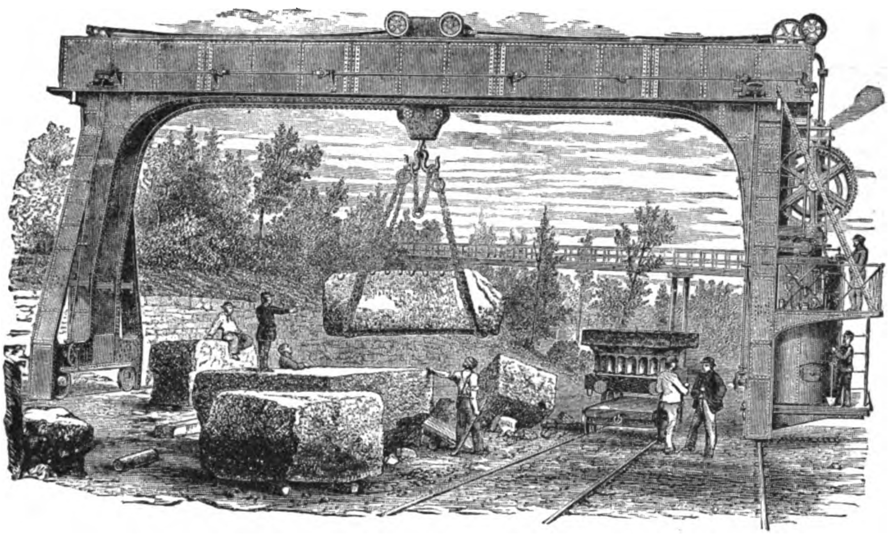
Saws for cutting cold steel are made of soft iron, and run sometimes with a periphery speed of nearly five miles a minute, melting the steel sparks, but not withdrawing the temper from the piece.

Tray Bat'te-ry. (*Electricity.*) One in which the tray forms one of the elements of the combination.

See THOMSON'S BATTERY, in which the tray is of copper.

Tree-fel'ling En'gine. An application of steam for felling trees.

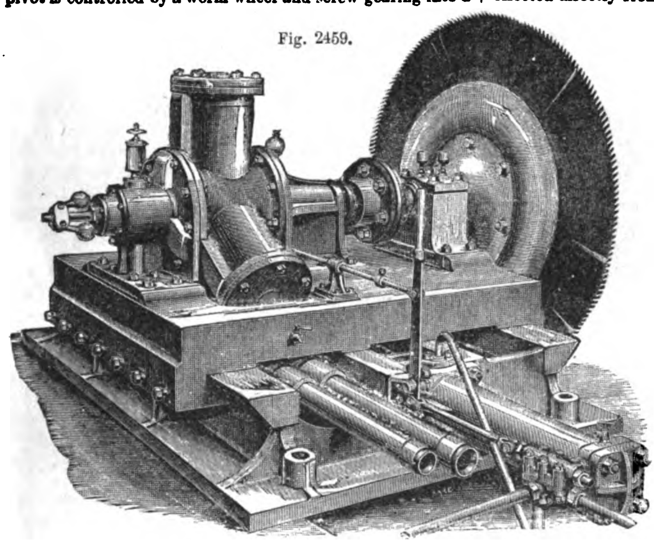
Fig. 2458.



Traveling Crane.

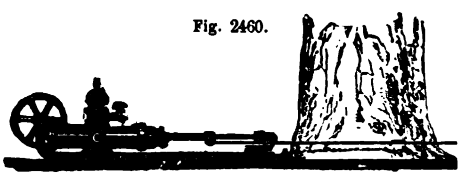
The illustration, Fig. 2460, shows a small steam cylinder, with comparatively long stroke, mounted on a light wrought-iron frame, pivoted on its center; a movement around this pivot is controlled by a worm-wheel and screw gearing into a circular rack. A saw is rigidly fixed to the cross-head, the teeth of the saw arranged to cut only during its in-stroke; that is, the teeth are hooked on one side and have a long bevel on the opposite one; the saw makes a draw-cut during its passage toward the cylinder, which enables a brace between the cylinder-frame and the tree to resist in compression alone the force of the cut. The steam distribution is effected directly from the cross-head, and so arranged as to take full steam for the in or cutting stroke of the saw, and but one tenth the amount for the return or idle stroke.

Fig. 2459.



Traversing Sawing Machine.

Fig. 2460.



Tree-felling Machine.

Trem'bler. (*Electricity.*) A contact breaker for induction coils.

The improvement of M. Trouvé is designed to secure various rates of vibration of the *trembler*, so as to obtain intermittent induction currents of different periods. The length of the vibrating stem is made adjustable, and its range limited according to a scale on the instrument.

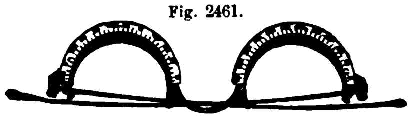
"*Teleg. Journal*" . . . v. 280.

Trial Sight. (*Optical.*) An oculist's case of trial lenses, etc., for testing sight. Nachet's complete series has the following: —

32 pairs each of spherical convex and concave lenses, from 2″ to 72″ focus.
19 pairs each of plain cylindrical convex and concave lenses, from 6″ to 60″ focus.
9 prisms of angles, from 2° to 10°.
4 plane colored glasses.
1 white glass disk.
1 half ground surface.
2 metallic disks with stenopaic slit.
1 metallic disk with hole.
1 metallic disk, solid.
1 adjustable spectacle-frame, with revolving graduated fittings for holding the various lenses.
1 ditto, not graduated.

Trial Spec'ta-cle Frame. Fig. 2461 shows a trial spectacle frame, with double grooves to

Fig. 2461.

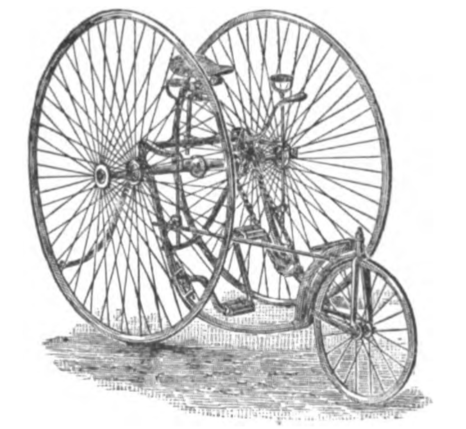


Trial Spectacle Frame.

each eye, graduated to 180°. Any desired combination of spherical and cylindrical lenses can be adjusted in a moment to this frame, and given to the patient for trial. Used for finding the axis of imperfect vision in astigmatism or cylindrical cornea.

Tri'cy-cle. The name was given to a specialized, three-wheeled velocipede in France, as long ago as 1828. It has been made in variously modified forms ever since that time, but has gone into extensive use only in recent years, after the more successful bicycle had led the way, and improved materials and means and modes of construction had enabled it to be made lighter and more effective and elegant. It is now very popular in England and throughout Europe, where it is ridden by ladies as well as by gentlemen, not only for occasional pleasure riding and useful conveyance, but also on very long tours through the various countries. It is rapidly coming into use in America, and the latest and most improved form is the Columbia tricycle, of American make, shown in Fig. 2462. The wheels are 48″ in diameter, the width over all is 38″, and the weight 92 pounds. It has

Fig. 2462.

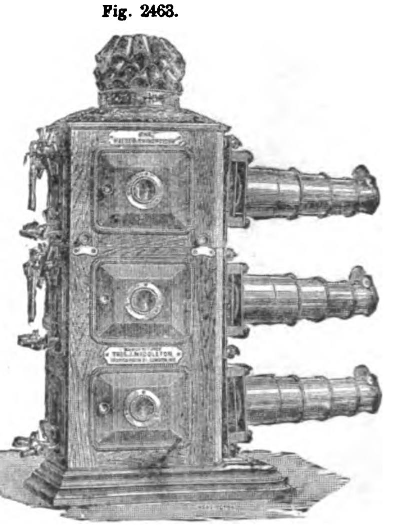


The Columbia Tricycle.

contractile round rubber tires, direct spokes in the suspension wheels, adjustable anti-friction bearings to every shaft, axle, pin, and pedal, and adjustable seat and handles to suit it to the individual rider. Ingenious mechanism is shown in the "balance gear," or compensating axle gearing, by which the power is distributed to both driving wheels, which may run at differing speeds on curves; and also in the friction-disk brake, which with a slight pull on the handle will effectively control the machine on any grade. This tricycle contains fifteen or more inventions secured by United States patents. There is also adapted to it a device by which different speeds may be attained with the same power, or power economized at the expense of speed in hill-climbing; and there are many useful adjuncts called "accessories" for the convenience of riders. The tricycle is brought to such a state of perfection and specialized detail in construction and finish as to be only comparable with the bicycle.

Trin-op'ti-con. The "Malden" trinopticon, Fig 2463, is an apparatus for the exhibition of dissolving views and dioramic effects. It consists of a combination of three achromatic lanterns, which can be used in its complete form; or the bottom portion, that is similar to an ordinary two-tubed

Fig. 2463.

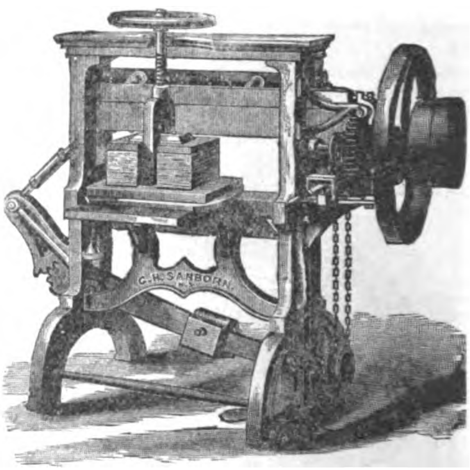


Trinopticon.

apparatus, can be used separately, and the upper can then be employed for phantasmagoric effects.

Trim'mer. (*Bookbinding.*) The Star book trimmer, Fig. 2464, is a single, or double clamp power machine, with a draw-slide knife.

Fig. 2464.



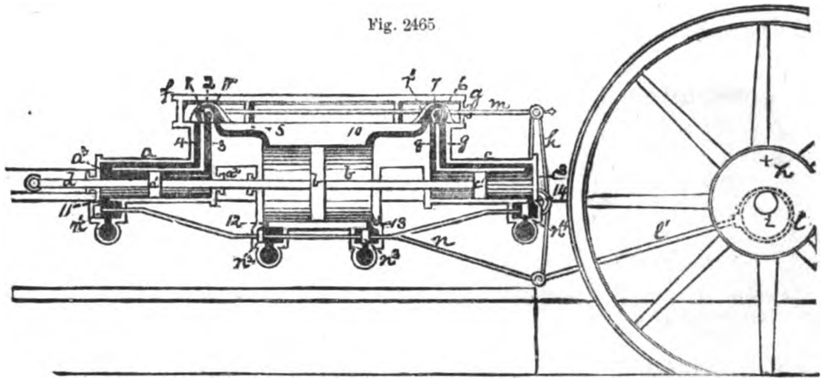
Book Trimmer.

Trip Cut Off. An arrangement to disconnect one portion of the valve motion from the other, so as to allow the cut-off valve to close with great rapidity, the concussive effect arising from stopping the rapidly moving parts being absorbed or taken up by acting upon a confined indestructible fluid, as water, air, etc.

Trip'le Cyl'in-der Steam En'gine.

Alexander's compound balanced piston engine, Fig. 2465, has a large central vacuum or exhaust cylinder, *b*, at each end of which is a smaller working cylinder, *a c*; the pistons of the three have a common piston rod and their valves are operated by the rods *d e* from the eccentric *f*, being so arranged that a part of the exhaust from either working cylinder, as *a*, is conducted into the corresponding end of the exhaust cylinder *b*, alternately through the passages *g g′* at the same moment that the steam is admitted to the opposite end of the other working cylinder: the pressure of the exhaust

Fig. 2465.



Triple Cylinder Steam Engine.

steam from *a* on either side of the piston *b'* is thus caused to help work the pistons *a' c'*. The steam escaping from *a* or *c* is worked expansively in *b*, being reduced to a pressure equal to that of the atmosphere by the time *b'* reaches the end of its stroke.

The remaining portion of the exhaust is conducted through an appropriate post to the end of either working cylinder at which the piston of that cylinder has arrived, to balance the piston so that it may offer no resistance to the action of the large piston in the exhaust cylinder, and to that of the other working cylinder to which the live steam has just been admitted.

Trip'le Flu'id Bat'te-ry. (*Electricity.*) One in which the respective fluids containing the elements are separated by a cell containing another fluid which may be neutral or may have the effect of preventing the entry of the positive liquid into the negative cell, or *vice versa*. For instances, see list under GALVANIC BATTERY.

Trip'le Tel'e-phone. One having two receiving ear-pieces, and a transmitting mouth-piece mounted on one stem, which may be held to the head by a spring.

Pritchett . . . . . * "*Telegraphic Journal*," vi. 471.

Trip'o-li. Infusorial earth: the cast-off shells of microscopic infusoria. Used in the manufacture of nitro-glycerine, cements, as polishing powders, and food.

Tro'car. (*Surgical.*) A perforator, stylet, and canula combined; a three-part instrument.

Trough Bat'te-ry. (*Electricity.*) One in which the elements occupy a series of cells in a common trough.

The earliest of these was Cruikshank's, and the second Wollaston's, which see. See also MUIRHEAD BATTERY.

Trou-vé' Bat'te-ry. (*Electricity.*) 1. A battery consisting of a pile of zinc and copper disks separated by paper disks, saturated with exciting and depolarizing liquids.

See MOIST BATTERY.

Niaudet, American translation . . . * 112.
"*Scientific American*" . . . . . . * xxxvii. 323.

2. A compound Grenet battery, in which several pairs of removable elements are mounted on a frame which can be lowered into the liquid.

Niaudet, American translation . . . . . . * 224.

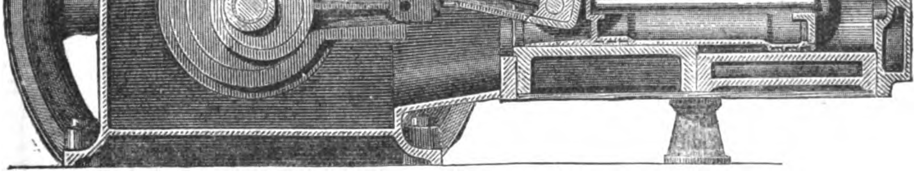
3. *Trouvé's* inversion battery.

"*Telegraphic Journal*" . . . . * vi. 475.

4. Improvement on Daniells.

"*English Mechanic*" . . . . * xxvi. 326.

Fig. 2466.



Trunk Engine.

Trunk Steam En'gine. One in which the direct connection of the piston with the crank is secured without the use of the beam or oscillating the cylinder. Fig. 2466 shows Virey's French trunk engine, with the piston rod, crank shaft, and eccentric in the steam chest, attached to the steam cylinder, the revolving shaft working through packings in the steam chest.

Trus'sing Ma-chine'. One for tightening the truss hoops on barrels. Holmes's machine, Fig. 2467, for trussing tight and slack barrels, will drive all the truss hoops upon a slack barrel at the same time at the rate of 1,500 per day. When used for tight barrels the quarter hoop drivers are removed, and the machine is in condition to drive the truss hoops upon tight barrels.

Fig. 2467.

Trussing Machine.

Tube Clean'ers. For cleaning tubular boiler tubes. A steam-pipe having perforations to correspond with the ends of the tubes is fitted to each row of tubes and steam blown through them.

Tube cleaner . . . . * "*Scientific American*," xxxiv. 248.
"National" . . . . * "*Iron Age*," xvii., March 30, p. 7.
Boiler, *Cooke* . . . * "*Iron Age*," xxiv., Sept. 11, p. 16.
Tube-cleaning rings. *Paulson*, Br.
* "*Railroad Gazette*," xxiv. 205
* "*Engineer*," xlix. 235.
Tube scraper, *Knott* . . * "*Engineer*," xlii. 33.
Rastrick, Br. . . . . * "*Engineer*," xliv. 149.
Boiler, *E. Ry. of France* * "*Engineering*," xxix. 7.

Tube Draw'ing Ma-chines'. Metallic tubes are drawn through formers, somewhat after the manner of wire.

Tubes for particular purposes are drawn inside and out, giving them a hard, smooth finish. Ordinary brass tubes are soldered together and drawn through holes to shape the outside, leaving the inside as it was.

Fore . . . . * "*Iron Age*," xxii., July 11, p. 1.

Tube Valve. A tube forming a valve, held up against its seat by a ball-weighted lever.

Tube, Weld'ed I'ron. Instead of heating the whole of the strip or skelp of iron, Roden heats only the edges which are to be welded together and the parts adjacent thereto. In order to effect this, he constructs a furnace, having a long, narrow opening at its top, and the strip of iron from which the tube is to be made having been bent into a tubular form, with its edges overlapping, is placed upon the said opening in the furnace, the said overlapping parts being alone exposed to the strongest heat of the furnace, while the greater part of the tube, being external to the furnace, is but slightly heated. Near the end of the furnace a bulb mandril, supported on a rod, is situated, the axis of the said bulb mandril being in a line with the axis of the partially formed tube on on the furnace.

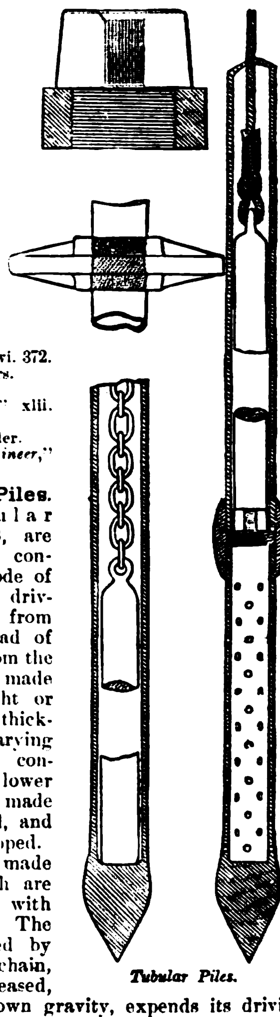
The end of the mandril-rod is fixed to a wagon, capable of traveling on a draw bench. Underneath the bulb of the mandril is a pressing-roller, which is pressed upwards or against the bulb of the mandril by a spring or weight or otherwise. A pair of tongs, connected to the wagon of the draw bench or other drawing mechanism, take hold of the partially formed tube at its upper side, and motion being communicated to the said chain, draw bench, or other drawing mechanism, the partially formed tube is drawn off from the furnace on to and over the bulb mandril, its overlapping and heated edges being pressed between the bulb of the mandril and the roller underneath and thereby welded together. After the welding of the skelp has been effected, the mandril and its rod, together with the tongs and welded tube, are removed to a sufficient distance from the furnace to allow the tube to be removed from the mandril. The mandril and other parts are then restored to their original positions near the furnace, ready to act upon and weld a second skelp. By means of this invention, welded iron tubes or pipes can be readily and quickly made, and from thinner iron than can be conveniently used in the ordinary method of manufacture.

Weldless metallic . . "*Iron Age*," xvii., May 11, p. 32.
Welded iron, manuf. of "*Scientific American Sup.*," 1886.

Tu'bu-lar Boil'er. One in which the water circulates in pipes. See STEAM BOILERS, *supra*, and pp. 2325–2328 and 2649, "*Mech. Dict.*"

Babcock & Wilcox . . * "*Iron Age*," xix., May 31, p. 1.
Benoit, Fr. . . . . * "*Engineer*," xlv. 354.
Pregardieu, Ger.
* "*Engineer*," l. 228.
Sinclair, Belg.
* "*Engineer*," xlvii. 42.
Steinmüller, Ger.
* "*Engineer*," xlix. 428.
Wigzell & Ramsden.
* "*Engineer*," xli. 313.
"Montana" "Birkenhead."
* "*Engineer*," xli. 316.
Mast,
* "*Manuf. & Builder*," viii. 246.
Tubular flue boiler.
Sulzer, Swiss.
* "*Engineering*," xxviii. 175.
Farcot, Fr.
* "*Engineering*," xxvi. 372.
Tubular steam boilers.
Babcock & Wilcox.
* "*Scientific Amer.*," xlii. 319.
Tubular vertical boiler.
Pope, Br. * "*Engineer*," xliii. 251.

Fig. 2468.



Tubular Piles.

Tu'bu-lar Piles. Le Grand's tubular piles, Fig. 2468, are unique in their construction and mode of propulsion, being driven internally and from the bottom, instead of externally and from the top. The piles are made of either wrought or cast-iron, and of thickness to suit the varying circumstances of construction. The lower end of the pile is made solid and pointed, and generally steel-tapped.

The piles are made in sections, which are screwed together with joint sockets. The rammer is raised by rods, rope, or chain, and on being released, falling with its own gravity, expends its driving force on the point just where it is wanted.

This principle of internal pile-driving has been applied to the sinking of tube-wells, and for driving the foundations of telegraph posts, etc. When used in connection with tube wells, the first socket above the perforated end is made sufficiently long to allow of a strong iron ring being placed in the center of it in such a way that the two lengths of tube, when screwed together, butt against it. The interior of this ring is of sufficient size to allow the water to pass freely, but it has a screw thread cut throughout its whole length. During the operation of driving the aperture is closed by a steel square-headed screw plug, the head resting firmly on the ring. After driving, the plug is removed, allowing the water free passage.

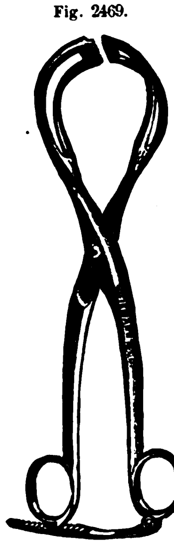
Le Grand & Sutcliffe . "*Van Nostrand's Mag.*," xx. 521.

Tu'la. The Russian niello silver. See NIELLO SILVER.

Tu'la Sil'ver. The composition tula silver, which was long kept a secret, has been discovered to consist of 9 parts of silver, 1 of lead, and 1 of bismuth. The metals, in the proportions stated, are melted together. The addition of sulphur gives the beautiful steel-blue tint for which this composition is so highly prized.

Tu'mor E-cra'seur. Fig. 2469 represents an instrument used in operating on uterine tumors.

Fig. 2469.



Tumor Ecraseur.

Tung'sten Bronze. A bronze produced by Majeon by adding tungsten to a composition of copper, zinc, lead, and tin; a bronze of small cost, possessing, according to the proportions of the elements, malleability, ductility, sonorousness, and conductivity of electricity.

Used for dies, bells, clockwork, ornaments, type, piano strings, brass for rolling, drawing, and chasing.

"*Iron Age*," xx. Sept. 6, p. 20.

Tung'sten Steel. (*Metallurgy.*) A steel containing tungsten, which is added in the form of Wolframite to the charge. See p. 2366, "*Mech. Dict.*"

Tungsten steel . . . "*Scientific American Sup.*," 278.

Tun'nel. (*Fishing.*) The funnel-shaped conductor leading from the *heart* to the pound in a *pound-net*, which see.

(*Engineering.*) An underground passageway for aqueducts, railways, or opening up mines, etc. See "*Mech. Dict.*," pp. 2653–2655.

Tunneler, *Dowd* . . . "*Scientific American*," xliii. 280.
Tunneling, accurate . . "*Scientific American*," xxxix. 406.
Tunneling machine.
Dowd . . . . . * "*Manuf. & Builder*," xii. 244.
Tunneling, history of, *Drinker*. Wiley & Snow, N. Y.
See excerpts in "*Engineering & Mining Journal*," xxv.

Tu'pe-lo Di-la'tor. (*Surgical.*) A dilator for the cervix uteri, made from the wood of the pepperidge (sour grass, *Gray*), a tree of the dogwood family and genus *Nyssa* (Indian name *tupelo*.) — *Sussdorff*.

Tur'bine. A water wheel with curved buckets. See p. 2656, "*Mech. Dict.*"

Turbine water wheels.
Trials of, Phila. 1876 * "*Scientific American Sup.*," 964.
Turbine wheels, on.
Gevelin . . . . . "*American Miller*," v. 11.
Turbine, *Alcott* . . . * "*Iron Age*," xx., Oct. 18, p. 1.
* "*Manuf. and Builder*," viii. 247.
* "*American Miller*," vii. 166.
Burnham . . . . . * "*American Miller*," iv. 83.
"Eclipse," *Stillwell & Bierce* . . . . . * "*American Miller*," iv. 33.
Dorsey & Kemper . . * "*American Miller*," iv. 35.
"Delphos" . . . . * "*American Miller*," iv. 35.
Leffel . . . . . . * "*American Miller*," iv. 36.
* "*Manuf. & Builder*," ii. 198, 225.
* "*Engineer*," xliii. 59.
Obenchain . . . . * "*American Miller*," iv. 38.
Carley . . . . . * "*American Miller*," v. 101.
Mullikin . . . . . * "*American Miller*," v. 101.
Capron . . . . . * "*American Miller*," iv. 2.
Brooks . . . . . * "*American Miller*," v. 83.
Risdon . . . . . * "*American Miller*," v. 121.
* "*Manuf. and Builder*," ix. 56.
"Little Giant," *Jones* * "*American Miller*," vi. 152.
Tompkins . . . . * "*American Man.*," July 9, 1880, p. 13.
On. *Trowbridge* . . * "*Van Nostr. Mag.*," xx. 244, 346.
"Victor," *Stillwell & Bierce* . . . . . * "*Eng. & Min. Jour.*," xxviii. 145.
* "*American Miller*," vii. 163.
Whitmore . . . . . * "*American Miller*," iii. 179.
"Victor," *Holden* . . * "*Scientific American*," xl. 166.
"Canadian" . . . * "*Iron Age*," xxii., Dec. 12, p. 5.
Truax . . . . . * "*American Miller*," viii. 68.
Ridgeway . . . . * "*American Miller*," viii. 32.
Bollinger . . . . * "*American Miller*," viii. 64.
Todd . . . . . * "*American Miller*," viii. 225.
Walton . . . . . * "*Scientific American*," xxxiv. 374.
Jouval. Augsburg Water Works . . . . * "*Engineering*," xxix. 244.
Test of. Phila., 1876 "*Scientific American Sup.*," 927.
Centennial, "Allentown," *Thompson* . "*Iron Age*," xviii. Aug. 31, p. 7.
Centennial. *Boyden, Bollinger*, "National," *Hunt, Houston* "*Iron Age*," xviii., July 20, p. 3.
Leffel, "American," "Eclipse," "Eureka," *Cope* . . . . "*Iron Age*," xviii., July 27, p. 5.
Alcott, Risdon, Gayelins', Jouval . . . "*Iron Age*," xviii., Aug. 3, p. 3.
66″. Gunpowder factory, Watham, Br. . * "*Engineer*," xlii. 379.
And pumps, *Buxton*, Br. . . . . . . * "*Engineering*," xxx. 546.
Tests, Holyoke . . . "*Scientific American*," xli. 336.

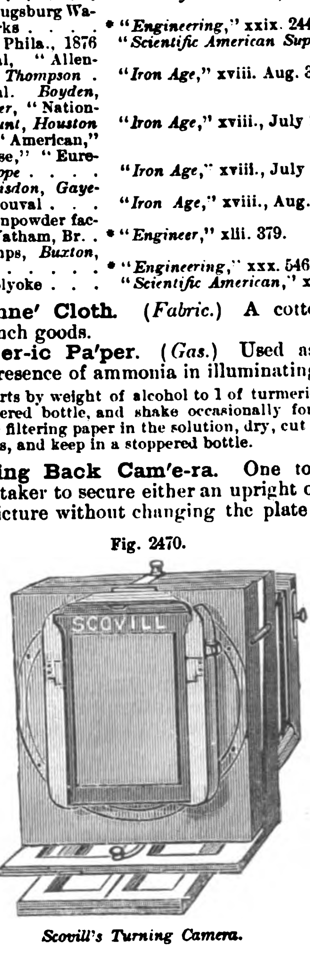
Tu-renne' Cloth. (*Fabric.*) A cotton and wool French goods.

Tur'mer-ic Pa'per. (*Gas.*) Used as a test for the presence of ammonia in illuminating gas.

Add 6 parts by weight of alcohol to 1 of turmeric powder in a stoppered bottle, and shake occasionally for 3 days. Soak white filtering paper in the solution, dry, cut in convenient pieces, and keep in a stoppered bottle.

Turn'ing Back Cam'e-ra. One to enable the view taker to secure either an upright or a horizontal picture without changing the plate holder,

Fig. 2470.



Scovill's Turning Camera.

after it has been slid into the carriage. The carriage is simply turned about in the circle and automatically fastened. By this latter provision the carriage may be secured at either quarter of the circle. The ability to withdraw the slide to the left enables the photographer to obtain a view which he could not get with the usual provision in a camera. The photographer of experience is well aware of the difficulty, when taking an upright picture with a large camera, of reaching up to draw out the slide at the top, and, what is more essential, of getting out the slide without changing the plate in the holder.

Turn'ing Mill. See Boring and Turning Mill, Fig. 389, p. 122, *supra*, and Fig. 6799, p. 2660, "*Mech. Dict.*"

Turn'ing Mold'-board Plow. One which has a capacity by an optional adjustment of the mold-board and share for turning a furrow to the right or to the left respectively.

In this country it is usually called a side-hill plow, as it is used only on hill-sides for throwing a furrow constantly down hill at each passage of the plow.

Murray, Br. . . . . * "*Engineering*," xxx. 56.
French & Amer., Paris * "*Scientific American*," xxxix. 168.

Turn'ing-off Ma-chine'. (*Knitting.*) A machine for closing hose which has been knit flatwise. See Sewing Machine.

Tur'nip Cut'ter. The "Picksley" cutter is a double-action machine, with a pulper disk, adjustable to fine and coarse cutting. The disk has two knives, and is so arranged that a pair of stripping plates are attachable for cutting finger-pieces.

Turnip cutters, old . . * "*Engineer*," xlvii. 474.
Turnip thinner, *Everitt*,
Adams & Co., Br. . . * "*Engineering*," xxx. 80.

Tur'nip Seed Drill. A drill for the automatic deposit of small seeds. (See Fig. 2471.)

Fig. 2471.

Turnip Seed Drill.

Turn-ta'ble. (*Optics.*) An instrument for making cells of gold size or other varnish. It is revolved by one hand while the other holds the brush containing the liquid.

These instruments are supplied with various appliances for holding the slide on the center of the revolving part of the table: either springs or volute movement, beneath which actuates the clasps.

Fig. 2472.

Turntable.

Tur'pen-tine.

Tar, etc., distillation.
Zacharias . . . . "*Scientific American Sup.*," 1671
Works in the woods . . * "*Scientific American*," xliii. 279.

Tur'ret. A report on the "*Fabrication of Iron for Defensive Purposes*" was made by Colonels Barnard and Wright, of U. S. Engineers, 1871.

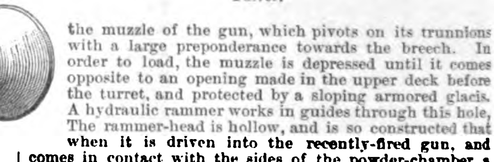
Iron cased forts of Portsmouth, Britain, defenses. Plate LI.
Gruson chilled iron casemate, German. Plates XXVI.-XXX.

Plate LIII. is a vertical section of a tower for harbor or land defense, having exterior and interior walls, with dome-shaped roof, revolving by gearing upon friction rollers. The artillery platforms have guns mounted upon the carriages, which radiate from the common center. The central turret revolves independently of the tower upon a shaft by means of a rod and gearing. On the left of the shaft is seen the circuit-closer, forming the connection between the galvanic battery and the conducting chains passing to each gun. Holes in the top act as ventilators, while at the sides of the turret, near the bottom, are casemates with guns, independent of the revolving tower, while below are walls of subterraneous foundation for the tower, forming chambers for stores and munitions.

Fig. 2473 is a view of the turret and glacis of the "Inflexible."

Two guns will be mounted side by side in each turret. Each gun will be mounted so as to be supported on three points. The trunnions will rest on blocks sliding on fixed beams bolted down to the floor of the turret, while the breech will rest on a third block, sliding like the others between guides, upon a beam or table. Behind each of the trunnion-blocks, in the line of recoil, are two hydraulic cylinders, connected with them by piston-rods. The cylinders communicate by a pipe, on which there is a valve, that, on the recoil of the gun, opens and allows the pistons of the rams to run back slowly, checking the recoil. By reversing the apparatus, the gun can be run out again. The beam on which the breech rests is supported by a third hydraulic ram, fixed vertically beneath it in the turret. By this means the breech can be easily raised or lowered, thus elevating or depressing

Fig. 2473.



Turret.

the muzzle of the gun, which pivots on its trunnions with a large preponderance towards the breech. In order to load, the muzzle is depressed until it comes opposite to an opening made in the upper deck before the turret, and protected by a sloping armored glacis. A hydraulic rammer works in guides through this hole. The rammer-head is hollow, and is so constructed that when it is driven into the recently-fired gun, and comes in contact with the sides of the powder-chamber, a valve opens, and it discharges through a number of holes small jets of water, thus acting as a sponge, and extinguishing any remnants of the charge or of the products of the explosion which may have remained smoldering in the bore. It is then withdrawn, and a hydraulic shot-lift raises up to the muzzle of the gun the charge, the projectile, and a retaining wad, and then a single stroke of the rammer drives them into the gun and home to the base of the bore. Again the rammer is withdrawn, the hydraulic ram under the breech of the gun elevates the muzzle, the turret swings round, and the shot is fired. A 9″ gun, mounted experimentally in a turret at Elswick, and loaded on this system, was brought to the loading position, sponged, loaded, and brought back to the firing point in twenty-three seconds. Equally rapid loading was effected with the 38-ton gun during the experimental trial of the hydraulic gear on board the Thunderer. Thus the first advantage of the system is rapidity of fire; the second is economy of labor. One man only for each gun is stationed in the turret, another works the hydraulic rammer on the main deck, six or eight others

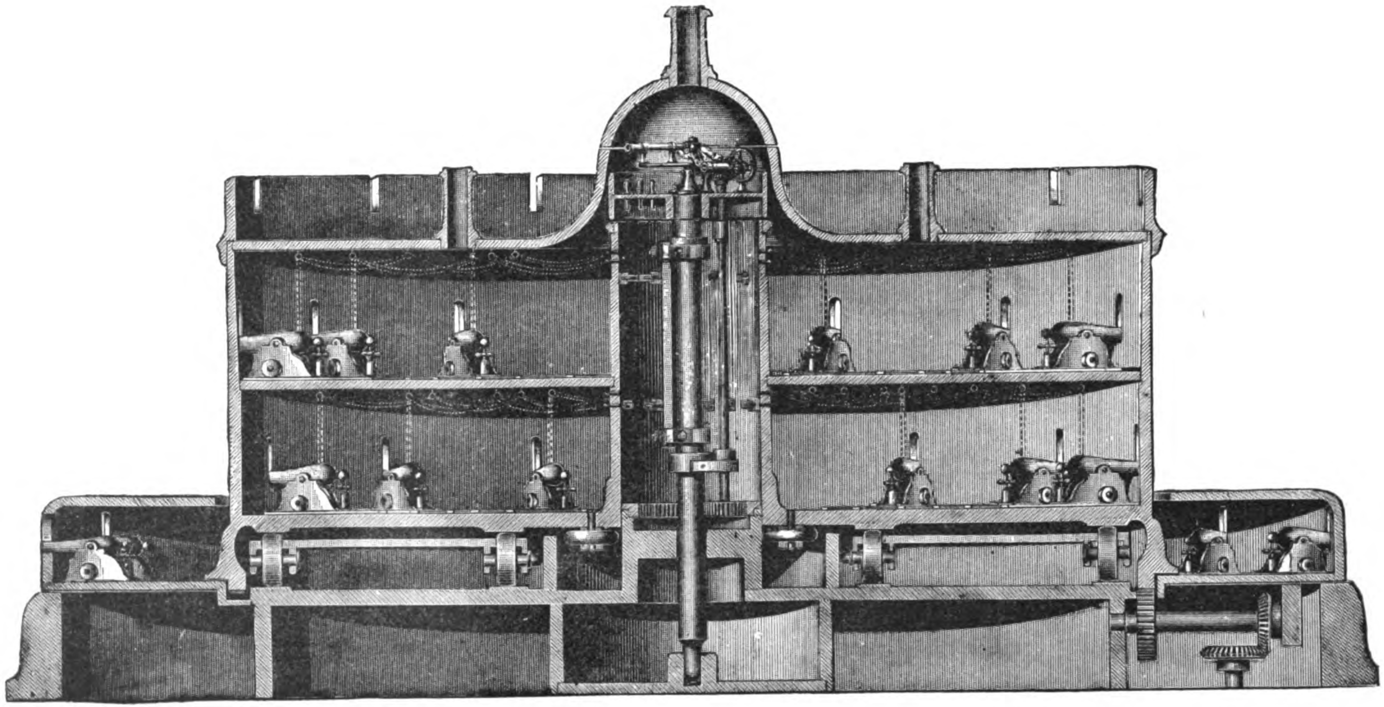


PLATE LIII. VERTICAL SECTION OF REVOLVING TURRET FOR HARBOR OR LAND DEFENSE. See page 908.

are employed in bringing up the ammunition to the shot-lift by means of a small tramway. There are two sets of loading gear for each turret; but even if both were put out of order, the gun could still be loaded, with an ordinary rammer and sponge, by a number of men stationed on the main deck.

The adoption of the system enables very heavy guns to be carried in comparatively small turrets. Those of the Inflexible are very little larger than those of the Devastation; so that with the old plan of having a numerous crew in the turret, and running in the gun in order to load it by hand, only the 38-ton gun could be carried. As it is, it is quite possible that the Inflexible will be armed with even a more tremendous weapon than the 81-ton gun. This has been held in view in designing the ship; and, by a slight modification, it will be possible to mount in each of her turrets a pair of 160-ton guns, with a bore of 30′ and a caliber of 20″.

A minor feature, which will perhaps be introduced in connection with guns of large caliber, is a steel plug containing within it a detonating apparatus for firing a charge of powder. This is intended to be fixed in the vent of a heavy gun, in order to prevent the upward escape of the gas and the consequent gradual erosion of the vent. The erosion very rapidly widens the vent, and at last disables the gun, and the fire has to be suspended until it is revented. Thus this system of firing, which has been invented by Captain Noble, R. A., would greatly increase the efficiency of the gun.

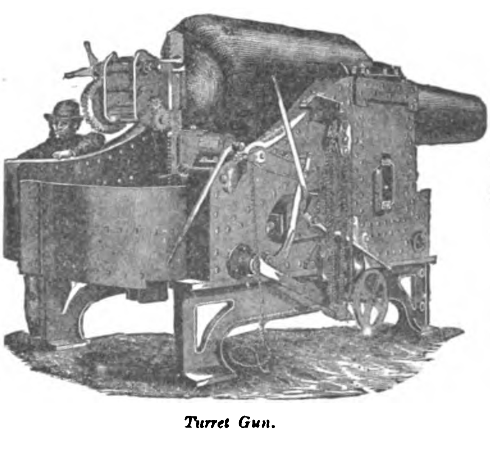
Some idea of the amount of ammunition required for the 81-ton gun will be given by the following calculation: Let us suppose that in an action the Inflexible would fire only ten shots from each of her guns; she would use up more than $6,500 worth of ammunition, burn upwards of 100 barrels of pebble-powder, and hurl nearly thirty tons of iron at the enemy.

"Inflexible," Br. . . * "*Engineer*," xliii. 435.
"Thunderer," Br. . . * "*Engineer*," xlvii. 19.
Clock, Bombay Univ., *Smith*, Br. . . . . * "*Engineer*," xlii. 395.
Lathe, *Harrington* . . * "*Iron Age*," xix., June 28, p. 1.
Screw machine, *Pratt & Whitney* . . . . * "*Thurston's Vienna Rept.*," ii. 226.
Ship, "Miantonomah" * "*Engineer*," xlix. 278.

Tur′ret Gun. (*Ordnance.*) One specially arranged to be used in a revolving turret. The peculiarity of guns of this class consists in the fact that their horizontal traverse is effected by the motion of the turret itself, the position of the carriage, with respect to the turret, being invariable.

Fig. 2474 illustrates an 18-ton gun and carriage. The brackets each consist of an inner and outer plate of ⅞″ wrought iron, stiffened by cast iron frames. The trunnions fit accurately between the brackets, having a play of but 1-32 of an inch, and serve to brace them; 1-32 of an inch play is also allowed between the carriage and platform, making the maximum deviation from the true line of sight but 1-16 of an inch. The elevation is effected on what is known as the principle of *compound pivoting*, the gun being raised or lowered by means of a hydraulic jack. The trunnions rest in blocks fixed on the extremities of a curved piece of wrought iron with steel side-pieces, termed the saddle, underneath the center of which the jack is placed; they may be supported at three different elevations on supporting

Fig. 2474.



Turret Gun.

blocks or steps of suitable height. On the highest step the gun may be laid at any angle between 6° depression and 3½° elevation; on the intermediate step between 2° depression and 7° elevation, and in the lowest position between 7° and 13° of elevation; it is shown in the figure in its highest position. The elevating apparatus consists of a straight vertical rack operated by a hand-wheel through the medium of a series of gears.

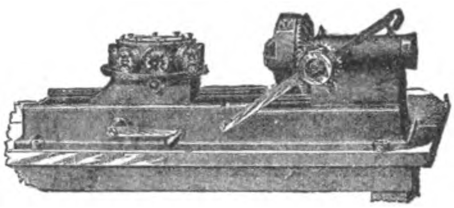
A second hydraulic jack is provided for the purpose of bringing the rollers into action upon which the gun is run out; in case of accident to the jack, tackles at the sides of the carriage are employed for this object.

Wedge-shaped iron plates depending from the brackets and fitting between corresponding plates on the slide act as compressors to limit the recoil of the carriage; and if required, additional friction may be obtained by means of a compressor screw and handle.

Tur′ret Head. The revolving head of a bolt cutter.

In Fig. 2475 the cylinder may be revolved at will, is secured in position by a spring bolt, and holds on its periphery seven

Fig. 2475.



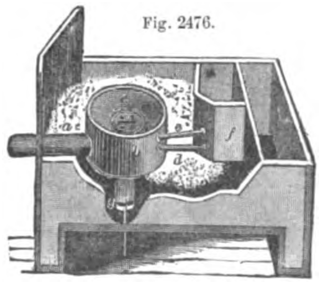
Turret-head Hand Bolt Cutter.

dies, either one of which may be presented instantly to the bolt to be cut, and carried forward by a crank, pinion, and rack. The cylinder holds also a collet, adapted for recessed plates, to receive square and hexagonal nuts of different sizes for tapping purposes. This collet is secured and removed readily, as are also the dies. The revolving spindle is hollow, to receive bolts of any length, and by removing the collet opposite the one that is at work, allowing the bolts to pass through the head, the thread may be cut to any distance required. The spindle is furnished with a chuck for holding the bolt or the tap, and it is driven by a crank, adjustable in length, and by bevel pinion and gear.

Tuy-ere′. A tube for regulating and directing the current of air to the fire in a forge or furnace.

In Bayliss's vertical hot blast and water tuyere and forge, instead of the blast passing into the fire cold, as in the ordi-

Fig. 2476.



Hot Blast Tuyere.

nary tuyere, it passes through a pipe, *a*, and takes a circle of the air chamber *b*, and enters the fire at a temperature of 300° through nozzle *c*, which is a hollow casting filled with water from an iron tank, *f*, by pipe *d*. The steam generated in the nozzle is conveyed to the tank by pipe *e*. Air is admitted to the air-chamber *c* through pipe *g*.

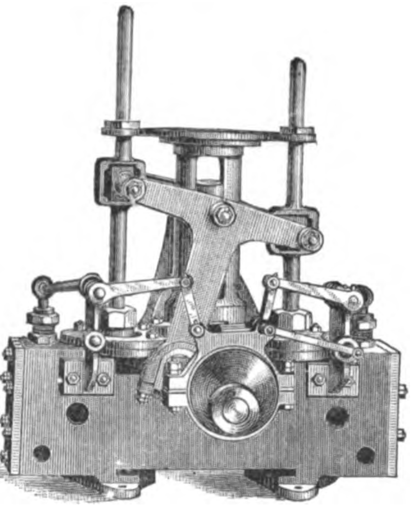
Lloyd's tuyere is an open spray blast for a furnace.

Safety, *Lloyd* . . . . * "*Iron Age*," xvii., June 27, p. 5.
* "*Scientific American Sup.*," 68.
Spray, *Plum* . . . . "*Iron Age*," xxii., Aug. 15, p. 15.
On, *Taws & Hartman* . "*Iron Age*," xxii., Aug. 22, p. 7.

Tuy-ere′ Coil. A convoluted pipe carrying water through a tuyere to mitigate the heat to which the tuyere is exposed in the fire. See "*Mech. Dict.*," Fig. 6827, p. 2666.

Twin Cyl'in-der Steam En'gine. In Fig. 2477, Bernay's twin cylinder engine, the general principle consists in placing the crank-shaft in the center line between the two cylinders, and making the connection between the crank and the two pis-

Fig. 2477.



Twin Cylinder.

tons by means of a triangular connecting-rod, one side of which (that opposite the crank) is guided in a cross-head. The arrangement for correctly distributing the steam consists in directing the motion of the slide-valves of both cylinders by means of one eccentric in a manner analogous to that by which the motion of the two pistons is directed through their triangular connection with one crank. The eccentric ring has two eyes prepared on it, whose up-and-down motion alone is made use of, and to which the valve levers or rods are hung. Straight lines drawn between these two eyes on the ring, and from the eyes to the center of the eccentric, constitute a triangle which bears the same relation to the eccentricity, or throw of the eccentric, as the triangle of the main connecting-rod bears to the throw of the crank. Any kind of expansion valves, and also link-motion, can be used with this engine.

For twin engines, boilers, screws, etc., see —

Ball, N. Y.	* "*Iron Age*," xx., July 5, p. 15.
Boat, Sailing Proa, "Ladronia"	* "*Scientific American*," xlii. 150.
Boilers, *Smith & Alexander*, Br.	* "*Engineering*," xxv. 27.
Screw	* "*Scientific American Sup.*," 2715.
SS. "Iris," Br. navy	* "*Engineer*," xlvii. 301.
	* "*Engineering*," xxvii. 330.
Engine and boiler, *Wilson*, Engl. . . .	* "*Scientific American Sup.*," 1071.
Gunboat engines, Motala Works, Sweden	"*Thurston's Vienna Rept.*," ii. 59.
Launch, Br. Navy . .	* "*Engineering*," xxv. 406.
Launch engine, *Wilson*, Br.	* "*Engineering*," xxiii. 91.
Propeller, *Hunt* . .	* "*Scientific American*," xxxvii. 1.
Propeller engine. *Whiting*	* "*Scientific American Sup.*," 141.
Steamboat, *Stevens* (1804)	* "*Engineering*," xxv. 72.
Ship "Castalia" . . .	* "*Engineering*," xxvii. 334.
	"*Scientific American*," xxxiv. 163.
"Express," Calais to Dover	"*Van Nostr. Mag.*," xviii. 477.
	"*Engineer*," xlv. 197.
Trial trip of (Dover to Calais	"*Scientific Amer.*," xxxviii. 247.
Bernays, Br.	* "*Engineering*," xxv. 353.
Watts, Br.	* "*Engineering*," xxvi. 118.
Wigzell & Halsey . . .	* "*Scientific American Sup.*," 1184.

Twin Fur'nace. A double furnace.

Twin Lo-co-mo'tive. Two locomotives, identical in their parts, attached to a long freight platform.

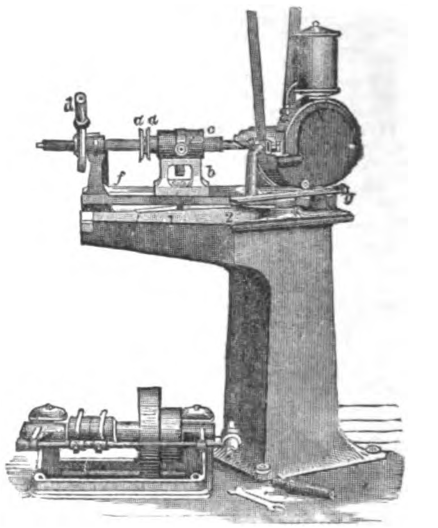
Twin locomotive . . .	* "*Scientific American Sup.*," 2717.
Villa Real Railway, Portugal	* "*Engineering*," xxvi. 511-515.

Twin Pow'er Press. One in which the power is brought to bear upon two objects in alternation. See Fig. 916, p. 291, *supra*.

Twist Drill Grind'er. This machine, Fig. 2478, is designed for sharpening twist and other drills from $\frac{1}{4}''$ to $1\frac{1}{2}''$ in diameter, and of any length. All the movements are self-regulating and automatic.

The head-stock of the emery-wheel has a transverse movement actuated by a lever, and is also capable of being set forward relatively to compensate for wear.

Fig. 2478.



Twist Drill Grinder.

The shank of the drill is held in a hollow arbor, the other extremity being supported near the grinding-wheel by a ring in which the drill is centralized by a screw.

The cut is made with mathematical precision, and the presentation is such that the length and angle of cut on the respective sides of the drill are exactly equal.

The emery wheel is kept wet by a trickling stream of water, elevated by a small rotary pump on the wheel arbor, and conducted by pipes from a reservoir in the post to the hood of the wheel; from the drip mass it returns by a pipe to the reservoir.

The pulley has two speeds, and the more rapid may be used when the emery wheel has worn to a smaller diameter, so as to preserve proximately the same speed at different periods in the life of the stone.

The drill-holding portion has a radial adjustment on the point of contact with the stone as a center, to govern the angle of presentation of the drill. A series of 41 rings, adapted to all sizes of drills, goes with the machine.

Thomson, Sterne & Co., Br.	* "*Engineering*," xxi. 23.
Fay	* "*Scientific American*," xxxv. 326.
Twist drills, on . .	"*Manuf. and Builder*," xi. 163.

Twilled Ar'mure. (*Weaving.*) A style of weaving produced by the four-leaved harness, making a twill. Also called *Batavia weave*. See ARMURE.

Twist'ing For'ceps. (*Surgical.*) See TORSION FORCEPS.

Twist'ing Ma-chine'.

Yarn. . . . . . * "*Scientific American Sup.*," 1075.

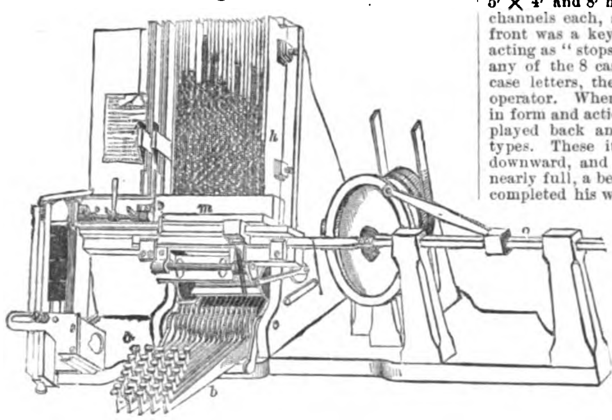
Ty'er Bat'te-ry. (*Electricity.*) The positive element consists of fragments of zinc in a bath of mercury at the bottom of the cell. The negative element (copper) is suspended above in dilute sulphuric acid.

Niaudet, American translation . . . . . . * 57.

Baron Ebner's modification consists in replacing the copper by a plate of platinized lead.

Niaudet, American translation . . . . . 58.

Fig. 2479.



Paige's Type-composing Machine.

Tym'pa-num Per'fo-ra-tor. (*Surgical.*) A fine, piercing instrument for perforating the tympanum. *Politzer.*

Forceps made specially for the purpose are used to introduce an eyelet into the perforated tympanum.

See page 87, Part II., *Tiemann's "Armamentarium Chirurgicum.*"

Type. Nickel is now used in electrotyping, giving a smooth, hard face to the type.

Type Com-pos'ing Ma-chine'.

Paige's type-composing machine has keys by which the different *sorts* are dropped in the required order from the receptacle pockets *h* (Fig. 2479), which contain them. The keys are shown in a group, *a*, in the lower part of the illustration, the right-hand lower one of the set being shown at *b*. The main shaft of the machine is kept constantly revolving, and when a key is depressed, the mechanism at a certain portion of the revolution causes the appropriate type-forcer to push out the lowest type of the rank into the race *m*, when the type-driving rod *o* sweeps it out of the race and into the line of composition, when the justifying mechanism *c* comes into play to form the matter in lines for the galley measure.

The "Felt" machine, patented May 29, 1860, and June 23, 1863, was the first machine constructed to set, justify, and distribute. It attempted too much. It occupied a space 5' × 4' and 8' high, and had 8 type-cases, consisting of 86 channels each, standing perpendicularly, side by side. In front was a key-board of 40 keys, like that of an organ, 7 acting as "stops," which adjusted the keys in relation with any of the 8 cases. Thus the keys acted upon the lower-case letters, the capitals, or the *italics*, at the will of the operator. When the machine was in motion, the "stick," in form and action suggesting the head and beak of a bird, played back and forth against the tubes, gathering the types. These it seized with its pincers, or beak, turned downward, and deposited in the line. When the line was nearly full, a bell announced it, so that the compositor only completed his word or syllable. By touching now the justifying-key, he caused the spacer to draw the line into another part of the machine to be justified, and so resumed his setting. The process of justifying consisted in the removal of the steel spaces, with which the matter was first set, and which were furnished with projecting heads for the purpose of withdrawal, and substituting others. This process was performed automatically, the lead added, and the line deposited on the galley. In distribution, the necessity of nicks in the type was sought to be avoided by means of a register, made in the process of composition. This consisted of a narrow strip of card or paper, in which holes were punched as the types were taken, and by which they were redistributed.

Type-casting machine . * "*Scientific American*," xlii. 8.
Type factory . . . . * "*Scientific American*," xlii. 239.
Type printing telegraph, *Vander Ploeg* . . * "*Telegraphic Journal*," vi. 417.
Instruments, Engl. . "*Scientific American Sup.*," 1178.
Type setting machine, *Heinemann* . . . "*Mining & Sc. Press*," xxxvi. 99.
And distributing machine, *Burr* . . . * "*Manufact. and Builder*," xli. 33.

U.

U Bolt. A clevis for the attachment of axles, rods, etc., in machinery and vehicles.

U-cha'ti-us Steel. (*Metallurgy.*) Iron, granulated by running it into cold water, is put into a crucible with oxygen-yielding material, such as spathose iron ore, and the pig-iron gives up its impurities to the oxygen.

Uchatius steel . . . "*Van Nostr. Mag.*," xv. 282, 474.

Un-bran'ning Ma-chine'. (*Milling.*) A machine for removing the bran or cuticle of the wheat grain. The Bentz process.

The process is partially accomplished by a vigorous application of brushes arranged as in the smut machine; also by scalding, which makes the cuticle roll off when rubbed. See SMUT MACHINE.

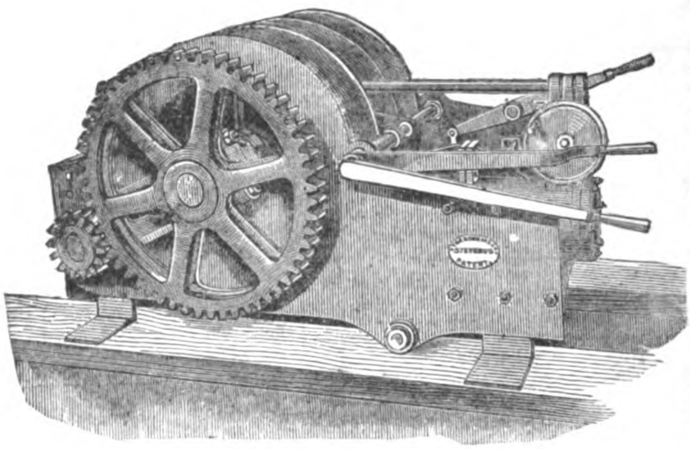
Un'der-grade. A term as applied to bridges synonymous with *deck* bridge, in which the track is above the truss.

Un'der-ground Haul'ing En'gine. Stevens's underground engine, Fig. 2480, exhibited at the Leeds Exhibition, is specially designed for underground haulage, and the object has been to provide an engine, with drums and everything complete, which shall do the work of four or five horses, and be so small and compact that it will pass underground through any space which is sufficient for an ordinary coal train. The engine is completely erected between two frames of boiler-plate, and the one exhibited, which will indicate about 6 horse-power with 20 lbs. pressure, and is fitted with 2 drums of 2' diameter, occupies a space of 6' 7" by 4' by 3' 5", and weighs 29 cwt. In using these engines no foundation is required, all that is necessary being to spike them down on timber. The drums which work on the second motion are loose on the shaft, and have independent brakes and a clutch for throwing them in and out of gear.

These engines are designed for using compressed air or steam; for the former the exhaust passages are made very large. Most of the new collieries that are now in progress of laying out are being arranged to use mechanical haulage.

Fig. 2481 is a view of the Uskside underground engine.

Fig. 2480.



Stevens's Underground Hauling Engine.

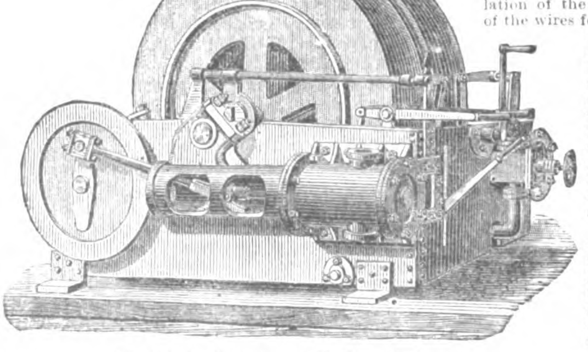
Fowler, Br. . . . . . . * "*Engineering*," xxvi. 5.
Stevens, Br. . . . . . * "*Engineering*," xxvi. 224.
Underground railways . "*Iron Age*," xxi., Jan. 10, p. 15.

Un'der-ground Wires. For telegraph, telephone, and other electric uses.

Underground electric ways arose with the electric telegraph. Messrs. Cooke and Wheatstone, in their earliest telegraph patents, No. 7390 of 1837, and No. 7614 of 1838, describe means for inclosing line wires in conduits to be used underground or placed upon posts above ground. Wooden rails were channeled or grooved upon their surface, and the wires laid in a resinous cement in the grooves. A second rail was then placed upon the first and bound down with iron bands. The wires were covered with cotton and varnished before being laid. They also used various shaped troughs and tubes, into which carefully insulated wires or cables were drawn. Iron tubes, like gas-piping with screwed joints, were laid down, and wires or cables drawn into them. A long coupling sleeve formed a junction-box for connecting up the wires. They also employed a split-iron tube, in the slot of which wires were introduced. The insulating material was poured in upon the wires and the edges of the slot drawn together.

In 1845, Patent No. 10,799, cotton-covered wires were placed in a lead pipe and pitch poured in, the lead pipe being used for the return circuit. In the same year, Patent No. 10,838, wires were laid in railway fences and at crossings, were brought underground and embedded in asphalt. In 1847, patent No. 11,974, parallel grooves were made in sleepers of wood, stone, concrete, or earthen-ware, the wires were then laid therein and supported by insulating supports, marine glue, gutta-percha, asphalt, or Stockholm tar was then poured in hot and an iron cover screwed down over the grooves. In some cases each wire was covered with cotton and then encased in lead. In 1850 Mr. Siemens used a plow, on the carriage of which was a reeled cable. The cable was laid down in the furrow as it was cut by the plow, and then covered under, *vide* Patent No. 13,062. In patent No. 2,710, of 1854, perforated or grooved blocks were made of artificial stone composed of bitumen, sand, and other ingredients. These were molded into the proper shape, and laid in line, and then bare or insulated wires threaded through the perforations. The wires were stretched tight and carefully joined. At the testing and junction boxes the wires were brought out and laid in a notched frame, so as to be readily accessible. Patent 2,089 of 1855, by Dr. Werner Siemens, is of interest as being the first attempt to avoid induction and the consequent retardation. In a cable for underground or submarine use two parallel wires are laid in gutta-percha insulation and one used as the return conductor for the other. As the current in the two is in opposite directions, each neutralizes the inductive effect of the other. Other wires placed in the same cable are each equidistant from the first two wires so as to be equally and oppositely affected by them. In one form a central insulated copper wire is surrounded by a number of iron wires which form the return part of the circuit of which the copper wire is the direct.

Fig. 2481.



The Uskside Underground Hauling Engine.

Patent 119 of 1859. An iron trough laid beside the curbstone contains the wires.

Patent 2,759 of 1859. Earthenware troughs are provided with hooks or notched projections or frames of insulating material on which the wires are supported. The troughs are covered up and sealed with pitch.

Patent 130 of 1868. A conduit of molded blocks of earthenware, with perforations for the wires. The wires are drawn in by pneumatic pressure or by percussion.

Patent 3,863 of 1873. The wires are supported in pipes by means of perforated disks. Dry air is forced into the pipes to absorb moisture and maintain the insulation. The air is dried by being passed over quick-lime or sulphuric acid and pumice-stone. The pipes are of glass, cement, composition, or earthenware.

In the United States but comparatively little has yet been done in underground electric ways, and most of the devices are small modifications of those described above.

In the Brooks system, Patent No. 165,535, July 13, 1875, wires covered with jute or cotton and soaked in paraffine are placed in an iron tube and the tube then filled with heavy paraffine oil or liquid paraffine which is maintained under pressure. Horner, Patent No. 173,170, February 6, 1876, uses a hollow curb-stone in which there is a box or tube containing properly insulated wires. Delany, Patent No. 240,236, April 19, 1881, places within his conduit a pipe for conducting hot air or steam which prevents moisture injuring the insulation. He insulates with powdered talc. Edison, Patent No. 251,552, December 27, 1881, uses semi-cylindrical rods for conductors which are supported in iron tubes by manilla washers; the tubes are then filled with melted asphaltum under heavy pressure.

Every practical underground way involves complete insulation of the wires, protection from moisture, accessibility of the wires for connections and testing, and means for adding new conductors as the needs of the service increase. Perhaps the greatest desideratum, however, is the prevention of induction between different classes of wires. The device used by Siemens has been mentioned. A device, invented by Foucault, Patent No. 90,089, May 18, 1869, is to surround each insulated wire with a thin metallic layer, which is connected to the ground at intervals. This metallic layer is supposed to take up the inductive energy of the wire, and prevent its disturbing action on the neighboring wires.

The first practical device, however is of recent American invention, having been patented to the inventors, Messrs. Bentley & Knight, May 1, 1883. Electric light, telephone, and telegraph wires are all laid in the same conduit. In one form the light wires are run up one side of the conduit and return down the opposite side. Between them are the telephone wires, which cross over at intervals from one side to the other of the conduit, so as to be equally and oppositely influenced by the two branches of the light-circuit. The telegraph lines consist of cables wherein a common return is used for a number of direct lines and neutralizes their inductive effect. In a second form the light wires are crossed at intervals, so that the positive and negative wires exchange their lineal positions; the telephone wires are straight, while the telegraph wires are cabled as in the first arrangement. In a third form the telephone and telegraph wires are both single and are each equally distant from the two branches of the light circuit. The light conductors are made in strips and serve as inductive shields between the telephone and telegraph wires.

The underground telegraph wires of the French cities are thus arranged: The conductor, formed of a wire-cord of four strands, spirally twisted, is covered with a sheath of gutta-percha of about 5 millimeters in diameter, and surrounded by a covering of cotton saturated with wood-tar, and another not so saturated. These envelopes of cotton are dipped in sulphate of copper solution. The cables contain from 3 to 7 conducting wires, according to the needs of the service. They are laid in cast-iron pipes similar to those used for gas, 2½ meters in length, and of a size proportioned to the number of cables. The lengths of a pipe are united by leaden rings; every 50 meters there is a joint of larger diameter, which slides over its neighbors like a sleeve. At the moment of laying the pipes in the trench dug to receive them, a thread is passed through the pipe, which, at the adjustment of each length of 200 meters, introduces a larger cord; one of the ends of this cord is rolled upon a winch, and the other attached to a small iron bar mounted with "gudgeons," which hold the cables to be inserted. The cable is thus drawn through the pipe, passing first over a pulley whose horizontal tangent is in a line with the pipe. If the joints are well made, the pipe is weather-proof, and the cable is sheltered from all infiltrations of water or of gas. The use of the larger joints of pipe above mentioned makes the repair of the cables in case of accident an easy matter.

The wires are run underground in the cities of Berlin, Dresden, Breslau, Dantzig, Stettin, Hamburg, Bremen, Cologne, Frankfort-on-the-Main, Mayence, Carlsruhe, and other large cities and towns of Germany, and in Geneva, Lausanne, Berne, Neufchatel, Zurich, Winterthur, Schaffhausen, Saint Galle, and Lugano, in Switzerland. In nearly all the cities of Europe neither posts nor wires are visible, but the system of underground cables is adopted instead. These cables contain from 5 to 7 conductors each, insulated with gutta-percha, and the whole protected with an armor of iron wires. This system has shown itself in practice to be both economical and reliable. There are now in Paris working lines that have been buried for twenty years, and which have been the cause of little or no expense except their first cost. It is especially worthy of note in this particular that during the reign of the commune, when almost every institution of public utility was destroyed, not an underground wire was disturbed.

London . . . . . "*Iron Age*," xvii., March 16, p. 3.
"*Telegraphic Journal*," iv. 26, 97.
England . . . . . "*Scientific Amer.*," xxxvii. 278.

U'ni-cy'cle. A one-wheeled vehicle for propulsion by foot-power.

A Danish inventor has invented a single wheel in which is arranged a seat for the traveler who is to propel it. The wheel has one central rim, and to this are fixed the arms, which are, say, six or eight in number, half of them swelled, extended, or bellied out to one side, and half of them similarly to the other side, each set of arms being fixed to a nave or boss; these arms are bent out so far and the naves are so far apart that the traveler, when in the sitting posture, finds room in the wheel between them. The arms are by preference not arranged opposite to one another on the two sides, but intermediately. The naves carry each a crank, and these cranks are by connecting rods jointed to two bell-crank levers, having one arm placed about upright in a position convenient to the traveler to take hold of for working them backward and forward alternately. Each bell-crank lever has its fulcrum in the seat for the traveler, which seat is hung from the naves or axles of the wheel. The seat is by preference made in scroll form, of light, open-worked steel plate or wire-work, or partly so, and may have a part extending overhead to carry an awning to protect against dirt thrown up, and against rain. From each nave there may be hung a leg serving to steady the velocipede while entering the same, but which can be thrown up out of the way when traveling. The wheel, arms, and the rim may be fitted with stiffeners or diagonals to distribute the weight or strain over the rim as much as possible. This unicycle is eight feet and upwards in diameter.

U'nit. A basis for estimating or forming comparisons.

"One pound of good anthracite coal will produce, in combustion, 14,220 units of heat; while 1 lb. of bituminous coal will produce 13,500 units. Let us adopt the round number, 14,000 units: that is to say, the proper combustion of 1 lb. of coal should heat 14,000 lbs. of water 1°, or 140 lbs. 100°, or 14 lbs. 1,000° Fahr. But heating water 1,000° changes it into steam; and experiments have proved that it takes exactly as much heat to change 14 lbs. of water into steam as to heat 140 lbs. of water 100°. Therefore the 14,000 units of heat developed by the combustion of 1 lb. of coal will change 14 lbs. of water into steam; and it is by the intervention of this steam that we have to obtain the mechanical equivalent of the 14,000 units of heat. The well-established mechanical equivalent of each unit is 772 foot pounds. In fact, for every foot that we cause 772 lbs. to descend, we may actually obtain a unit of heat; and therefore we are entitled to expect inversely the development of a force of 772 foot pounds for every unit of heat expended. The 14,000 units of heat, obtained by the combustion of 1 lb. of coal, should give us, then, 14,000 × 772, or 10,808,000 foot pounds. If the coal is burned in 1 hour, we ought to obtain this force per hour; and, as 1 horse power is equal to a force of 33,000 foot pounds per minute, or 33,000 × 60 = 1,980,000 foot pounds per hour, we ought to have 10,808,000 ÷ 1,980,000, or 5.4 horse power per pound of coal consumed per hour. The best engines, therefore, in place of obtaining, as heretofore, only one tenth or one twentieth of the theoretical equivalent of the heat consumed, are reported to have reached nearly one fifth, which is certainly a wonderful advance. Of course, the full theoretical equivalent can never be expected, for reasons which we will not now discuss. Most engineers are agreed on the main features of the most economical steam engines. They are: Proportionally large boilers, with large heating surfaces, and proper grates; heating of the feed-water in the condenser; high pressure in connection with proper cut-off arrangements, so as to utilize the expansion; careful protection from loss of heat by radiation, and intelligent and faithful engineers and firemen." — *Technologist.*

Unit of light: —

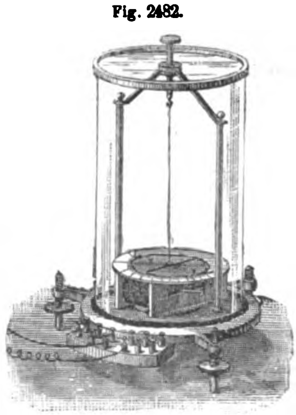
England: Spermaceti candle burning 8 grains per hour.
France: A carcel lamp burning 42 grams colza oil per hour.
Germany: A spermaceti candle giving 1·9 the light of the Fresnel unit.

U'nit and Safe'ty Valve. One exposing 1 square inch to the force of the steam.

U'ni-ver'sal Gal'va-nom'e-ter. Edgerton's apparatus, Fig. 2482, has leveling screws and astatic needles, suspended from the brass arm by a fiber of unspun silk, with arrangement for adjusting the zero of the scale to the axle of the coils.

It is convertible by adjustment from an ordinary quantity galvanometer into one for intensity or into a differential galvanometer for either intensity or quantity.

Fig. 2482.

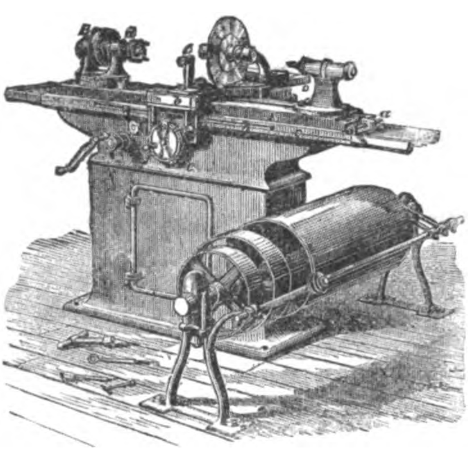


Universal Galvanometer.

U'ni-ver'sal Grind'ing Ma-chine'. One adapted for a great variety of work, with solid emery or corundum wheels.

The movable table is capable of adjustment by a tangent screw and graduated arc, and admits of straight and curved taper grinding with the centers of the machine always in line. It is specially adapted for grinding soft or hardened spindles, arbors, cutters, either straight or angular, reamers and standards also for grinding out straight and taper holes, standard rings, hardened boxes, jewelers' rolls, etc. The work can be revolved upon dead centers or otherwise. The grinding wheel can be moved over the work at any angle, by which means any taper can be produced. Emery wheels from ¼″ to 12″ in diameter can be used either with or without water. The feed-works and slides of the machine are

Fig. 2483



Brown and Sharpe's Universal Grinder.

covered and protected from grit and dust. The grinding of taper holes and angular cutters is provided for with graduated arcs.

U'ni-ver'sal Head. A portion of a watchmaker's lathe with face-plate and dogs for holding the work. See WATCHMAKER'S LATHE, where it is shown in connection with a jeweling rest.

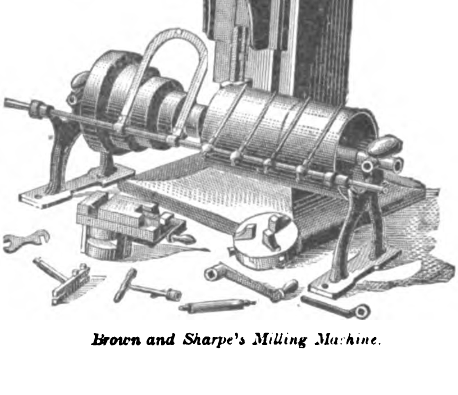
U'ni-ver'sal Joint. For diagrams, illustrations, and calculations; see *"Joint Universel,"* in *Laboulaye's "Dictionnaire des Arts et Manufactures,"* tome ii., ed. 1877.

U'ni-ver'sal Lathe. One for producing various forms, either circular or irregular.

Koch & Müller . . . . . . * *"Engineer,"* xli. 26.

U'ni-ver'sal Mill'ing Ma-chine'. (*Metal Working.*) A milling machine with a capacity and variety of adjustments of the tools and tables, to enable it to do a great variety of work.

Fig. 2484.

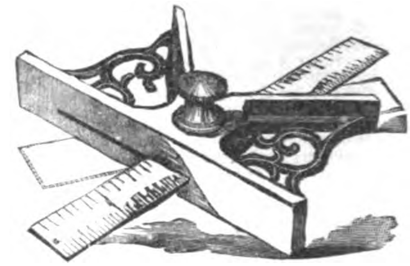


Brown and Sharpe's Milling Machine.

In addition to the movements of a plain milling machine, the one shown in Fig. 2484 has the following: The carriage moves and is fed automatically, not only at right angles to the spindle, but at any angle, and can be stopped at any required point. On the carriage centers are arranged in which reamers, drills, and mills can be cut either straight or spiral. Spur and beveled gears can also be cut. The head which holds one center can be raised to any angle, and conical blanks placed on an arbor in it, cut straight or spirally. Either right- or left-hand spirals can be cut.

U'ni-ver'sal Square. A combined try-square, miter, T-square, rule, and center square for finding the center of a circle. See SQUARE.

Fig 2485



Universal Try Square

Marshall's center square, Fig. 2485, combines in one seven different tools: the try-square, miter, T-square, bevel, center square, depth gage, and the graduated rule.

U'ni-ver'sal Wood Work'er. The Fay wood-worker, Fig. 2486, is a machine in which both sides may be operated, and either side started or stopped without interfering with the other.

As a planer, it is adapted for ordinary surfacing and thicknessing, planing out of wind, surfacing square, beveling, or tapering pieces, facing up bevels and baluster, etc. As a molding machine it will work moldings, either simple or complex, up to 8″ or 9″ in width, stick sash and doors, tongue and groove; and on the wood-worker side it will produce waved, oval, elliptical, circular, and serpentine and rope or twist moldings. Among its other uses are chamfering, cornering, rabbeting and joining window blinds, gaining, panel-raising on one or both sides, tenoning, ripping, cross-cutting, grooving, hand-matching, making glue and table joints, mitering, nosing, squaring up, and a multiplicity of other operations limited only by the skill of the operator.

The molder and wood-worker sides are securely connected upon one solid column with a substantial base, and the two sides of the machine are driven from one countershaft, which conveys power either separately or simultaneously.

The molding side is so arranged as to form a complete four-side molder. The side spindles are fixed to and move with the table, which has a vertical movement of 16″. The feeding rolls are arranged for fast or slow feed.

The wood-worker side is constructed on the same principle and embraces the same general features as the patent variety wood-worker above described.

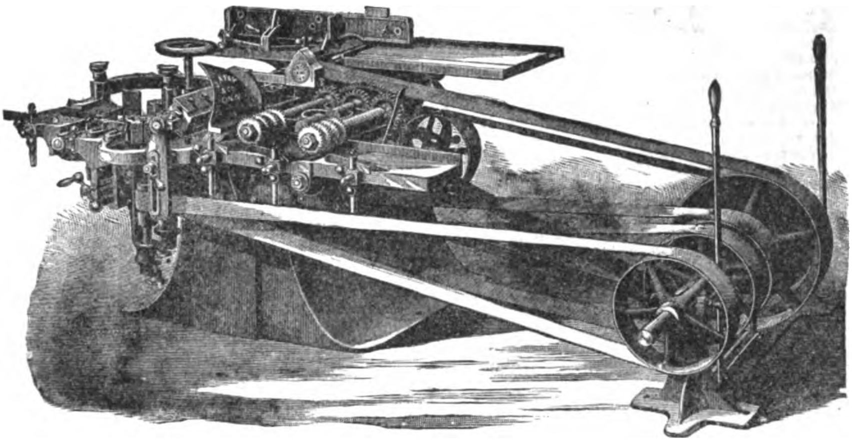
Un-load'er.

Hay, *Kelly* . . . . . * *"Min. & Sc. Press,"* xxxvi. 238.
Winter . . . . . . * *"Min. & Sc. Press,"* xxxvi. 313.

Up-end'ing Tongs. A long and strong suspended tongs to enable the shingler to tip the bloom on end on the anvil that the hammer may strike it endways and upset it.

Head . . . . * *"Engineering,"* xxiii. 429.

Fig. 2486.

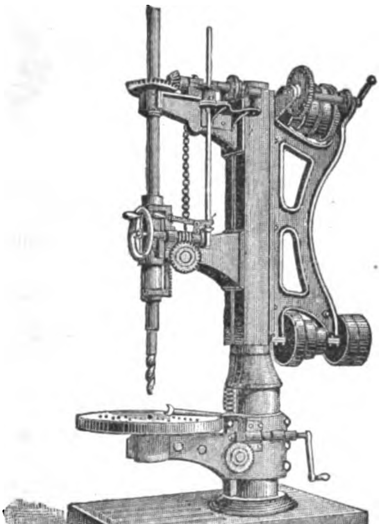


Universal Wood Worker.

Up'per Deck. (*Nautical.*) The highest continuous deck.

Up'right Drill. (*Metal Working.*) A term

Fig. 2487.



Upright Drill.

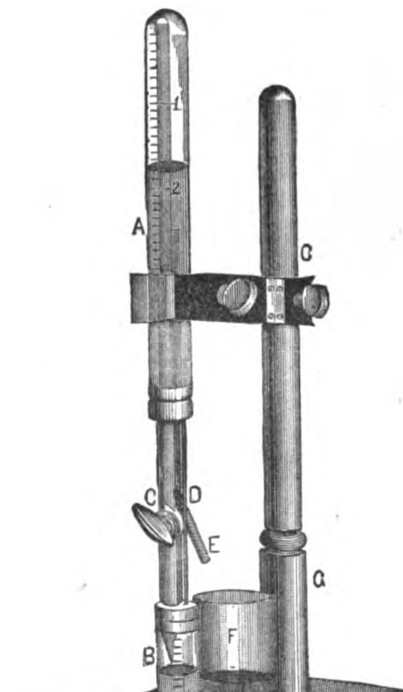
applied to a drill whose mandril is vertical, as in Fig. 2487. See also DRILL; BORING MACHINE, etc.

Ferris & Miles . . . . * "*Iron Age*," xx., Nov. 15, p. 1.

Up'right Mold'ing Ma-chine'. Blaisdell's upright molder has an adjustable table, operated by turning the wheel around the column. The spindle is placed in boxes inside the column, and into this the false spindle is fitted by a new device. The main spindle runs in self-oiling brass boxes.

U're-om'e-ter. In Hüfner's new ureometer, Fig. 2488, for clinical use, the exact methods for the determination of urea in organic liquids are far too complex and tedious to be of more than occasional service to busy medical men, whilst the readier methods are not sufficiently accurate to be of more than approximate value. The method of estimating urea by means of a solution of sodium hypobromite, given by Hüfner, and the modification of it proposed by Russel and West, are very

Fig. 2488.



Ureometer.

convenient for clinical purposes, but even these leave something to be desired on the score of accuracy.

In a recent January number of the "*Practitioner*," Drs. Russel and West state that they have found the hypobromous solution to decompose in hot weather more quickly than they expected, and that it is very important that it be freshly prepared.

They draw especial attention to this, and suggest that the solution be prepared in the following manner: —

A solution of caustic soda is made in water, in the proportion of 100 grams of solid caustic soda to 250 cc. of water. This solution may be made in large quantities, for it will keep good for a very long time. To part of this solution bromine is added, in the proportion of 25 cc. to every 250 cc. of caustic soda solution, at the time it is required for use.

With the view of simplifying the operation of ureometry to the utmost extent compatible with the necessary accuracy, M. J. G. Blackley, of London, devised the form of apparatus represented in the cut. It consists of two graduated tubes, a larger one, *A*, of about 75 cc. capacity, and a smaller one, *B*, of about 15 cc. capacity, closed by perforated india-rubber stoppers, through which pass the tubes *C* and *D*. *C* is the wider of the two, and is provided with a glass stop-cock. Its lower extremity, drawn to a fine point, descends about halfway into the tube *B*. *D* is a narrower tube, and ascends about halfway inside *A*. *E* is a short, slightly bent tube, passing through the india-rubber stopper into the tube *A*, and serving as an egress for the superfluous contents of *A*, which are collected in the beaker *F*, the whole being supported by the wooden stand *G G*.

The method of using the apparatus is as follows: —

The tube *A* is filled with a solution of sodium hypobromite, and its stopper inserted. Then 5 cc. of the liquid to be examined are placed in the tube *B*, and its stopper (which has previously been adjusted upon the ends of the glass tubes *C* and *D*) is inserted to the level of a scratch on the outside, and the stop-cock gradually opened. The hypobromite solution flows down the tube *C*, decomposition takes place, and the gases evolved, ascending through the tube *D*, are collected in *A*. The superfluous hypobromite solution flows out through the tube *E* into the beaker *F*. To complete the operation the apparatus is removed from the stand, after placing the finger over the mouth of the tube *E*, and agitated for a few moments. It is then replaced, and after allowing time for the froth to subside, the quantity of the gas collected is read off. After subtracting the small constant of air contained in the tube *B*, the remainder gives by calculation the quantity of urea present in the 5 cc. of liquid examined. Under ordinary circumstances the whole operation may be completed in five or six minutes.

Fig. 2489.

Instead of having the tube *A* graduated into cubic centimeters, it is convenient to have the graduation indicate at once the percentage of urea, as is the case with the tube supplied with Russel & West's ureometer. — *Journal Chem. Soc.*

U-re'thra Di-vul'sor. (*Surgical.*) See DIVULSOR.

U-re'thra In'stru-ments. (*Surgical.*) These are numerous and included under the following heads: —

Applicator.
Catheter.
Dilator.
Divulsor.
Forceps.
Lithotrity instruments.
Ointment bougie.
Porte-caustic.
Searcher.
Sound.
Speculum.
Staff.
Stricture cutter.
Stricture dilator.
Syringe.
Urethrameter.
Urethratome.

Otis's Urethrameter.

U're-thram'e-ter. (*Surgical.*) An instrument for measuring the diameter of the *meatus urinarius*.

Dr. Otis's apparatus, Fig. 2489, consists of a small, straight canula, terminating in a set of fine steel springs hinged upon the canula, and also upon the distal extremity of the instrument, where they unite. At this point a fine rod, running through the canula, is inserted. This rod (which is worked by a screw at the handle of the instrument), when retracted, expands the springs (six in number) into a bulbous shape, from ten to twelve millimeters in circumference when closed, and capable of expansion up to forty-five millimeters.

That of *Dr. Gross* has a pair of expanding arms on the end of a staff, and an index on the handle to show the degree of expansion in *situ*. Fig. 71, Supplement, *Tiemann's* "*Armamentarium Chirurgicum.*"

Dr. Weir's is on the same principle. Fig. 68, *Ibid.*

Dr. Otis's has expanding jointed toggle arms. Fig. 94, Part III., *Ibid.*

U're-thro-met'ric Sound. (*Surgical.*) An olivary sound in a canula, the shaft being graduated to measure the length of insertion or of projection of the bulb beyond the end of the canula.

Leonard, Fig. 93, Supplement, *Tiemann's* "*Armamentarium Chirurgicum.*"

U'ri-nal. Figs. 2490 and 2491 show forms of portable urinals for convenience of persons afflicted with incontinence of urine. They are adapted for constant wear on the person, and are made of the best rubber.

Fig. 2490.

Fig. 2491.

Portable Urinals.

U'rine Bat'te-ry. (*Electricity.*) The plates are immersed in a trough through which urine flows. Ammonia is the chief excitant.

U'ri-nom'e-ter. (*Surgical.*) Apparatus for making urinary examinations, including —

Balance = 1-50 grain.	Platinum spur for calculi.
Blow-pipe.	Retort stand.
Bunsen burner.	Specific gravity bottle.
Burette, etc.	Test tubes and stand.
Filtration apparatus.	Wash bottles.
Graduated glass.	Water bath.
Hydrometer.	Water oven.
Pipette.	

See pp. 78-80, Part II., *Tiemann's* "*Armamentarium Chirurgicum.*"

U'su-du'ri-an. A material for packing, made of unvulcanized rubber and other substances. It is a non-conductor, and when subjected to the action of steam it is vulcanized and enabled to resist influences which are usually very destructive of ordinary rubber packing. By the application of naphtha to their surfaces, two pieces of the usudurian may be united, and under pressure become practically one, which is a convenience, as the user is thus enabled to build up any desired thickness of packing.

U'te-rine Ap'pa-ra'tus. (*Surgical.*) This embraces the following: —

Applicator.	Forceps.
Cautery.	Injector.
Cervix uteri instruments.	Knife.
Dilator.	Leech.
Douche.	Ovariotomy instruments.
Dressing instruments.	Placenta instruments.
Ecraseur.	Probe.
Electrode.	Redressor.
Elevator.	Repositor.
Embryotomy instruments.	Scarifier.
Excision instrument.	Scissors.

Sector.
Speculum.
Supporter.
Syringe.
Tenaculum.
Tourniquet.
Tumor instruments
Tupelo dilator.
Uterotome.

See under the respective heads. See also Figs. 6881-6885, p. 2685, "*Mech. Dict.*"

U'trecht Vel'vet. (*Fabric.*) A furniture plush made entirely of mohair, or, in the common qualities, with cotton warp. See MOHAIR.

U-vu'la-tome. (*Surgical.*) A knife for operating on the *uvula*. See TRACHEATOME.

V.

Vac'u-um Brake. (*Railway.*) A system of continuous brakes which is operated by exhausting the air from some appliance under each car by which the pressure of the external air is transmitted to the brake levers and shoes. An ejector on the engine is ordinarily used for exhausting the air, and it is connected with the rest of the train by pipes and flexible hose between the cars.

The vacuum brake is to be distinguished from the air brakes of the Westinghouse and Loughridge class in which the brake-levers are operated by compressed air.

The *Smith* and *Eames* brakes are of the vacuum order.

The former has flexible cylinders beneath each car, connected by pipes and hose with an ejector on the locomotive, which operates to exhaust the air from the cylinders. The latter are collapsible, and the movable head is connected to the brake-levers. See Figs. 649, 650, *Forney's "Car-builder's Dictionary."*

The *Eames* brake is similar in mode of operation. *Ibid.*, Figs. 653, 654.

Vacuum brake, *Eames*.
* "*Iron Age*," xx., Aug. 16, p. 1.
Hardy, Austria.
* "*Engineer*," xlv. 346.
Hardy, Vienna.
* "*Engineer*," xlix. 297.
Smith . . . . . . * "*Engineer*," xlii. 451.
Automatic, *Aspinall*, Br. * "*Engineer*," xlviii. 166.
Automatic, self-registering, *Sanders*, Br. . . * "*Engineer*," xlviii. 216.
Automatic, *Sanders*, Br. * "*Engineering*," xxiv. 113.
Continuous, *Sanders*, Br. * "*Engineer*," xliv. 106.
Continuous, automatic, *Eames*, Br. . . . . * "*Engineer*," l. 28.

Vac'u-um Pan. A vessel for evaporating saccharine juices in vacuo.

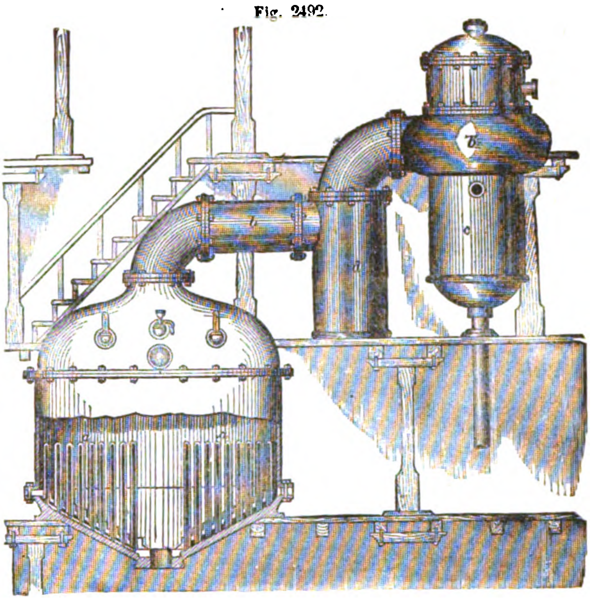
The "drum" pan, so called from its shape, is usually upright, and heated by a series of vertical tubes near the bottom.

In the "Gould" pan, Fig. 2492, the pipe that conveys the vapor to the condenser, passes round the latter, forming an annular space of semi-circular cross-section, joining the body of the condenser, and being continuous with it below and bolted to a flange upon it above.

Water falls upon the perforated reversible spray plate, that has its pivotal axis passing through a stuffing box, and attached to a hand lever, by which the plate is turned to allow the water to alternate to prevent the apertures from becoming clogged. The vacuum pump is connected with the top of the condenser.

The Colwell vacuum pan is elevated on great iron columns three stories high. Inside are four copper serpentines, and into these steam is led. The circulating pump and the centrifugal machines are placed on the first floor. On the second floor is a large receiver which receives the contents of the pan after concentration, in the shape of a dense mass of semi-fluid material, a magma. This goes into the centrifugal machines, which separate the sugar from the molasses. The vacuum pan of Messrs. Colwell and Brother, of New York, is 8′ in diameter, and, in a single operation of three hours in duration, can produce fifteen hogsheads of sugar.

Fig. 2492.

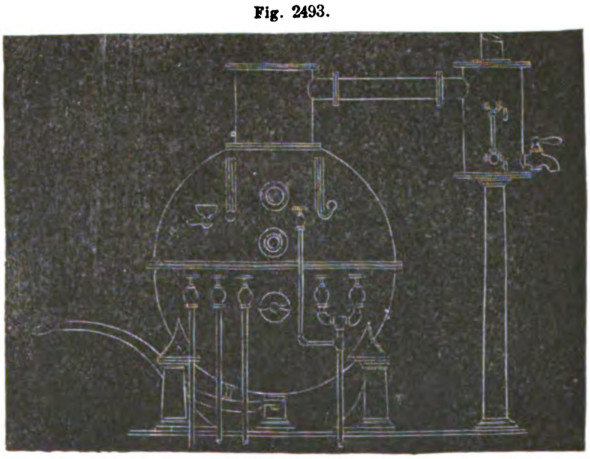


The Gould Vacuum Pan.

The Alvarado pan, Fig. 2493, is adapted to a factory working up fifty tons of beets per day. It is 6½′ in diameter and is 7′ high. The egress valve is operated by a lever from beneath the pan. A dome on the top is connected by a pipe to the safe, which has a glass gage, and a cock for drawing off the syrup that collects in it.

Two coils of pipe inside the pan heat the syrup and obtain

Fig. 2493.

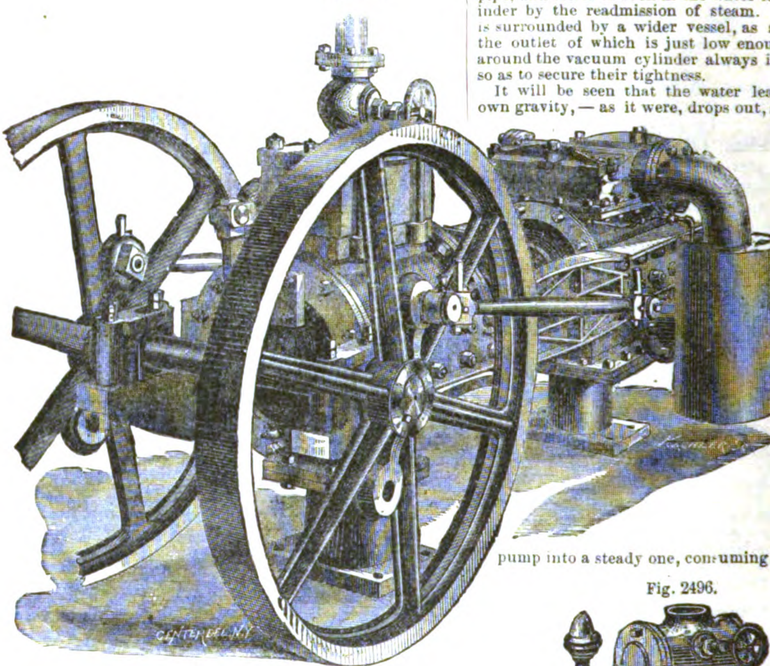


Alvarado Vacuum Pan.

their supply of steam by the pipe connecting with the generator.

Comp. Fivesdelle, Fr. .	* "*Engineering*," xxvi. 132.
Deeley & Co.	* "*Scientific American*," xliii. 335.
	* "*Manuf. & Builder*," xii. 273.
Immense	"*Iron Age*," xxi., March 7, p. 7.

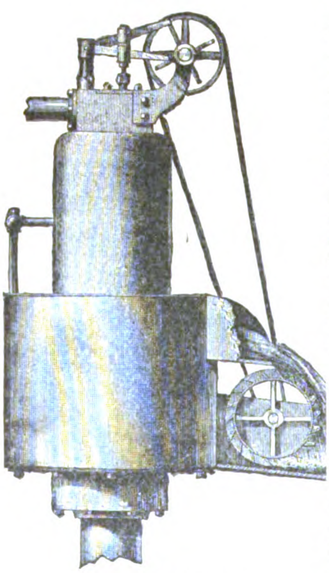
Fig. 2494.



Vacuum Pump.

Vac'u-um Pump. If the exhaust steam of a pumping or other steam engine is allowed to enter a closed vessel, and is there submitted to condensation by cooling, a vacuum will be formed. Such a vacuum may be utilized to raise water, if only the proper secondary appliances are added to make this condensation of the steam the subsequent raising of water, and its discharge and refilling with steam, alternate.

Fig. 2495.



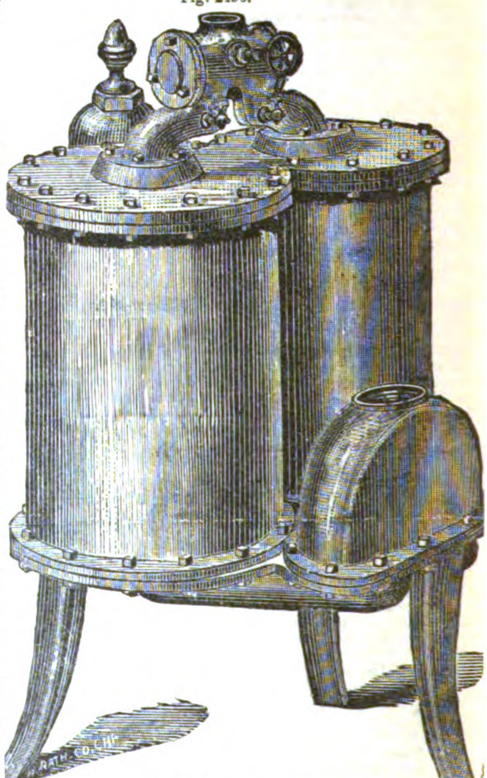
Vacuum Pump.

An ingenious way to effect this alternate action is represented in Fig. 2494, and is the invention of Mr. Wm. Burdon, President of the New York Hydraulic and Drainage Co. Water escaping from the vacuum cylinder is caused to turn a small overshot wheel, which, by means of a belt, is connected with a pulley on top, the revolution of which works the alternate admission of the steam into the vacuum cylinder. This cylinder is surrounded with large valves at its lower end, giving rapid exit to water and closing against its reëntering, while another valve at the top of the suction-pipe and the bottom of the vacuum chamber opens when the vacuum produces suction and draws the water up through the suction-pipe, and closes as soon as the water leaves the vacuum cylinder by the readmission of steam. The vacuum cylinder is surrounded by a wider vessel, as seen in the engraving, the outlet of which is just low enough to keep the valves around the vacuum cylinder always immersed under water, so as to secure their tightness.

It will be seen that the water leaves the pump by its own gravity, — as it were, drops out, so that the steam does not meet with any resistance whatsoever; on the contrary, when it enters it is rather drawn in and acts in this way on the steam-engine from which it is obtained almost like a condenser. The arrangement added to a high-pressure engine changes it practically into something even better than a condensing engine; in fact, into something similar to a compound engine; the steam is first utilized by its pressure and then by its condensation.

In order to change the intermittent action of this vacuum pump into a steady one, consuming a steady stream of ex-

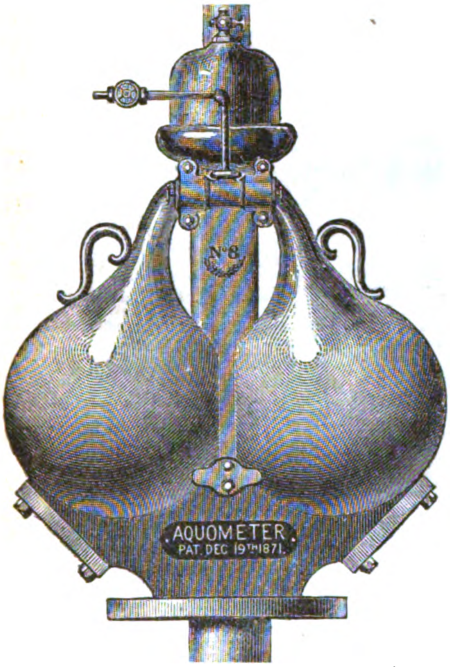
Fig. 2496.



The Nye Vacuum Pump.

haust steam, producing a continuous suction and rise of water and a steady stream of water, two suction pumps may be combined, the steam entering alternately the one and then the other, while this admission may be regulated in the same way as represented in Fig. 2495, or by means of other power, when the pulley is driven by a belt from shafting above.

Fig. 2497.



Vacuum Pump.

The revolution of this pulley opens and shuts the steam-valves alternately, so that the steam entering by the main pipe is in succession first thrown to the right and then to the left vacuum cylinder, so that while in one the steam enters it is being condensed in the other.

There is nothing to prevent multiplying these pumps and connecting them into one system, so as to be able to use all the exhaust steam disposable, when a steady, large stream of water may be obtained raised from a depth equal to that from which any suction pump may raise it by atmospheric pressure.

The "Nye" pump, Fig. 2496, is said to discharge 800 gallons per minute. It consists of two cast-iron cylinders lined with wood, to prevent loss of steam by coming in contact with the metal, the condenser (a plain chamber back of the cylinders), a simple balanced automatic steam valve on top of cylinders, and four valves covering suction and delivery ports.

The aquameter pump, Fig. 2497, has two chambers alternately occupied by water and steam. The steam being admitted by a balanced piston-valve forces the water out, and then condensing, forms a partial vacuum, into which the water rushes under atmospheric pressure.

Blake, * "*Manuf. & Builder*," x. 172.
N. Y. Drainage & Hyd. Co., * "*Man. & Builder*," viii. 29, 100.

Vac'u-um Shunt. An electric vacuum shunt of variable resistance was exhibited by Dr. Stone at the meeting of the Physical Society, on June 26, 1880. The variable resistance was formed neither by a set of coils, a platinum-iridium wire, or a tube of water, but by a Torricellian vacuum at the top of a mercury column, the height of which could be increased or diminished at will.

The apparatus consists of an ordinary barometer tube of glass 32″ long, and terminating above in a short vacuum chamber arranged transversely, and closed at either end by adjustable india-rubber stops, through which platinum terminals are passed. The tube is continued beyond this chamber to a stop-cock, by which small quantities of air can be admitted into the vacuum. The foot of the tube is connected by a flexible india-rubber pipe to an open glass cistern, like that of a Frankland gas apparatus. This cistern is nearly filled with mercury, which, on the barometric principle, ascends the tube till the height of the column above the surface level in the cistern just balances the pressure of the atmosphere. The cistern is suspended by a cord over a pulley, and counterweighted so that it can be raised or lowered through the whole 32″. On passing an induction spark through the Torricellian chamber all the discharge is diverted through this shunt. But on admitting a little air by the stop-cock to render the vacuum less perfect, and raising or lowering the cistern, so as to lengthen or shorten the mercury column, the resistance of the vacuum can be increased or diminished within wide limits. In this way, according to Dr. Stone, a point can be found at which the induction spark due to breaking contact is shunted through the vacuum tube, while the weaker discharge due to making contact is arrested. The induction current is thus obtained in a single direction, a matter of some importance in physiological experiments.

Va-len'ci-a. (*Fabric.*) A French dress goods woven on a taffetas loom. It has a silk chappe warp and a combed-wool weft.

Val'en-tine's Knife. A two-bladed knife for making a thin section of a tissue for microscopic purposes at a single stroke.

Val'gus, Tal'i-pes Ap'pa-ra'tus. (*Surgical.*) See CLUB-FOOT APPARATUS.

Valve. A device for regulating the passage of a fluid through a pipe or aperture. See p. 2688, "*Mech. Dict.*"

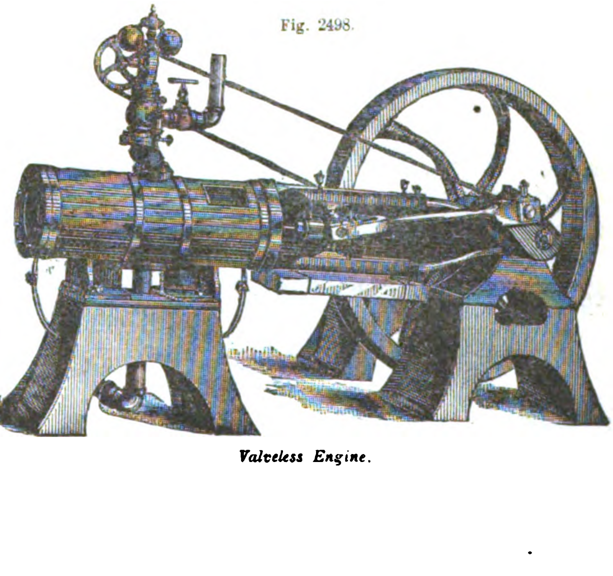
For water mains, *Armstrong*, Austr. . . .	* "*Engineering*," xxii. 335.
Manufacture of, *Ludlow*	* "*Scientific American*," xli. 79.
Mathewman & Johnson	* "*Engineer*," xlii. 298.
Oscillating, *Marigold* .	* "*Scientific Amer.*," xxxix. 134.
Water, *Chapman* . . .	* "*Scientific Amer.*," xxxix. 389.
Valve face planing machine, *Sharpe, Stewart & Co.*, Br. . . .	* "*Engineering*," xxvi. 322.

Valve Gear, Cut'-off. A detachable adjustable table or drop-off valve gear.

Valve'less En'gine. The "Wardwell" valveless engine, Fig. 2498, is horizontal, with one end of a girder frame bolted to and supporting the cylinder, and the other the pillow-block.

The cylinder has a bore 8″ × 35″; the stroke is 16″. The

Fig. 2498.



Valveless Engine.

pillow-block brasses have side adjustment by wedges, operated by bolts and nuts, from the top capface. The cross-head has V-shaped bearings, and has a gudgeon which provides journal-bearing for the fork-end of the connecting-rod. The piston-rod passes through the cross-head, in which it has journal-bearing for its semi-rotary motion; a nut and check-nut preventing longitudinal motion or "end-play" in this bearing. The connecting-rod has a strap at each end that is secured to it by a bolt passing through the ties, the key serving merely to adjust the brasses. Inside the outer fork of the connecting-rod is bolted a section of a bevel-wheel, with four teeth, and which gears into a similar but five-toothed section, keyed to the extreme end of the piston-rod. The reciprocation of the piston-rod produces an oscillation of the connecting-rod; but the two rods being geared together, the piston-rod and head are given the reciprocating semi-rotary motion desired.

The piston head is solid, having spring packing rings at each end, and a longitudinal spring-packing piece separating the steam passages. The steam port is in the center of the cylinder, at the top; its dimension is 3″ × ¾″. The exhaust port is 3″ × 1″, and diametrically opposite. The steam passages in the piston run along the circumferential surface of the piston head in a longitudinal but curved line which keeps the passage open to the cylinder port up to that part of the stroke and rotation when the cut-off is desired. Here the cut-off is effected by turning the passage sharply at right angles and in the direction of the piston rotation, giving the rest of the stroke under expansive steam. The steam-passage, after the abrupt turn mentioned, continues longitudinally to the end of the piston head; and at the end of the stroke is in communication with the exhaust port of the cylinder, and immediately acts as the exhaust passage, a similar or complementary passage alternating with it for steam and exhaust successively.

Van'ner. A separator and dresser for sifting minerals.

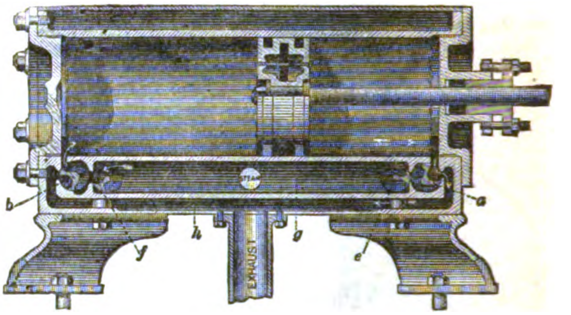
The Cornish vanner is a wide traveling belt of canvas and india-rubber, with a smooth rubber surface and deep flanges on each side, which travels slowly upward, and on the upper end of which the stuff to be dressed is carried by a launder and head. This belt, in addition to its upward motion, has a rapid shaking action imparted by cranks driven from a side-shaft, and the result is that while the waste is washed off the belt, at the bottom the mineral settles upon and adheres to it, and is carried over the upper cylinder and down into a coffer through the water in which the belt passes, and into which all the mineral is washed. The object throughout is, of course, to imitate the vanning action of the miner's shovel, the most efficient separator and dresser known. The machine at West Seton is larger than that put up at New Consols, the belt being 4′ in breadth and its upper surface 12′ in length. The inclination of the belt is 6″ in 1 foot, and the traveling speed about 10′ a minute, while the shakes are going at the rate of about 180 in the same space of time. But the speed, of course, depends upon the character and quality of the stuff. At West Seton the vanner has been tried on the tails of the slimes, and has thoroughly proved its efficiency by taking out all the mineral that is worth anything, that which passes off being worthless and utterly incapable of being treated profitably.

Va'ri-a-ble Cut'-off. One arranged to cut off at different parts of the piston stroke according to the speed of the engine.

In the Wheelock arrangement, Figs. 2499, 2500, the two winged induction and eduction valves *a b* have inclined conical faces, and are fitted rather loosely so as to pack by steam pressure as they wear. They are vibrated, through proper connections, by the rods *c d*, the latter attached to the eccentric. The cut-off valves *e f* have similar faces, and are also rather loosely fitted to insure constant light packing. They are operated by the dash-pot weights through the medium of a series of devices adjustably connected with the governor, so that they may be permitted to remain altogether inactive or arranged to cut off at varying points of the stroke depending on the speed of the engine. *g* is the steam chest and *h* the exhaust chamber, located beneath the cylinder to allow water of condensation to flow away.

Engine, *Porter Allen* . . * "*Engineering*," xxvii. 107, 115.
Fish . . . . * "*Sc. American*," xxxvi. 166.

Fig. 2500.



Sectional View, showing Valves.

Var'ley Bat'te-ry. (*Electricity.*) A battery in which the entrance of the sulphate of copper into the positive cell is prevented by the substitution of oxide of zinc for the paper partition. Any sulphate of copper entering the mass of oxide of zinc forms sulphate of zinc and deposits black oxide of copper.

Niaudet, American translation, 110.

Var'nish. The name is said to be from Berenice, a port on the Red Sea, 200 miles south of Cossier, established by Ptolemy Philadelphus as the port for landing the Oriental gums, etc., for the overland journey to Coptus on the Nile, 20 miles below Thebes.

The Orient is the home of many of the gums and resins used in the making of varnish, and some of the names have been strangely corrupted.

The *jackass* copal is a very unpoetical rendering of the Arabic *shikasi* (fresh) copal, so called as being *fresh* from the tree, to distinguish it from the half-mineralized copal which is dug out of the ground on the site of extinct copal tree forests.

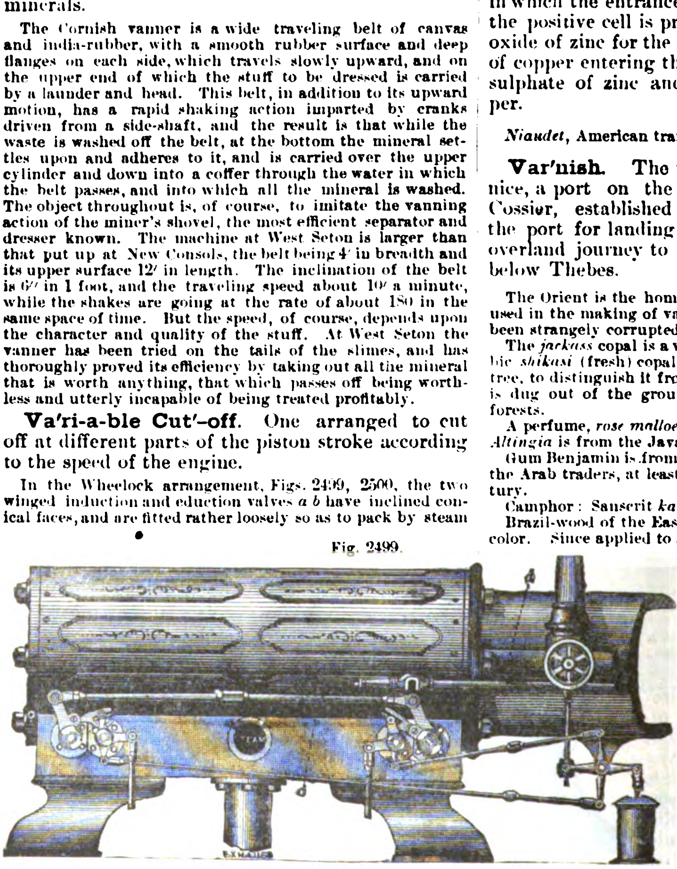
A perfume, *rose malloes*, the liquid storax of *Liquid-ambar Altingia* is from the Javanese *rasamala*.

Gum Benjamin is from the name *luban djawi*, given to it by the Arab traders, at least as long ago as the fourteenth century.

Camphor: Sanscrit *karpure*: Arabic, *kafur*.

Brazil-wood of the East Indias; *braise*, hot coals, from its color. Since applied to a dye-wood of Brazil, also.

Fig. 2499.



Variable Cut-off Engine.

FOR SILVER WARE.

Gum elemi	30
White amber	45
Charcoal	30
Spirits turpentine . . .	375

Used in a heated state, the metal being also heated.

Mr. F. Thies, of Bissendorf, Germany, claims the following preparation to be a good substitute for varnish. Heat 100 parts of colophonium and 20 parts of crystalized soda with 50 parts of water, and then add 250 parts of water and 25 parts of ammonia. The mass thus obtained is said to be fit for painters' use.

Boiler, *Werner*.
* "*Scientific Amer. Sup.*," 2715.

For foundry patterns . "*Scientific American Sup.*," 2440.
Making . . . . . . "*Manufact. & Builder*," ix. 256.
Removing . . . . . "*Scientific American Sup.*," 1481.
Varnishing, Japanese . "*Scientific Amer.*," xxxvii. 297.

Vas'e-line. A product of petroleum. Petroleum jelly. The heavy residuum of distillation is filtered through animal charcoal, which deodorizes and decolorizes the viscid hydro-carbon, and gives the familiar, bland, neutral product known as vaseline. This forms a vehicle for medicaments of various kinds; with 3 per cent. of carbolic acid it is a valuable antiseptic, and cerate for eczema.

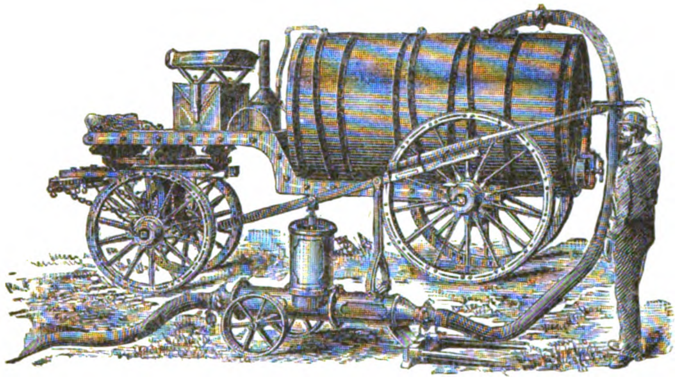
Vat. (*Leather.*) A large rectangular pit used in tanning.

Vat Net. Used as a strainer over a tub or tank.

Vault Emp'ti-er. A combined pump with deodorizing apparatus for emptying vaults, cesspools, etc.

The deodorizing can in front of the tank contains a chemical mixture through which the foul air displaced from the tank must pass in its escape. It is claimed that it is thoroughly disinfected, destroying all offensive odor. See Fig. 2501.

Fig. 2501.

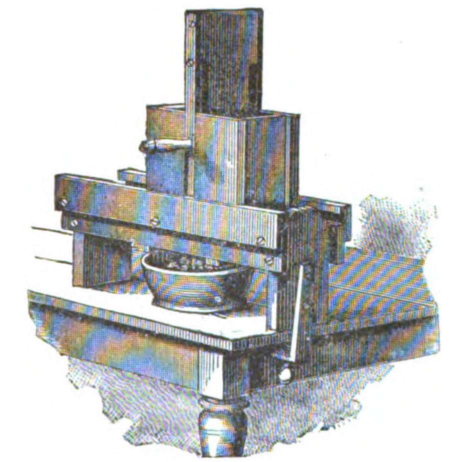


Vault Emptier.

Veg'e-ta-ble Cut'ter. A device for slicing vegetables for cooking or table use.

Fig. 2502 has a two-edged stationary knife, with the bottom of the laterally sliding box in two sections, each end rising alternately, being lifted by cams beneath according as it is working towards the knife or away from it, so as to present the material to the cutting surface of the knife.

Fig. 2502.



Vegetable Cutter.

Veg'e-ta-line. A substitute for ivory, coral, leather, caoutchouc, etc., lately patented in England under the name of *Vegetaline*, is prepared as follows: Cellulose (woody fiber), from any source whatever, is treated with sulphuric acid of 58° B. (= sp. grav. 1.676) at 15° C. (= 59 Fah.), then washed with water to remove excess of acid, dried and converted into a fine powder. This is mixed with resin-soap, in a mortar, and the soda of the soap is removed by treatment with sulphate of aluminium. The mass is now collected, dried again, and pressed into cakes by hydraulic pressure. These cakes are then cut into thin plates, which are shaped by again subjecting them to pressure. By adding castor oil or glycerine to the mass before pressure, the product may be made transparent. Colors may be imparted by the use of vegetable coloring agents. Facts respecting the strength and elasticity of this product are wanting.

Ve'hi-cles. See under the following heads: —

Ambulance.
Ambulance stretcher.
Army wagon.
Gun barrow.
Gun carriage.
Mortar carriage.
Mortar truck.
Shell truck.
Sling wagon.
Stretcher.

Ve'hi-cles and Me-nage'. See under the following heads, (for irons, see HARDWARE): —

Aparejo.
Axle.
Baggage barrow.
Baggage truck.
Bag-holding truck
Barrow.
Bicycle.
Block truck.
Bloom truck.
Box barrow.
Box truck.
Buck-board.
Cabresto.
Carboy barrow.
Cart.
Charging barrow.
Chock-block.
Coach.
Coal barrow.
Coal car.
Coke barrow.
Dirt barrow.
Dirt cart.
Dog velocipede.
Dry-goods truck.
Dumping barrow.
Equalizer.
Equibus.
Express wagon.
Food car.
Garden barrow.
Hand cart.
Hand truck.
Hook and ladder truck
Hose carriage.
Hose cart.
Hose reel.
Hotel coach.
Hub.
Iron barrow.
Ladder truck.
Liquid manure cart.
Litter.
Mail coach.
Mortar barrow.
Off-bearing barrow.
Omnibus.
Ox cart.
Pedomotor.
Pig-iron barrow.
Platform truck.
Pump barrow.
Pump cart.
Quadricycle.
Railway barrow.
Roller skates.
Rubber wheel.
Runner.
Sack barrow.
Sack holder.
Sack truck.
Saddle.
Seal spring.
Sewer-shaft wagon.
Sprinkling cart.
Steam trolly.
Stone barrow.
Stone cart.
Stone truck.
Stove truck.
Street sweeper.
Sulky.
Sweeping machine.
Tank barrow.
Timber cart.
Toboggin.
Transplanting wagon.
Tricycle.
Trolly.
Truck.
Tub barrow.
Two-wheel barrow.
Unicycle.
Van.
Velocipede
Wagon.
Wagon lock
Wagon seat

Warehouse truck.	Wharf barrow.
Water barrel truck.	Wheel.
Water cart.	Wheelbarrow.
Watering cart.	Wood barrow.

Vein. (*Mining.*) Aggregation of mineral matter in fissures of rock.

Ve-lo-cim'e-ter. An apparatus for measuring the velocity of projectiles in guns.

The methods that have been tried for ascertaining the law of motion of a projectile in the bore of a gun (with a view to finding the law of pressures developed) give only a small number of points of the curve of spaces traversed in given times, and they involve perforation or other injury to the walls of the gun, so that they are applicable only to large pieces.

A new and ingenious method, advantageous in these respects, has been contrived by M. Seibert. In the axis of a cylindrical hollow projectile he fixes a metallic rod of square section, which serves as guide to a movable mass. This mass, or runner, carries a small tuning-fork, the prongs of which terminate in two small metallic feathers, which make undulatory traces on one of the faces of the rod (blackened for this purpose with smoke) as the runner is displaced along the rod. The runner, it will be understood, is situated at first in the front part of the projectile, and while the latter is driven forward remains in place, the rod of the projectile moving through it. The escape of a small wedge between the prongs of the fork at the moment of commencing motion sets the fork in vibration. It can be easily shown that, owing to the very high speed imparted to the projectile, the displacement in space of the inert mass, through friction and passive resistances, which tend to carry it forward with the projectile, is such as may be quite neglected. So that the relative motion of the mass recorded by the tuning-fork may be considered exactly equal and opposite to the motion of the projectile. A study of the curves produced guide to the laws of the motion and of the pressures developed by the charge. Evidently the motion of a projectile, as it buries itself in sand or other resistant medium, may be similarly determined.

Also used to measure the recoil of guns during the first instant after the charge is fired. See TACHOMETER.

For ordnance, *Sebert* .	"*Van Nostrand's Mag.*," xxi. 171.
Potot's tube for gaging streams, *Robinson* . .	* "*Van Nostrand's Mag.*," xviii. 255.

Ve-loc'i-pede. Velocipede is a generic name, of French origin, applied to that class of carriages propelled by the feet of the rider, of whatever construction or by whatever mechanical means the power is communicated, so as to drive the vehicle. Less strictly, it has been applied to vehicles propelled by the hands only, and guided by the feet.

The term vélocipède is found in French patents early in the century, and the class of carriages to which it was applied is found to be described and illustrated in the books and the patent records for more than a hundred years past.

Velocipedes, like wagons, have been constructed with one, two, three, or four wheels, and sometimes with greater number. One-wheeled velocipedes, or monocycles, have been constructed in a variety of ways; sometimes so that the rider should be seated above the wheels, but more often that he should be seated inside the wheel, and so as to be propelled sometimes by the hands, and sometimes by the feet. They have never in any form been made a practical success, and their use has been little attempted except for purposes of exhibition.

Scuri, the Italian gymnast, has been more successful with a machine patented by him, consisting of one wheel, axled in a fork or perpendicular frame, and foot-cranks attached to the axle, a handle rod upon the upper part of the fork or perpendicular frame some distance above the wheel, and a saddle attached to a projection from the frame, but with no other supporting or steadying part of the machine touching the floor than the tire on the one wheel.

Two-wheeled velocipedes were made as early as 1816, the first one of which we have any account being attributed to the Baron Von Drais, of Manheim, which had its two wheels in the same plane, one before the other, and was patented in France, and with some improvements patented in England by Denis Johnson, in 1818, under the name of "Pedestrian Curricle." This form of velocipede was patented first in France by Louis-Joseph Dineur, and in the patent it was simply called a velocipede. It acquired the name, however, of *célérifère* and *draisina*, and *draisienne*. This machine was improved from time to time in England, where it obtained the name of dandy horse, and sometimes of hobby horse. In 1821 it was modified in construction by Gompertz, and a rack and pinion attachment, for aid by the hands in propulsion, applied to the front wheel.

In 1819, a United States patent was granted to William K. Clarkson for an improvement "in the velocipede." In all these two-wheeled velocipedes, however, the propulsion was mainly by the thrust of the feet alternately upon the ground as the rider sat astride the horizontal bar or perch; and it was not until 1862 or 1863 that any mechanical means of propulsion was applied to this arrangement of two wheels in the same plane, by which the rider was enabled to take his feet off the ground, and still propel and guide his vehicle. For later developments see BICYCLE.

Two-wheeled velocipedes have also been constructed with the wheels abreast, and considerable success has been attained in the use of this by foot driving mechanism, particularly in the form known as the "Otto," in England. The forms constructed and patented in the United States have differed somewhat in details of construction from that which has achieved some success in England; but nowhere has this form yet become of any extended use or comparative value.

Three-wheeled velocipedes were constructed early in the century, and as early as 1828 were given the more specific name of tricycle. This variety of velocipede, offering as it does by reason of its three points of support, the greatest steadiness of base with least resistance of roadway, and the lightest construction consistent with stability of base, has been constructed with great variety of detail, and become very much specialized, and widely used. See TRICYCLE.

Velocipedes of four wheels have frequently been termed *quadrocycles*, and though at different times and in different countries they have been made in considerable number, they have not been found comparatively practicable as yet, the greater weight, friction, road obstruction, and air resistance, making them less desirable than the bicycle or tricycle.

Velocipedes constructed with more than four wheels have been interesting chiefly for their phenomenal or ingenious construction.

The term velocipede, and the names marine velocipede, water velocipede, etc., have been applied to machines for travel by foot propulsion on the water as well, with various details of construction by means of which the rider was enabled to propel himself; sometimes with paddle wheels, and sometimes with screw or other propellers acting upon the water. The latest and most successful of these has by misnomer been called "marine bicycle," and is at present in considerable use in the United States. It consists of two floats, 4' or 5' apart and 20' in length, connected by bars and crank axle, with pedals for the feet of the rider, and connecting mechanism operating a screw propeller, and a rudder operated by steering bar, held and worked after the manner of the steering mechanism of a bicycle.

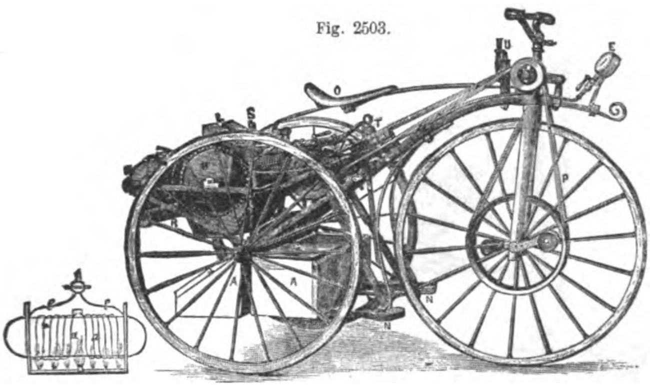
See BICYCLE and WHEEL.

Aquatic, *Jobert* . . .	* "*Scientific American Sup.*," 128.
Engl.	* "*Scientific American Sup.*," 731.
Ice, *Arnao*	* "*Scientific Amer.*," xxxv. 325.
Grant	* "*Scientific American Sup.*," 128.
Propeller, *Zoebl* . . .	* "*Scientific American Sup.*," 2525.
Sled, *Story*	* "*Scientific American Sup.*," 128.
Tricycle, *Ruggles* . .	* "*Scientific American*," xli. 338.

Ve-loc'i-pede, Steam. At the recent Industrial Exhibition at the Champs Elysées, Paris, M. Perreaux, of Orne, exhibited a steam velocipede, which is illustrated herewith. Fig. 2503.

The generator, the fireplace, and the motor are arranged behind the saddle of the velocipede, after the manner of the portmanteau of a horseman. Chains or belts transmit motion from the engine to the wheels. All the parts are small, well put together, and very compact. The small tubular boiler is cylindrical and has a capacity of about three quarts; and at the sides there are two receptacles containing a sufficient supply of water to last during a journey of two to three hours. The piston of the engine is about 1'' in diameter and has a 3'' stroke. The whole engine is a mere plaything, and yet, with a pressure of 3½ atmospheres, it has sufficient power to drive the velocipede at a speed of from 15 to 18 miles per hour. The fireplace which heats the boiler is an ingenious novelty, and consists of a small gasometer fed by wood spirit. The vapor of the alcohol issues through holes, and gives a flame endowed with great calorific power. The fire is lighted at will, and in a few minutes steam is up. A method is provided for regulating the escape of the alcohol vapor, and consequently the intensity of the heat. Externally the boiler is furnished with two tubes rolled in the form of a spiral, so that the steam which is produced circulates through these continuously, and is exposed directly to the fire before entering the motor. The steam being superheated, no water is carried over with it. With a speed of 18 miles an hour, the cost of alcohol consumed is from 40 to 60 cents (this calculation, of course, for France). This is certainly not very economical, but it is very pleasant to have a horse under control which eats only when he works.

Fig. 2503.



Steam Velocipede.

Ve-lom'e-ter. A name given by the inventor, Mr. Durham, of Barnet, England, to a governor for marine propeller engines, to prevent racing of the screw.

"*Engineer*" . . . . * xlvi. 190.

Ve-lon-tine'. (*Fabric.*) A corded French fabric, with fancy wool warp and merino wool weft.

Ve-lours'. (*Fabric.*) A French goods, all wool.

Vel'vet. (*Fabric.*) Old English *velouette*, from the Italian *vellute*, fleecy, nappy, and Latin *vellus*, a fleece.

Ve-neer'. A thin slip of wood, ivory, stone, etc., cemented to the face of some other material to form an ornamental finish thereto.

Celluloid veneers are made by applying a coating of the celluloid, colored, to imitate any desired wood or metal.

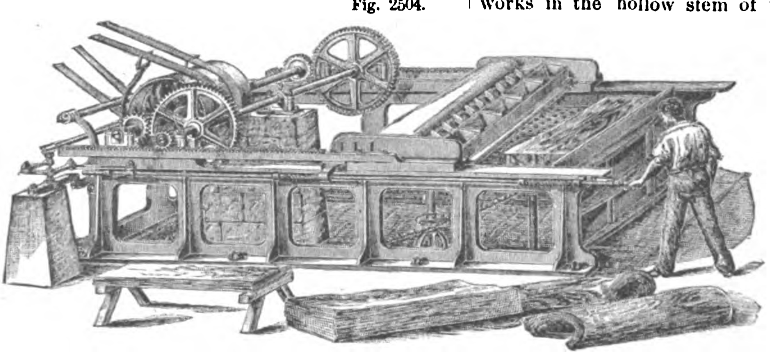
Veneers are cut in two ways, by sawing, and by what is termed a slicing-machine, which is fitted with a sliding knife-block and a thin knife and back iron.

Ve-neer' Cut'ter. The cutter, Fig. 2504, is a slicing machine, and is fitted with a sliding knife-block, and a thin knife, and back-iron, and is used for cutting up blocks 5', 7' 8", and 10' wide.

The cutter is placed obliquely, so as to lessen the shock that might otherwise displace the wood. The thin knife with back iron does away with the special machine for sharpening, that is usually necessary. When the knife rest is unscrewed from the saddle care should be taken to keep the three pieces, the knife-rest, knife, and back iron together.

In machines with connecting-rod motion for blocks 3' 3" the knife is square across the machine or under; so that the fiber is cut along its whole length at once, which is very necessary for some kinds of wood.

Fig. 2504.



Veneer Cutter.

In the larger machines the cutter is placed obliquely so as to diminish the shock, which might displace the wood, but in these machines the workman often places the block parallel to the cutter.

The thin knife with back iron does away with the special machine for sharpening, which is usually necessary.

The wood should first be steamed and the workman should know how to set it according to the grain, to sharpen his knife according to the kind of wood to be cut, and should also watch it drying very closely.

Veneer machines cut from 10 to 15 veneers per minute and from 100 to 150 to the inch, whereas the sawing-machine will not cut more than from 20 to 25.

We allow that for very perfect veneers sawing is better, but for work of usual quality these machines answer admirably. The power required is about 4 horse-power for the large machine; the smaller one can be driven by hand-power.

These machines are also used for cutting veneers up to 4 or 5 mm., and work very well.

Manufacturers of small boxes, etc., profit immensely by their use. In a day of 10 hours, and with horse-power, such a machine will turn-out 3,000 sheets, 4 mm. thick, 16" long, by 10¼" broad.

These veneers are cut so cleanly that for common work polishing is quite unnecessary.

The brick palaces of Assyria, Kouyunjik, for instance, were veneered with slabs of coarse alabaster or gypsum held in place by cramps and plugs of metal or wood.

Each slab usually bore upon its back an inscription recording the name, title, and descent of the king forming the same.

Fig. 2506 is Arbey's horizontal reciprocating saw with a single blade for cutting veneers and thin woods of valuable timber. Has a rising face carriage with automatic intermittent feed.

See VENEER SAW, p. 2702, "*Mech. Dict.*"

Cutter, *Read* . . . . . . * "*Manuf. & Builder*," ix. 222.
Seasoner, *Read* . . . . . * "*Manuf. & Builder*," ix. 223.

Ve-neer' Scra'per. Bailey's scraper or plane, Fig. 2505, is an adjustable tool for dressing veneer.

Fig. 2505.

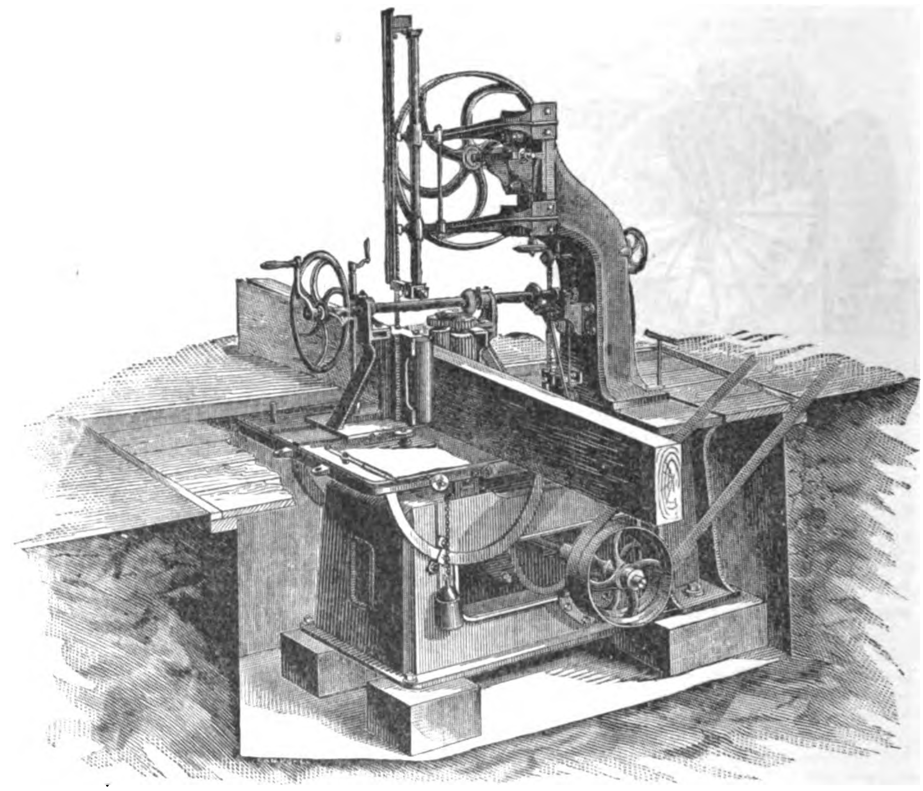
Veneer Scraper.

Vent. Love's liquid vent, Fig. 2507, is a combined gimlet, tubulated vent, and sample pump. It is so operated that as the gimlet opens a passage through the barrel a vent is opened to the plunger that works in the hollow stem of the gimlet, and a sample is drawn from the barrel through the hollow T of the handle.

A spiral spring within gradually stays the piston at the termination of its plunge, the liquid enters the tube above the plunger and on the removal of the thumb the spring lifts the plunger and discharges the liquid through the tube.

The instrument is transferable into a siphon by detaching

Fig. 2506.

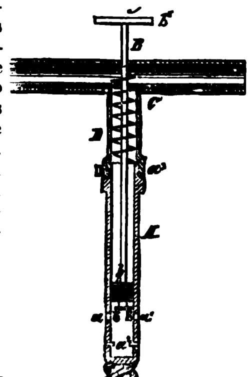


Veneer Saw.

the upper cross-tube and attaching a siphon tube for the passage of the liquid from one barrel to the other. See also VENT FAUCET, p. 2703, "*Mech. Dict.*"

Ven'ti-la'ting Saw. One with the web perforated in numerous places, to allow circulation of air to keep the saw from heating and to admit saw-dust, and thus prevent friction of the saw in the kerf. — *Hoe.*

Fig. 2507.



Love's Liquid Vent.

Ven'ti-la'tion. An elaborate treatise, with illustrations, on ventilation of theaters, hospitals, schools, and public buildings is in *Laboulaye's "Dict. des Arts et Manufactures,"* article "*Ventilation,*" vol. iii., ed. 1877.

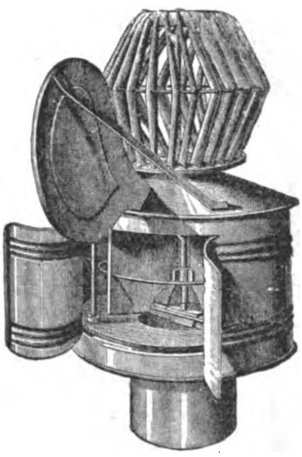
Butler's "*Ventilation of Buildings.*" Illustrated.
Atkinson's "*Friction of Air in Mines.*"
Rafter's "*Mechanics of Ventilation.*"
Schumann's "*Heating and Ventilation.*"
Armstrong's "*Chimneys for Furnaces,*" etc.
Tomlinson's "*Warming and Ventilation.*"
Walker's "*Useful Hints on Ventilation.*" Explanatory of its leading principles, and designed to facilitate their application to all kinds of buildings.

Ventilating blower.
Root . . . . . . * "*Scientific Amer.,*" xxxvii. 243.
Chimney, *Hinckley* . * "*Scientific Amer.,*" xxxviii. 210.
Cowl, *Banner*, Br. . . * "*Engineer,*" xli. 51.
Bohn, Br. . . * "*Engineer,*" xli. 98.
Engine, mine, *Soc. de Couillet*, Fr. . . . * "*Engineering,*" xxviii. 354.
Fan, *Pelzer*, Ger. . . * "*Engineer,*" l. 153.
Fan engine, *Sacre Madame Colliery*, Fr. . . . . . . * "*Engineer,*" xlvi. 372.
Rooms, *Dodge* . . . "*Scientific Amer.,*" xxxvii. 321.
Soil pipes, *Banner* . . "*Scientific American Sup.,*" 884.
Ventilation, Hoosac Tunnel, *Doane* . . * "*Van Nostrand's Mag.,*" xvi., 359.
Methods of, *Pfeiffer* . "*Scientific American Sup.,*" 970.
Mine . . . . . . "*Scientific American,*" xxxv. 343.
Apparatus, on (6 figs.) Br. . . . * "*Engineer,*" xliv. 332.
Of Madison Square Theater, New York *Hogg* . . . . . * "*Scientific American Sup.,*" 3981.
Coal mines, *Andre* . "*Van Nostrand's Mag.,*" xix. 369.
Schools, *Winsor* . . "*Scientific American Sup.,*" 1556.
Ships . . . . . "*Scientific American,*" xxxiv. 149.
Ship board . . . * "*Engineering,*" xxi. 327.
Railway tunnels . . "*Scientific American,*" xxv. 154.
System of, *Green* . . * "*Scientific American,*" xlii. 86.
Ventilator, mine "Champion" . . . . * "*Iron Age,*" xviii., Nov. 2, p. 1.
Chilton Colliery, Br. . * "*Engineering,*" xxiii. 468.
High Blantyre Colliery, *Stevenson* . * "*Engineering,*" xxvii. 177.
Thwaites & Carbutt, Br. . . . . . * "*Engineer,*" xliii. 412.
And engine, *Liege* . . * "*Engineering,*" xxii. 275.

Ven'ti-la'tor. Fig. 2508 represents Gen. Billings's wing fan ventilator.

The ventilator shaft used in connection with this device is enlarged as it extends upward, so that each successive story of a building may discharge into it without interfering with the proper ventilation of the lower stories. The cowl into which the ventilating shaft discharges is large and nicely pivoted, so that it turns easily with the wind. Its flaring mouth gives it peculiar advantages over the ordinary form of cowl, so that this of itself is a very efficient ventilator; but the chief merit of this device lies in the arrangement of the fan and its propelling wind wheel seen at the top of the cowl.

Fig. 2508.



Wing Fan Ventilator.

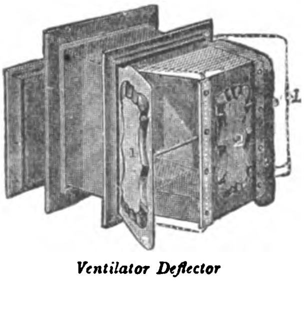
All the parts are made to work very freely and with but little friction. The fans are arranged so as to swing around the inner periphery of the casing, leaving an undisturbed central core, while the enlarged hood and vertical position of the fans offer no resistance whatever to the upward current of air in case the fan should not be in motion. In motion they force the air out through the lateral opening, thus producing a vacuum, aiding the natural draught or creating one where there is none.

With the wing fan ventilator it is found after many tests that when the wind is not strong enough to run the fan, the peculiar form of the cowl, its enlarged size, and prompt action in shifting itself to windward, will give a regular current of from 100′ to 200′ per minute; while with a fair to brisk wind to run the fan the velocity will go up to 300′ and 400′, while with a strong wind it often records over 500′, and has in several cases reached over 600′ per minute. Six tests made November 20, 1879, at St. Denis Hotel, where there is a 24″ shaft capped with a wing ventilator, showed an average of 438′, being an actual exhaust of fully 100,000 cubic feet of foul air per hour. December 22, 1879, in public school branch of No. 15, Brooklyn, six tests showed a current of from 225′ to 357′ per minute, with 8 12″ pipes leading into two large pipes of 24″ each, showing an exhaust of over 146,000 cubic feet per hour, with only a light wind and no fires. Later in the same day the one in Brooklyn "*Eagle*" building showed a current from 230′ to 270′ per minute. November 20, 1879, the Irving House, where there are two of these ventilators, one over each tier of water-closets, gave a current of 525′, there being a good breeze.

Ventilator. *Murphy*	* "*Eng & Min. Jour.*," xxii. 219.
Centrifugal screw, *Petry & Hecking*, Ger.	* "*Engineering*," xxx. 123.
Pelzer	* "*Scientific American Sup.*," 3932.
For chemical works, *Hall*, Br.	* "*Engineer*," xliv. 50.
Rotary, *Bracher*	* "*Iron Age*," xxi., Jan. 24, p. 3.
Self-acting, *Gilmore & Clarke*, Br.	* "*Engineering*," xxix. 264.
Window, *Sayers*	* "*Scientific American*," xlii. 274.
Frame, *Sayers*	* "*Manuf. & Builder*," xii. 139.
Wall and cowl, on (16 figs.), *Trewman*	* "*Engineer*," xli. 365.

Ven′ti-la′tor De-flec′tor. On railway cars; a window so hung as to draw the air to or from the inside according to its angular position relatively to the line of motion and to the car. See Fig. 2509.

Fig. 2509.



Ventilator Deflector

Ven′ti-la′tor Hood. A shield over the outside of a ventilator to prevent the entrance of sparks, cinders, rain, or snow. It is sometimes intended to direct the current of air either into or out of the car.

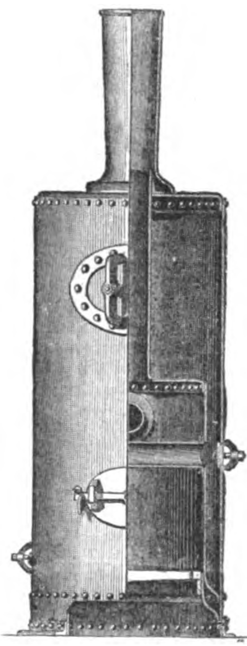
Ver′meil. Silver-gilt.

Ver-nier′ Scale Sight. (*Rifle.*) A hind sight with a vernier scale for accurate adjustment. The peep-sight is elevated or depressed by a screw; the scale on the bar of the sight being slotted.

Ver′tic-al Boil′er. A convenient form of steam boiler occupying but small space and well adapted for those of moderate size. The cylindrical shells are now rolled without longitudinal joints, which adds to the neatness of appearance, avoids to that extent the grooving and corrosion which always begin at the joints, and is convenient for fixing the mountings.

There are many forms: Multiflue, multitube, hanging tube, cross tube, spiral tube, etc.

Fig. 2510.



Vertical Boiler.

Fig. 2510 is a plain form without longitudinal rivet joints either on the shell or fire-box, the boiler space being all around the furnace and flue. The flame space is crossed by two large tubes of 6″ or 8″ diameter, one of which is shown in cross and the other in longitudinal section. A manhole is shown in front and mud hole at one side; on the other side is a cover and bridge for the hole by which the flue is reached to remove scale.

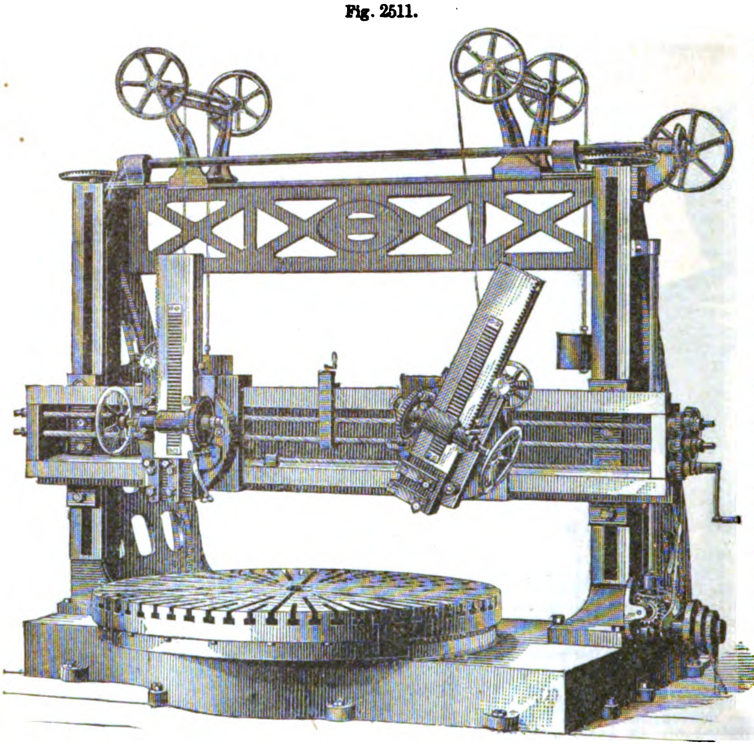
Blake, Br.	* "*Engineering*," xxix. 147.
	* "*Engineer*," xlix. 447.
Cochran, Br.	* "*Engineer*," xlv. 288.
	* "*Engineering*," xxvi. 303.
Talbot, Br.	* "*Engineering*," xxix. 108.
Proctor & Wallis, Br.	* "*Engineer*," xlviii. 306.
Double-chambered. *Smith*, Br.	* "*Engineering*," xxviii. 69.
Tubulous boiler, *Smith*, Br.	* "*Engineer*," xlviii. 24.
Tubular flue boiler, N. Y. Safety Steam Power Co.	* "*Engineer*," xli. 209.

Ver′tic-al Bor′ing and Turn′ing Machine′. The Beuvant machine, Fig. 2511, swings 12′ diameter and 6′ high. The face plate is driven by spur pinion with 20 changes of speed, and is supported upon a spindle, with step to sustain the weight, and adjusted vertically and laterally, giving steadiness to large work.

The tool slide has 30″ vertical or angular traverse, rapid hand-motion, and counterbalance carried on frame of the machine. There is self-acting feed at all angles and in either direction, with four changes. The cross-head is raised and lowered by power.

The French vertical boring machines have their special uses with different kinds of borers and slides. They are used for routing sabots and gun stocks. The rounded ends of the mortise are squared out by a double chisel worked by a lever. The French use a simple hollow bit, like a pod bit, and run the mandrel 2,000 revolutions per minute.

Fig. 2511.

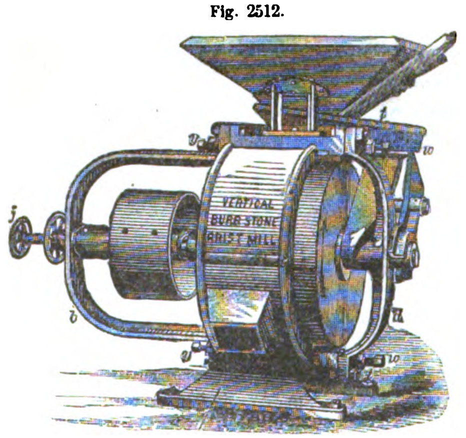


Vertical Boring and Turning Machine.

Ver'tic-al Burr Mill.

Silliman's vertical burr stone mill, Fig. 2512, has large openings for receiving and discharging the grist. It is never liable to choke or clog; the grain drops from the shoe directly into the radiating centrifugal feeder, which throws it evenly between the stones on all sides alike, above as well as below; thus for the first time obviating a vital objection to all vertical mills. In taking the mill apart to dress the stones, the foundation bolts are never disturbed, and each

Fig. 2512.



Vertical Burr Mill.

stone is taken out separately. As shown by the cut it is so constructed that it may be belted to from almost any direction, above, below, or at either side, as most convenient.

See also, Fig. 2316, p. 1021, "*Mech. Dict.*"

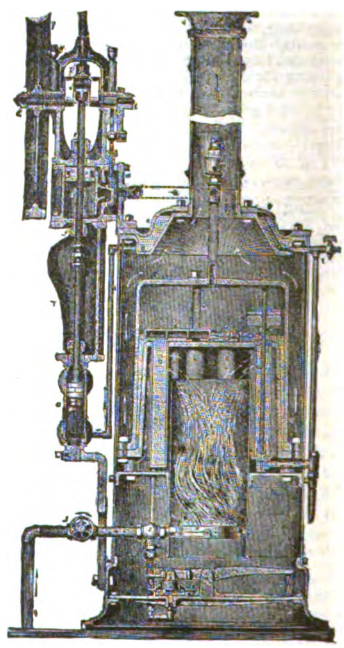
Ver'tic-al Drill. The "Niles" vertical drill is calculated for drilling from $1\frac{1}{2}''$ to the smallest work. The cone has 4 speeds for 2″ belts, and gives a wide range in speed and power; the spindle is driven by cut bevel gear (2 to 1); the arm carrying the belt shifter can be revolved around the driving shaft to suit the direction of the belt; the table arm has a lift of 20″, and can be swung entirely around the column. The base is provided with T slots for securing work, and the table is raised and lowered by a worm and oblique rack, enabling the operator to manipulate the table when it is loaded. By an arrangement of sheaves the spindle and lower stock is balanced by a single weight; the balance weight plays within the hollow column. See UPRIGHT DRILL.

Woodward.

* "*Scientific American Sup.*," 836.

Ver'tic-al Mul'ti-flue Boil'er. A form of boiler with flue pipes extending between the crown plate of the furnace and an upper flue

Fig. 2513.



Vertical Steam Engine.

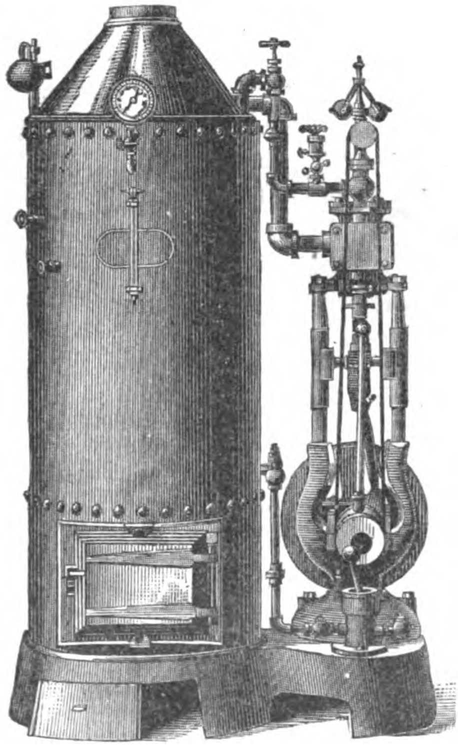
plate, being surrounded by the water in the boiler. See MULTIFLUE BOILER.

Ver'tic-al Steam En'gine. Fig. 2513 represents Maxim's automatic steam engine.

The cylinder is 2″ in diameter and has 2½″ stroke of piston. It is supplied with all the attachments used in large engines, the governor being inside the belt pulley, and operating directly on the point of cut-off, enabling a small amount of steam to do a large amount of work. The engine is ready to work in ten minutes from lighting the gas, and will run all day without any attention whatever. With a supply of gas and water it is its own engineer and fireman. It is admirably adapted to the use of dentists, jewelers, and amateurs.

Lovegrove's portable engine, Fig. 2514, occupies a floor space of only 20″ × 34″. The boiler is 18″ diameter and 42″ high. It is made of charcoal hammered iron and contains 20 2″ tubes, 30″ long, and is tested to 200 lbs. pressure, though the working pressure is from 60 to 90 lbs. With this boiler and a cylinder 3″ diameter and 4″ stroke, is obtained a two horse-power. The engine is fitted with all the necessary accompaniments of pumps, valves, etc., complete. It is furnished with the Pickering governor, and the steam and exhaust connections are quite short, avoiding expense in long pipe and waste of steam. The pulley which drives the governor affords connection for the pump at the same time. The vertical guides are bolted to the base plate, and are fitted up in as plain and substantial a manner as possible. There is a complete supply of lubricating valves, gages, blow-off valve, etc. The fly-wheel is 12″ diameter and 3″ face, and insures steadiness of motion.

Fig. 2514.



Vertical Portable Steam Engine.

In the "Shapley" vertical engine and boiler, the engine is not attached to the boiler but rests on the same base, permitting adjustment of the parts, if necessary while steam is on. The boiler is in two sections, the upper part of which serves as a steam space. The fire-box is conical and from it radial tubes communicate with an annular smoke space having down-cast flues passing perpendicularly through the boiler, and conveying the products of combustion after passing over water to the smokestack, into which the exhaust steam is also discharged.

N. Y. Safety Steam Power Co.	* "*Manuf. & Builder*," ix. 73.
	* *Thurston's "Vienna Exp. Rept.*," ii. 27.
Snyder	* "*Eng. & Min. Jour.*," xxvi. 256.
	* "*Manufacturer & Builder*," ix. 247; x. 201.
Whitmore	* "*Iron Age*," xvii., Jan. 27, p. 1.
Double-acting, *Turner*	* "*Scientific American Sup.*," 1764.
Small	"*Scientific American Sup.*," 1839.
Blake	* "*Scientific American Sup.*," 165.
Haskins	* "*Iron Age*," xix., June 14, p. 1.
Head, Br.	* "*Engineering*," xxi. 270.
Heald & Sisco	* "*Manuf. & Builder*," xi. 245.
Hampson, Whitehill & Co.	* "*Manuf. & Builder*," viii. 103.
Lovegrove	* "*Iron Age*," xxi., May 2, p. 41.
	* "*Manufacturer & Builder*," viii. 52; x. 81.
	"*Scientific Amer.*," xxxviii. 34.
Shapley	* "*Iron Age*," xxi., May 2, p. 41; xxii., Aug. 8, p. 30.
Fitchburg St. Eng. Co.	* "*Iron Age*," xxii., Aug. 8, p. 29.
Mundy	* "*Iron Age*," xxii., Aug. 8, p. 29.

Ver'tic-al Ten'on-ing Ma-chine'. Fay's car gaining and tenoning machine has traversing cutters and automatic feed. The table is low, and the cutter-heads are adjusted independently by a screw to each, so that they can cut a tenon of the desired thickness, with any proportion of shoulders within the capacity of the machine.

The back of the upright stand carries a head for gaining a double tenon to 4″ in length. This is raised by a screw, and can be moved out of the range of single tenoning. The side of the upright stand has a movable piece, which when taken out makes the whole length of the tenon 12″.

The belt that drives the heads is retained at its proper tension by a sheave and weight in connection with a binder pulley, that compensates for the motion of the heads. The table rests upon friction rollers that run upon planed ways, one of which has a groove in which is fitted a corresponding tongue on the table, to keep it at a constant right line with the line of the heads.

Ver'tic-al Tube Coil. An arrangement for steam heating purposes.

Ver'tic-al Tu'bu-lar Boil'er. The Safety Steam Power Co.'s tubular boiler has the tubes pass at about the water level, through the baffle plate. A large tube hangs from the center of the plate, nearly to the crown of the furnace, and an annular space is left around the outside of the baffle and between it and the outer shell sufficient for the easy escape of the steam and water.

This arrangement is intended to stop the current of steam and water tending to shoot up between the tubes, and compel it to flow outward and escape between the baffle and shell, at which point the steam and water separate. The steam is taken off from the center of the boiler, and as the steam is delivered at the outer edge of the baffle it must flow inward, between and around the tubes, on its way to the engine, becoming dried and slightly superheated.

Vi'bra-ting Ap'pa-ra'tus.

Affecting chemical phenomena, *Berthelot*	* "*Scientific American Sup.*," 3829.

Vi'bra-ting Ar'ma-ture. (*Electricity.*) The moving bar at the end of the helix by which the circuit is opened or closed, automatically or otherwise.

Vick'ers Steel. (*Metallurgy.*) A steel made by combining iron scrap, ground charcoal, and oxide of manganese.

Vig-net'ter. A mode of making vignetters by means of gelatine-chromate is: —

From a good positive in black or some non-actinic color a number of negatives of different sizes are taken, but in doing this the image on the ground glass plate must not be focused too sharply. Or, where suitable vignettes are already at hand, the negatives can be taken from them directly by any convenient method; either a collodion emulsion may be used, or chromated gelatine, as described below. To prepare the latter a solution is made of five parts pure white gelatine in sixty parts of water, to which two parts of ammonium bichromate are added, and, when the film is afterward to be drawn off, a few drops of glycerine may be introduced to make it less brittle.

After filtering this solution, pour it, while still hot and fluid, on a well-cleaned glass plate; care must be taken to have this plate placed in a perfectly horizontal position, which is best effected by resting it on a larger plate that has already been carefully leveled. The gelatine solution must not be allowed to run over the sides of the plate, or the film may turn out to be too thin; to prevent this give the plate a raised edging of wax. When the chromated gelatine has set, let the plate dry completely in a dark and moderately warm room.

Artificial heat should not be used in drying, especially when the film is afterward to be drawn off; when this is the case, the plate should first be rubbed over with powdered talc or diluted ox-gall, and then, on heating, the film easily flies off.

On plates prepared in this way the negatives are now copied, and that as intensely as possible by a long exposure. The copies cannot be too intense, provided that the negatives are quite black in the center of the aperture. When they have been sufficiently exposed, wash them several times in cold water, and, finally, with distilled water; then plunge them, while still wet, into a solution of one part lunar caustic in fourteen parts water acidulated with one part acetic acid. It will now be seen that the film is coated with a precipitate of silver chromate, which is in the highest degree non actinic, and is much denser toward the side of the plate. Should there be a trace of chromium salt left, as is often the case, it is of no importance; on the contrary, when really intense vignetters are required, it is not necessary to thoroughly wash out the chromium salt. But in order to obtain the requisite transparency in the center of the plate, the whole of the silver nitrate must first be washed out, and then a soft and strong hair brush dipped in dilute nitric acid. This is passed over the plate with a few rapid strokes in a circular direction from the center outward up to the commencement of the shading, and the plate is then quickly rinsed. With a little skill a great variety of effects may be obtained in this way, and any required degree of shading.

After drying, the film is coated with a little castor oil collodion, and then, if it be desired to draw it off, with a hot twenty per cent. solution of gelatine to which a small quantity of glycerine has been added. The plate must be laid horizontal, and the addition of a little alcohol to the solution facilitates its flowing. When the gelatine is set, the plate is placed for a couple of days to dry, and it is again coated with some thin collodion; the edges are then cut through, and the film is drawn off.

Vi-gogne′. (*Fabric.*) A silk-and-wool, or an all-wool French dress goods.

Vig′o-rite. A nitro-glycerine explosive, manufactured at Marquette.

Bjorkmann, of Stockholm, Sweden, gives the following recipe for the manufacture of the new explosive, vigorite: Mix in a wooden or rubber vessel 5 to 20 parts of sugar or molasses, 25 to 30 parts of nitric acid, and 50 to 75 parts of sulphuric acid. 25 to 50 parts of this mixture, called nitroline, are mixed with 15 to 35 parts of nitrate of potash and 15 to 35 parts of cellulose.

Vi-nasse′. The residuum of the wash in the still after distillation.

(*Beet-root.*) The residuum of the distillation of fermented beet-root molasses.

Vine Pull′er. A machine for extracting vines, Fig. 2515. A pair of double-grip pinchers hang by a chain from a double-pivoted lever that surmounts a truck-frame.

Vine Shear. See PRUNING SHEARS.

Vine′yard Bisse. A French double vineyard plow.

Vine′yard Cul′ti-va′tor. Fig. 2516 represents a cultivator as used in the vineyards on the Continent of Europe.

Fig. 2515.

Vine Puller.

Fig. 2516.

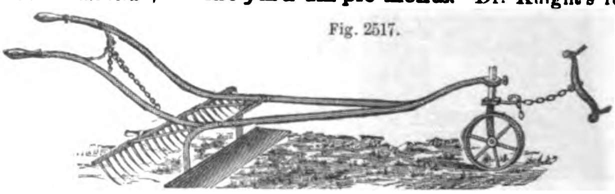
Vineyard Cultivator.

A combined horse-hoe and rake, Fig. 2517, in use as a cultivator in French vineyards.

Cal., *Ross* . . . . . "*Min. & Sc. Press*," xxxvii. 69.

Vine′yard Im′ple-ments. Dr. Knight's report on agricultural implements at the Paris Exposition of 1878 (see "*Paris Exposition* (1878) *Reports*," vol. v., pp. 216–223) describes and illustrates the following: —

Fig. 2517.



Horse Hoe and Rake.

Vineyard plow, *Moreau-Chaumier*	France.
Déchausseuse, *Renault-Gouin*	France.
Rechausseuse, *Renault-Gouin*	France.
Plow for hilly ground, *Moreau-Chaumier* . .	France.
Vineyard plow, *Renault-Gouin*	France.
Double mold-board plow, *Moreau-Chaumier* .	France.
Gang plow for vineyards, *Renault-Gouin* . .	France.
Vineyard plow of Burgundy, *Renault-Gouin* .	France.
Vineyard horse-hoe, *Souchu-Pinet*	France.
Vineyard harrow, *Souchu-Pinet*	France.
Scraper and rake, *Renault-Gouin*	France.
Machine for crushing and stalking grapes, *Charanette*	France.
Grape crusher, *Meixmoron de Dombasle* . .	France.
Grape mill, *Mabille Frères*	France.

See also PRESS.

Vi'no-sal-o-rim'e-ter. The vino-salorimeter is a modification of the old colorimeter of Payen, but its dimensions are much smaller, and the addition of the micrometer screw allows the depth of the layer of wine to be measured with accuracy.

Vi'o-lin. For history of the violin in the United States, see report of H. K. Oliver on Group XXV., in vol. vii. of "*Centennial Exhibition Reports*," p. 48.

The President de Brosses, "*En Italie*" (1739), mentions a virtuoso in Florence, Tagnani. "Il a inventé une clef aux violons faites comme celles des flûtes, qui s'abaisse sur les cordes en poussant le menton, et fait la sourdine; il a assez ajouté, sous le chevalet, sept petite cordes de cuivre, et je ne sais combien d'autres mièvretés." I. 272, ed. 1858, Didier, Paris.

The invention of laying the strings over and above each other is certainly a very old one. Even before the invention of the hammer-piano there was added to the bass strings of the old clavichord a string sounding the higher octave. This string was fastened upon a bridge which is situated below the lower strings upon the sounding-board. Various experiments to utilize the crossing of the strings failed utterly, so that even authors of repute believed that strings lying above each other throw their respective vibrations into confusion. This, however, is not the case, as is sufficiently proven by Helmholtz's analysis of the system of sound-waves. This is done no more when lying above each other than by strings lying side by side.

The vina of India has an antiquity of 2,500 years at least. The bow is claimed to have been invented in India.

Pocket . . . . * "*Manufacturer & Builder*," viii. 187.

Vis-co-sim'e-ter. The viscosimeter is the name given to an instrument by means of which the viscosity of a sample of beer can be determined.

It consists in its simplest form of a funnel-shaped vessel, the lower extremity of which is drawn out to a fine point, so that the internal diameter is as fine as a capillary tube. A certain quantity of distilled water being placed in the funnel-shaped reservoir, a determination is made of the quantity which will run through in a given time, say five minutes; for example, we will assume this to be 21 cubic centimeters; the same quantity of the beer to be tested is then placed in the instrument, and an observation made of the quantity running through in the same time, we will suppose this to have been 15 cubic centimeters. This viscosity is in inverse proportion to the quantity of fluid flowing through the tube in a given time; taking the viscosity of water at 1,000, we have the following proportion: —

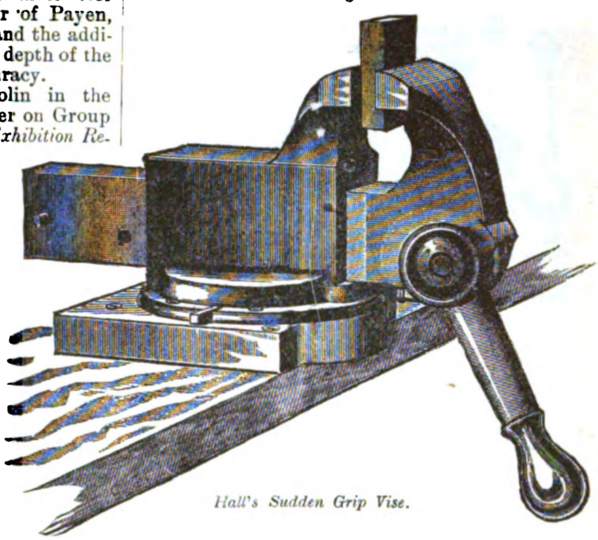
$$15 : 21 :: 1000 : V.$$
$$V = 1400.$$

Many precautions have, of course, to be taken; all determinations must be made at the same temperature, and, if possible, at the same barometric pressure; any excess of carbonic acid gas should be previously removed from the beer, by shaking a portion of it in a bottle until no more gas is given off; if the beer is at all thick it must be filtered, otherwise some of the suspended particles may mechanically close up the capillary tube. The determination of the viscosity of beer is of value for many purposes, for any great excess is an unfavorable sign. Any tendency toward "ropiness" can be detected by this instrument. It would also probably be of considerable value to the practical brewer for testing his worts, with the view of determining the dextrine ratio. A dextrinous wort will run through much slower than a saccharine wort, and we think some very useful results might be obtained by the aid of this instrument. Its construction is very simple, and any one with but a slight experience in chemical manipulation may make one for himself.

Vise.

Fig. 2518 represents Hall's sudden grip vise. It is intended to save the time used in operating a screw vise. The movable jaw and sliding bar are cast in one piece, with a hollow chamber below, to contain the working parts of the vise. The stationary jaw is so cast that the sliding bar fits into it, and with a base to fit the swivel plate. The lever has two disk-like portions on each side to fit into recesses in the under part of the movable jaw, and having frictional surfaces around the peripheries. A band retains the lever in the recess, and an adjustable screw regulates the tension of the band.

Fig. 2518.

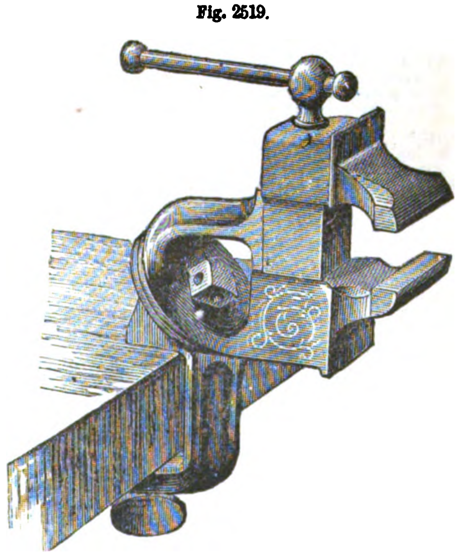


Hall's Sudden Grip Vise.

Smith's heavy chilled beam vise is one with sufficient weight of metal to give it the inertia of an anvil. The jaws move parallel so as to take a firm hold.

Stevens's vertical and horizontal vise, Fig. 2519, here illustrated, is so hung upon an angular swivel that a half revolution upon its base brings the jaws from a vertical position to a horizontal position. In their passage from one position to the other, the jaws occupy every angle of inclination, and the vise may be fastened to its base in any position. Our illustration represents a jeweler's portable or clamp vise,

Fig. 2519.

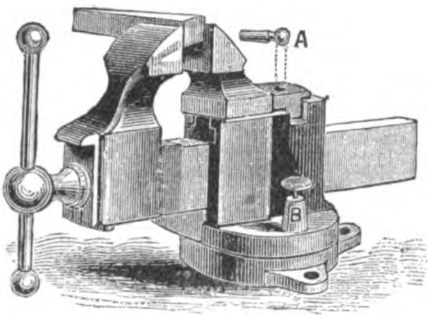


Vertical or Horizontal Vise.

arranged to fasten to any table without marring it. The two plates of the swivel are faced true, and held together very firmly by a central bolt, which may be made fast by a tenpenny nail as a lever to turn the bolt. The larger vises turn upon a large cylindrical bearing which projects into the lower plate, the plates and bearing being turned true, and the binding bolt, or nut, is turned by any wrench beneath the bench. It may be changed from one position to the other in a few seconds.

The Prentiss vise, Fig. 2520, has a back jaw that is adjustable and in use instantaneously conforms by automatic ac-

Fig. 2520.



Angle Vise.

tion to any angle, adjusts itself, and makes firm the object held, whether it be straight, beveled, or wedge-shaped. Or, if desired, by inserting the pin *A*, the jaw becomes fixed and immovable, thus making a perfect parallel, or solid jaw vise.

The adjustable jaw, resting and working as it does upon and against the solid body of the vise, is thereby rendered absolutely as strong and durable as the old permanent jaw. By means of the new patent swivel bottom this vise may be readily adjusted to any angle, right or left, at will of operator, by simply raising rachet-pin *B*, which, on being freed, is instantly forced home by a spring, rendering the vise solid and firm as if stationary.

See also under SUDDEN-GRIP VISE.

The following are the names of vises of various designs: —

Parallel bench vise, round jaws.
Swivel bench vise, round jaws, with cast-steel anvil.
Oval slide bench vise.
Round slide, double swivel bench vise.
Swivel bench vise, swivel jaw.
New model swivel bench vise.
Sudden-grip bench vise.
Improved swivel bench vise.
Stationary parallel bench vise.
"Rapid Transit" parallel bench vise.
"Rapid Transit" swivel bench vise.
"Rapid Transit" woodworkers' bench vise.
Woodworkers' parallel bench vises.
Woodworkers' swivel bench vise.
Woodworkers' swivel bench vise, with swivel jaw.

Newell	"*Engineer*," xlii. 42.
Simpson	"*Iron Age*," xxi., May 2, p. 25.
Smith	"*Scientific American*," xxxiv. 54.
Starkey	* "*Scientific American*," xxxix. 370.
Zanetti	* "*Scientific American*," xlii. 51.
And anvil drill	* "*Scientific American*," xlii. 130.
Bench, *Hall*	* *Thurston's* "*Vienna Exp. Rept.*," iii. 257.
Parallel, *Fisher & Norris*	* "*Scientific American*," xl. 7.
Parallel, *Simpson*	* "*Iron Age*," xvii., Jan. 27, p. 20.
Penfield	* "*Iron Age*," xvii., March 30, p. 1.
Sinclair	* "*Iron Age*," xix., March 1, p. 18.
Solomon	* "*Scientific American*," xxxix. 390.
Stevens	* *Thurston's* "*Vienna Exp. Rept.*," iii. 295.
Swivel-jaw, *Bonney*	* "*Iron Age*," xxii., Nov. 14, p. 5.

Vise Cap. A brass cap for the upper section (the contact edge) of a vise.

Vise Clamp. A device with serrated jaws for holding pipes, rods, etc.

Vise Clamp. A clamp for temporarily fastening the vise to the bench or other object to which it is attached.

Vis-i-om'e-ter. An instrument by which to determine the numbers of lenses.

A proposed formula of procedure is in multiplying the distance of normal vision (12°) by the distance of distinct vision, and dividing the product by the difference between the two.

Vode. (*Fabric.*) An all-wool French dress fabric made for religieuses.

Vol'ley Gun. (*Ordnance.*) See MITRAILLEUR.

Volt. (*Electricity.*) The *practical* unit of electro-motive force. Equals one hundred million absolute units of potential. 1 volt = 10^8 (C. G. S.). — *Gordon.*

Vol-ta'ic Ar-ma-dil'lo. (*Surgical.*) A battery of plates in a belt or sole, linked together so as to resemble, in a degree, the cuirass of an armadillo.

Vol-ta'ic Pen'cil. There is at the present time scarcely a single branch of industry to which electricity is not lending its aid. Art, however, has thus far received but little benefit from this source, if we except the application of electricity to electro-metallurgy.

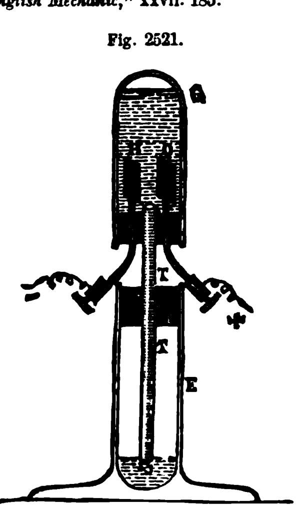
An important discovery, however, has just been made in Paris, by M. Bellet, whose invention consists of a voltaic pencil, by the use of which designers and draughtsmen may be enabled to dispense entirely with the aid of the engraver. The editors of "*Electricite*" state that they have examined beautiful proofs of lithographs and etchings obtained, without the use of the engraver, by the effect of a voltaic arc produced at the point of an ordinary lead pencil. Encouraged by this success the inventor has taken out patents in various countries, and a company has been formed to carry out the process, which will soon be placed before the public. At present there are being prepared models of a series of apparatus which will allow any artist, however ignorant of the mysteries of electricity, to reproduce immediately, and without the aid of any artisan, the most delicate and complicated drawings; and this, too, by a very simple process and at a very moderate price. By a slight modification of the system there may be produced: 1. Stencils analogous to those produced by the Edison pen; 2. Lithographs; 3. Etchings; 4. Stereotypes for typographical work. The initiators of this discovery are confident that an entire revolution will take place in the process of illustrating papers by means of their electrography. Either copper or zinc plates may be used. A late number of "*Nature*" describes the *modus operandi* as follows: A thin sheet of paper is attached to the plate. One of the poles of a Rhumkorff machine is connected to the plate, and the other pole to the top of the pen. The electricity then runs through, making a spark which perforates the paper in whatever direction the artist directs the pen. As soon as the drawing is finished, the paper is rubbed over with greasy ink, laid on with an ordinary roller. The paper is removed, and the plate is dipped into the acid, which cuts away those portions not protected by the ink. The light of the spark is said to be sufficient for the artist, even when he works in a dark room; and the pen is stated to be as manageable as an ordinary pencil.

Vol-ta'ic Pile. (*Electricity.*) A number of disks of silver or copper, wet cloth or zinc, in the order named. Invented by Volta in 1800. See Fig. 6990, p. 2714, "*Mech. Dict.*"

Also * "*Scientific American Supplement*," 2489.
Niaudet, American translation, 2.
Ayrton & Perry, "*English Mechanic*," xxvii. 185.

Vol-tam'e-ter. Fig. 2521 represents a detonating voltameter.

Fig. 2521.



Voltameter.

The following experiment, due to M. Bertin, is but little known, yet is exceedingly interesting, inasmuch as it puts on evidence certain phenomena connected with the polarization of electrodes which always take place under different conditions. The simple apparatus, represented in the engraving, consists of an inverted bell glass, *G*, closed with a cork, through which pass two platinum wires provided at their ends with broad plates, *H O*, of the same metal. It is supported by a glass tube, *T*, open at both ends, and fixed in the cork which closes the mouth of a test glass *E*. Two wires from the batteries are connected with the platinum wires by means of ordinary binding screws. The bell glass *G* is filled with water acidulated with one tenth of its volume of sulphuric acid. If this mixture be now decomposed by a strong current from a Bunsen battery of 50 elements, the water will be seen to lower very rapidly; and when the bell glass is almost full of gas, the mixture will detonate spontaneously, and be seen to take fire. This experiment is not attended with any danger whatever; the recomposition of the products of electrolysis takes place immediately, and during the passage of the current. It is necessary that this polarization current should have a certain tension; the phenomenon does not take place with a battery of 30 elements, but is at once spontaneously produced when the 20 elements that are necessary to make up the complement are added. With 30 elements, instead of a detonation, there will be observed a phenomenon of a different nature, but none the less curious. The water, which at first lowers very rapidly to some millimeters below the platinum plates, all at once stops, in spite of the disengagement of gas on the wires. The plates recompose above what the wires decompose below.

By using pure water the decomposition takes place more slowly, and the detonation is not produced, even with 50° Bunsen elements. Still, a curious phenomenon is produced: the water lowers to the base of the plates, and then does nothing but oscillate between the base and top of these. The water is decomposed below and recomposed above. A weaker current, of 30 elements, decomposes the whole.

These curious phenomena are due to the polarization of the electrodes and not to the catalytic force of the platinum, for they may be obtained with electrodes of various metals.

Edison . . . . . . "*Manuf. & Builder*," x. 230.
Detonating, *Bertin*, Fr. . * "*Engineer*," xlvi. 123.
Exploding, *Bertin* . . * "*Telegraphic Journal*," vi. 399.

Vo-lute' Spring. A spring made of a flat bar of steel coiled with a kind of scroll resembling the volutes used as an ornament in the capitals of ancient Roman and Grecian architecture. The coil is made in a conical form so that the spring can be compressed in the direction of the axis around which it is coiled.

Vul'can-ite. Sulphide of caoutchouc; sulphur and india-rubber.

India-rubber in its crude state becomes soft when subjected to heat, and very hard and rigid when exposed to severe cold; but, by the vulcanizing process invented by the late Mr. Charles Goodyear, — which consists of incorporating with the rubber a small proportion of sulphur, and subjecting it to from 250° to 300° of heat for several hours, — it is rendered uniformly elastic when exposed to the most intense cold or to any reasonable degree of heat. Steam "heaters" for vulcanizing are of cylindrical form, 5′ to 6′ in diameter and over 50′ long. These heaters are of wrought iron, one end opening on hinges, and through this open end the goods to be vulcanized are run in on a railway carriage. The end or door is then closed, and the steam let on and maintained at the proper temperature, ascertained by the aid of thermometers placed in the top of the heater, until the articles in it are thoroughly vulcanized. Vulcanizing under the pressure of metallic molds or sheets imparts to the articles so vulcanized a solidity and quality not otherwise obtainable. In the manufacture of rubber from 3 to 10 per cent. of sulphur, and various metallic oxides — chiefly lead and zinc — are combined with it; the quantity of the latter depending on the degree of elasticity and other properties required in the article to be manufactured; and to judiciously combine these substances with the rubber in suitable proportions to produce the desired end, as well as in properly vulcanizing it afterwards, requires great experience and skill. A certain degree of honesty on the part of the manufacturer is also essential to abstain from introducing more adulterating substances into his "compounds," and thus cheapen the product at the expense of its quality; and we are sorry to say that this latter practice is carried to excess by some ignorant or unscrupulous manufacturers, whose aim appears to be to make — what always proves very expensive to the consumer — a low priced article regardless of its quality, with a view of underselling more reputable and skillful manufacturers.

It is a common error with persons not conversant with the subject, to suppose that rubber in being manufactured is treated with solvents, and can therefore, if necessary, be run into a mold like molten lead; but this is entirely a mistake, as since Mr. Goodyear's invention of vulcanizing rubber no solvents have been used in its manufacture, the entire mixing being done by the operations of machinery, after the manner of mixing dough for bread; and at no stage of the process up to the time of vulcanizing is the rubber softer than stiff dough, and consequently it has to be pressed and molded into the various forms required.

Vul'can-ized Fi'ber. Paper, paper pulp, or other vegetable fibrous substance that has been so prepared by saturation, and coating with chloride of zinc, or chlorides of tin, calcium, magnesium, or aluminum, etc., as to give it in a measure metallic toughness and strength.

Vul'can-ized Glass. This invention consists in the sudden cooling of all kinds of glass (in proportion to the temperature at which they must be worked), at a temperature relatively high in relation to their qualities, by plunging them into baths composed, when the glass consists chiefly of silicates of potassa and of lead, of the following substances: cheap oils or fats, and by preference paraffine heated from 450° to 550° F.; glycerine, among other advantages, is not so liable to catch fire, and has more favorable properties in regard to the temperature at which the glass has to be worked; glycerine can easily be maintained at a temperature of 480° F., which is its boiling point, when an addition of basic salt raises its boiling point to a constant temperature of 530° to 600° F. The silicates of potassa and lime, and the silicates of carbonate of soda and lime, require a much higher temperature. Hydrated sulphuric acid boiling at 600° to 640° F. can be used with advantage. The silicate of soda and of lime, which melts at 1,200° to 2,300° F., must be cooled in melted saltpeter, or in an alloy of metals composed of antimony and tin, which melts at 460° to 680° F., while for the silicates of borax and baryta the cooling has to be done by an amalgam of lead and antimony, the melting point of which is 750° F.

Vul'can-iz-ing. In vulcanizing caoutchouc the purified and masticated gum is kneaded on warm rolls with the proper proportion of flowers of sulphur. Other substances, as whiting, white lead, litharge, zinc oxide, disintegrated refuse rubber (vulcanized), etc., are often added to increase the volume of the product and economize the more costly caoutchouc. Lead compounds blacken the goods through the formation of lead sulphide.

The heating or vulcanizing is conducted in strong cast-iron cylinders, one end of which is movable and serves as a door. The goods to be vulcanized are loaded upon a car and run in upon a railway extending along the bottom of the chamber. Powdered steatite (soapstone) is freely used to prevent adhesion of the different articles, the goods often being packed in boxes filled with this substance. When the heater is charged and the door made fast, high pressure steam is admitted until the desired temperature is attained. This varies somewhat with the character of the articles — according to Dr. Chandler, five hours at 240° Fah. is said to be the temperature for fire hose. In factories where smaller articles are made, the goods are generally exposed in the heaters for four to four and one half hours, the temperature, at first about 250°, gradually being augmented to 275° Fah., at the termination of the operation. A temperature exceeding 280° Fah. injures the goods. Hard rubber, vulcanite, or ebonite differs from ordinary vulcanized rubber only in that a much larger proportion of sulphur enters into its composition and the vulcanizing process is conducted at a more elevated temperature. Usually the caoutchouc has incorporated with it half its weight of sulphur; but, as in the preparation of soft rubber, various foreign substances — metallic sulphides and oxides, shellac, asphaltum, etc. — are often added. Mixed with a litharge it becomes very black; with sulphide of mercury (vermilion), bright red; and composition similar to the red vulcanite used for dental purposes is prepared with six parts of sulphur, sixteen of caoutchouc and eleven or twelve of vermilion.

The vulcanizing operation is usually conducted at temperatures increasing from 275° Fah. to 305° Fah., the time required being about six hours. The articles are packed in steatite or supported in water trays in the vulcanizer, and, if to present a glossy exterior, are sometimes enveloped in thick tin foil.

Thin sheets of rubber or small articles are sometimes vulcanized by what is called the cold process (Parks's). In this the caoutchouc is simply immersed in a mixture of forty parts of carbon disulphide or benzolene and one part of sulphur chloride. It is next placed in a room heated to 70° Fah., and when all the carbon sulphide has been volatilized the process is in so far complete that it is only requisite to boil the material in one pound of caustic potash in about 2 gallons of water, the vulcanized caoutchouc being next washed to remove excess of alkali. The results of this treatment are not always satisfactory, owing to the superficial action of the vulcanizing substances.

Vul'can-iz-ing Flask. Hayes's flask and clamp is intended for vulcanizing ovens, boilers, etc. The lug joint of the clamp is so constructed that all the strain comes on the casting. The pin only serves to keep the lug in place when not in use.

W.

Wab'ble Saw. One set at an angle to the arbor, to cut a wide kerf or groove.

Wag'on Box Rod Plate. The washers attached to the wagon box on which the rod-nut turns.

Wag'on Seat. Fig. 2522 shows a lap seat spring that is hinged in front so as to make a turnover seat.

Fig. 2522.

Wagon Seat.

Walk'er Bat'tery. (*Electricity.*) A modification of the small battery in which the negative plate of platinum is replaced by platinized carbon of the gas retort.

Niaudet, Am. trans., p. 56.

Walk'ing Cul'ti-va'tor. A corn cultivator or plow with which the driver walks, in contradistinction to a sulky cultivator, in which he rides.

Wall Crane. One affixed to a wall as a hand power foundry or forge wall crane. It is attached to a wall or column so as to command a sweep over a given area, an overhead traveler reaching the nearer positions.

Wall En'gine. One attached to a wall, usually vertical and serving either to drive shafting, or supply feed-water to a boiler. See instances in *Aimer's*.

"*Engineer*" . . . . * xlv. 393.

Wall Knot. The wall knot, either single or double, forms a handsome ending to a rope. To make a single wall untwist the ends of a rope — in half-inch rope the strands must be untwisted for ten or twelve inches — and make a bight with the first strand; pass the second strand over the end of the first, and the third strand over the end of the second and through the bight of the first, then haul tight.

Wall and Crown. This knot should be finished with a crown: Lay the first strand over the walling, the second strand across over the first, and the third strand across over the second and through the bight of the first; then haul the ends tight, pinching the knot into shape as you haul. When it is made snug and tight, cut the ends of the strands off close to the crown.

A double wall knot is made over a single wall by passing the ends, singly, close underneath the first wall, and thrusting them up through the middle, the last end coming up under two bights, then finish with a crown.

Wall Pa'per. Ornamented paper for decorating the walls and ceilings of rooms.

Paper-hangings are necessarily divided into two classes — hand-printed papers and those made by machinery. These papers differ materially from each other in cost of manufacture and durability when in use; a hand-printed paper being worth, at least, twice as much, and frequently twenty times as much, as the same pattern would be if produced by machinery, and, as it is frequently impossible for a person unacquainted with the trade to detect the one from the other, especially if the two modes of manufacture are mixed, great care ought to be exercised in the purchase of paper-hangings; the fact being that very few dealers are aware of the class of goods of which their stocks are composed, and hence arises the great differences in the estimates supplied by competing paper-hangers. The public will do well, therefore, to deal only with practical men. The cause of this great difference we will now endeavor to find out.

There are various kinds of paper-hangings made in this country, all of which are made in pieces of eight yards long, or double pieces, sixteen yards long. In France the standard length is nine yards, and in England twelve. The cheapest kinds of paper-hangings are those manufactured by machinery, in which case the design is cut upon a cylinder, or rather a series of cylinders, for each color requires a separate cylinder. The cylinders, when set in motion, are filled with color much after the manner in which a printing machine is supplied with ink. The papers are run off some hundreds of yards long, and are then cut to the required length of a piece. A machine will print some thousands of pieces in a day, complete with all their colors, while a man will not hand-print more than one hundred, and that in one color only; but then the machine-printer must use his colors so composed that they will flow into the machine in a state something like printers' ink, and must only use such binding materials for sizing his colors as will not be impaired by being subjected to the great heat to which the paper so made must be subjected in the drying process. Now all this is exceedingly injurious to colors, and very much affects their durability and softness of tone; hence the extremely fugitive character of all paper made by this process. The hand-printer, on the other hand, can use his colors in considerable thickness, and as he only puts in one color at a time, and then allows his work to dry in the ordinary temperature of a room, before he adds the next color, he can use as a binding medium a well-made spetch size, and thus produce firmness and stability of color; and as he only lays on one color at a time, he secures clearness and delicacy of outline utterly unapproachable in machine-made papers; in fact, the one will last ten years without fading where the other would not be fit to look at in three.

Block-made papers are composed of various qualities of cartridge-paper, upon which a solid flat ground of distemper is laid, and the design stamped upon it with a block upon which the pattern has been cut. According to the quality of the cartridge-paper and ground-work, as also the number of times it must go through the stamping process to produce the various tints and shading of the pattern, is the price of this kind of paper-hanging regulated.

The next class of papers is composed of those that have satin grounds, the luster of which is produced by friction. These grounds are often embossed with patterns, some of which represent watered silk, and others a flowered or striped pattern. Upon this a colored pattern is printed in distemper, in the same way as upon the plain grounds. This class of paper-hangings is of all others the best, as it is the most impervious to the absorption of moisture from the atmosphere, the most easily cleaned, and decidedly the most durable.

Another class of papers is that called "floured" or "velvet" paper, and is produced by the pattern being stamped on any description of ground-work with Japan gold-size, and dyed wool, ground into a powder, shaken over it while the pattern is wet. This woolen powder, which is called "flour," then adheres to the Japan gold-size, which forms the figure of the pattern. When dry, the loose "flour" is dusted off and the pattern is generally then enriched by the application of additional blocks, with color or dry; in the latter case the "flour" receives an impression which considerably enhances its effect. It is this class of "flour-paper" to which Scott's new process applies. Several coatings of "flour" are added one upon the other, until a considerable amount of relief is obtained. The whole surface is then sized and painted, and a very handsome and durable wall surface produced.

The next class of wall-papers embraces those in which the pattern is either wholly or partially produced by metal. The metal is either applied in powder, in a similar manner to "flour," or in leaves, like those of gold. This metallic powder is bisulphurate of tin, and the leaf metal is made of fine copper, or a mixture of copper with zinc, tin, or some other metal that will give it more the color of gold than when in its natural state. These metals are often added to colored and floured patterns. Paper-hangings upon which leaf metal is employed are much more expensive than those done with the metallic powder only; but the leaf kind has much greater brilliancy, and is more durable than the other, especially — if — as is now very frequently the case — the pattern be stamped into the gold with a die. Many papers so produced are exceedingly beautiful, and are known as "stamped golds." — *American Builder.*

Paper has been used as a wall covering by the Chinese from time immemorial. It was introduced in Europe, as a substitute for the ancient tapestry hangings, by the French, among whom its manufacture has always been a prominent industry. Paris contains numerous factories, employing over 3,000 workmen, and several large establishments exist in the southern cities of France.

In New York City three factories are in operation. Philadelphia has six, producing annually paper hangings to the value of $800,000.

Wall paper is prepared in several different ways. The cheap varieties are rapidly printed by ingenious machinery, but for the more elegant and elaborate patterns hand-labor is almost invariably used. The paper is procured by the manufacturer in large endless rolls, weighing some 80 to 85 lbs. each. In this condition, if of fine quality, it costs about 17 cents per pound; if ordinary or cheap, the price fluctuates according to the market.

The designs to be printed are prepared as follows: Sketches of the different patterns are made in this country by artists employed for the purpose. These, on being approved, are forwarded to France, where elaborate drawings are made from them. Each color entering into the design must be printed separately, so that there must necessarily be as many blocks or types prepared to make the impressions as there are tints in the pattern. The blocks are constructed of two layers of wood, a thin piece of maple fastened to a thicker backing of pine board. Each block is about 20″ wide, 2′ long and 1½″ to 2″ in thickness. On the maple, all of the design to be printed in a single color is drawn and afterwards cut out by engravers, or rather wood carvers, so that the lines are left in high relief. When the carving is completed, the work is brushed over with boiled oil, and, when dry, sent to the printer for use.

The paint employed for coloring the paper is ground color mixed with warm size and passed through several sieves so that it is rendered perfectly smooth and free from lumps.

The design being decided upon, the block carved, and the paint mixed, the first process the paper has to undergo is its uniform covering with a ground tint. This is effected by passing the paper over an endless rubber belt-working on rollers. A copper cylinder at one end of the machine used for the purpose rotates in a box of prepared color. From the cylinder, the paint is distributed to revolving brushes, by which it is applied to the paper passing over the belt. As the paper issues from the machine it is drawn out along the loft and then hung up, in festoons over sticks resting on long frames, to dry. It is then wound on a large reel from which it is cut by boys into pieces of eight yards in length.

In case a pattern resembling oak wood is to be applied to the paper, another machine is employed. The paper is passed around a large cylinder, receiving an impression resembling the grain of oak from a smaller revolving wooden cylinder, which is suitably engraved and covered with the proper colored paint.

The rolls of paper, as they are wound by the boys from the large reel, are sent to a workshop below, where they are stamped with the patterns. This process is done by hand. The workman stands before a table over which passes the paper. Hanging above the table, supported by an india-rubber cord, is the block on which the design is carved. The upper end of the rubber cord is attached to a small wheel traveling on an iron guide, so that the block may be swung from the table over to the place where it receives its covering of color.

The method of making the impression is very simple. The paint is obtained from what is termed the "slush box," which consists of a shallow box, the bottom of which is covered with painted ticking made water-tight. This box floats on water contained in a larger box, so that its bottom is always perfectly level. Inside of the first mentioned box is placed a piece of woolen cloth on which the paint is uniformly distributed. The workman first places the paper across his table, then swings the block over to the slush box, and brings its carved side down on the paint. Next he carries the block back again, and places it on the paper, of course using great care in the registering so that the impression may fall exactly on the right place. A vertical movable arm attached to a frame above is now rested upon the back of the block, and forced down by means of a lever worked by the foot of the operator, thus completing the impression. This process is repeated until the whole piece is covered with the pattern, when it is hung up for from five to ten days until perfectly dry.

If the design is to be gilded, the parts which are to receive the gold leaf are printed in the same manner as above described, only glue size is used instead of paint in the impression. Gold leaf is afterwards applied by girls in the ordinary method.

Satin papers are sometimes prepared by mixing with the coloring matter sulphate of alumina and finishing off with a brush. Velvet or flock paper resembling velvet plush is made after printing the colors, by fixing to the surface some finely ground fibers of wool of the proper hue, by means of glue or white lead and oil.

Paper after being printed is also often embossed by being passed between steel rollers on which a design has been engraved.

The great care which is exerted in printing the many tints of the more elaborate decorations has rendered hand labor necessary in place of machine power; but the expense of producing the material has of course been proportionally increased. Large quantities of the finer qualities of hangings are imported hither from France, but it is a well-known fact that much that is represented as of French manufacture is in reality made in just such establishments and by the same processes as above described.

Of late paper has been printed in patterns which have been suitable for theatrical scenery. At Booth's theater, several of the handsomest scenes are thus made, while in Wallack's the decoration of the entire auditorium is in paper.

In price the fine grades of wall paper vary according to quality, but average from 25 cents to $4.50 per roll of 8 yards.

Paper is extensively used in Japanese houses as a substitute for glass in the windows and sliding doors, and possesses not only the advantage of an immunity from breakage by the frequent earthquakes, but also occasions only a small loss when the house burns down, which happens often enough. Whatever may be its drawbacks, the use of paper for the above purpose is intimately connected with the system of house building in Japan; and it will be long before it is entirely abandoned.

Wall papers are used in all the houses, and are manufactured, not in rolls, but in small sheets ornamented with all kinds of designs printed from wooden blocks, on which the pattern has been cut in relief. The colors having been mixed with some thickening paste, are applied to the block, either by means of a brush or by tamping; after which the paper sheet is laid on the block and rubbed with a flat rubber lined with the smooth bud-scales of bamboo, and used like a printer's ball. Very fine white mica powder is applied to the wall paper, and produces a metallic luster resembling silver.

The crape-paper, which is a most perfect imitation of the real crape, is made by a very ingenious and most simple process. In the first place, that which may be called the matrix-paper is prepared by laying a moistened sheet of strong paper on a wooden board cut with fine grooves, running parallel or crossing one another at very small angles, and by beating it with hard brushes, so as to force it into these grooves. It is then painted over with the frequently mentioned "shibu," in consequence of which operation the paper becomes so elastic that when let go after having been stretched out, it refolds itself. For the production of crape, several sheets of thin moistened paper are laid, alternately with sheets of the above-mentioned matrix-paper, one upon the other. The package is then wound on to a round piece of wood, and pressed several times with a strong lever, as if it were to be stripped off from this piece of wood. By means of this operation, the soft and moistened paper is forced into the folds of the matrix, and consequently folded in a similar manner. By repeating this manipulation 10 or 12 times, each time unrolling it in order to change the position of the paper between the sheets of matrix-paper, and by winding it again on the piece of wood, the paper becomes gradually folded in all directions, the intersecting points of all these folds producing the craped surface. Naturally, this process causes the paper to shrink considerably. This kind of craping is done with printed pictures, and also with colored papers, which are used for coiffures.

The paper imitations of leather are made in the same manner, but of stronger paper. After it has been craped, it is beaten with hard brushes into the molds which produce the relief patterns; and these designs are afterwards painted as required, with the help of "shibu," or the "Ye-no-abura," and lacquer.

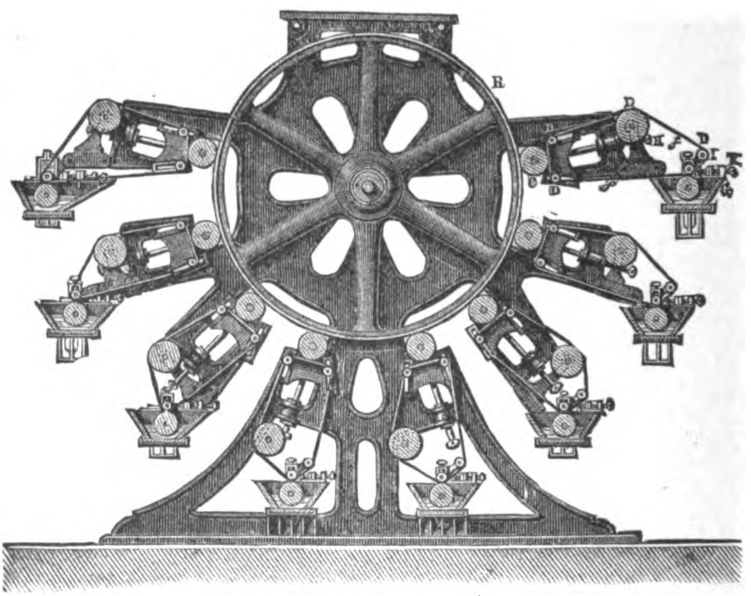
Paper is also often used as a substitute for cloth, for umbrellas, rain-coats, etc., and even for dress cloth. "Shibu," and the "Ye-no-abura," are the means employed for rendering the paper waterproof. This cloth is generally made of paper alone, by beating it to make it soft, and impregnating it with gummy substances, to make it more resistant to the action of water. Another kind of cloth, called "shifu," consists of silk warp and paper woof. The paper is cut into fine strips, twisted together into threads, and spooled for weaving. Paper strings, of great regularity, great strength, and prettily colored, are made in a similar manner, and were formerly used in large quantities for tying up the hair. They are now only used for tying presents and other small parcels.

A veneered wall paper is also made. The wood is cut to the thickness of paper, and by a peculiar process stuck on the paper, which serves as a protection against the influence of the walls on the graining and color of the wood. The delicacy of the machinery employed in cutting so thin a veneer may be gathered from the fact that 200 leaves are cut out of an inch of white maple wood, and 125 out of wood with very open grain, such as oak and walnut.

Wall Pa'per Ma-chine'.

Wall paper machines, printing from cylinders, were made successful by Zuber, of Reixheim, near Mulhouse, about 1832. Rising from the number of 2 or 3 cylinders, they have

Fig. 2523.



Gadd's Wall-paper Printing Machine (English).

attained as great a number as 20, printing in as many grounds, colors, or shades. The machine of Gadd, of Manchester, having 8 cylinders, will, however, give as accurate an idea of the construction as one possessing a larger number. It is shown in longitudinal vertical section in Fig. 2523, and works equally well as a calico printer or wall-paper printer.

Great difficulty occurred in working machines in which the printing cylinders were driven by gearing, as it was necessary to preserve scrupulous exactness in the sizes of the printing rollers in order to secure correct registry of the parts which combined to form the pattern. In the Gadd machine this difficulty has been met by moving the printing rollers by surface contact.

The central driving cylinder *R*, which forms the platen at the back of the continuous paper sheet, whose other side is exposed to the printing rollers *C*, is mounted upon interior arms or spokes whose hub has a bearing upon the central axis to which the driving power is applied. The printing rollers *C*, engraved in relief, are driven by contact with cylinder *R*, and receive their color from an endless felt cloth *f*, which is distended by interior wooden rollers *D D*. Eight groups of inking and printing devices are arranged about 220° of the perimeter of the driving platen cylinder *R*, but a description of one answers for each of the others, as the action of each is similar, each having its part to perform in adding its quota of color to make up the design which is the sum of contributions of each of the series.

The felt cloth, at its lowest position, is pressed by a roller against the color-feeding roller which revolves in the copper color-trough *G*; the pressure is adjusted by small hand-screws above. Two tension rollers, *D D*, are placed near the surface of the large cylinder and are moved between slides by means of a screw, *H*, so that the felt cloth is pressed against the graven printing roller with the required force. In leaving the inking roller, the felt passes against a *doctor* which removes superfluous color. The screw *K* regulates the *doctor*.

Printing rollers engraved in intaglio, similar to those used in printing tissues, are suitable for some descriptions of wall paper, but little charged with color, for delicate designs and for spotted cards.

For printing striped papers a machine has a reservoir composed of as many compartments as bands are required on the endless web of paper. Each compartment is pierced with an opening at bottom, as wide as the width of band required, the whole forming a series of stripes upon the paper traversing beneath, much as, so far as the paper is concerned, paper ruled with wide striping pens on the paper-ruling machines. Figs. 4499, 4500, p. 2002, "*Mech. Dict.*"

The drying of the paper was formerly done by suspending it from rods in a frame, the piece or bolt occupying 2 of these rods. The wall paper sticking machine of J. & E. Waldron, of New Brunswick, N. J., shown at the Centennial, is a great advance upon hand methods. It places the fold of the paper upon the rod which traverses along a lengthy frame, the rods being automatically supplied, adjusted, and the paper hung thereon and then traversed along the frame, and then returns, doubling the length of time of drying exposure within given limits to the length of the machine.

See view of wall paper printing machine, "*Scientific American*," xxxvii. 223.

Other machines in the manufacture of wall paper are the —

Grounding machine, for putting on the body color.

Sticking machine, for hanging the paper in festoons to dry.

Polishing machine, for giving a satin finish to the ground color to be overlaid by the dead color pattern.

Trimmer, for trimming the edge of the paper, *Boust*, * "*Scientific American*," xxxiv. 230.

Wall Pa'per Pol'ish-ing Ma-chine. A machine for giving a satin finish to wall paper.

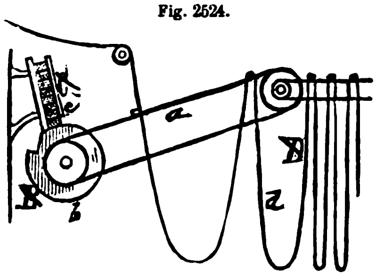
It consists of a central rotating brush against which the paper is repeatedly carried by rotating cylinders. The polish is upon the surface of alumina and oil which is known as the *grounding*.

The printed pattern is usually laid on this in dead color.

Wall Pa'per Stick'ing Ma-chine'. A machine for hanging wall paper in festoons to dry.

The paper from the grounding or the printing machine is conducted between endless belts across which sticks are laid automatically and over which sticks the paper is suspended in festoons. The sticks are so placed that a length of paper measuring just four yards hangs between any two. The belts are kept in constant motion, and, by means of the second belt, the paper is thus conducted along the loft, which measures some 160' in length. Steam coils are placed beneath the belts, and a temperature of 120° F. maintained. About nine minutes are occupied by any one festoon of paper in making the journey from the grounding machine to the point where

Fig. 2524.



Wall Paper Sticking Machine.

it is again made into a roll, and during this period it becomes thoroughly dried.

The device employed for placing the sticks under the paper is represented in Fig. 2524. At the ends of the roller over which the endless belt *a* passes, are two cams, one of which is shown at *b*. Above the cams and resting on their periphery is a pile of sticks, *c*. The cam shoulder equals in height the thickness of one stick. Hence at each revolution of the cam a stick is moved trom the bottom of the pile and carried down on and across the belts. Between the latter comes the paper *d*, which thus falls in folds over the sticks as they are laid in place.

Walls. (*Mining.*) The sides next to the lode.

Wall Scra'per. A broad chisel-edged tool with a socket in which can be inserted handles of various lengths for scraping and preparing walls for papering.

Warp'ing. (*Nautical.*) To move a vessel from one place to another by warps, which are attached to buoys, other ships, anchors, bollards on shore, etc.

Warp'ing Ma-chine'. (*Weaving.*) A machine for laying out the threads of the warp and winding them on the warp roller. The spindles containing the threads turn in bearings in the uprights of the frame, and the threads are carried through a separator and between two rollers, by which they are laid out flat and parallel, and are finally wound upon a roller journaled in the arms and resting upon the drum by which it is turned.

Warping, scouring, sizing, drying, and beaming machine.
Leach & Sons, Engl. * "*Scientific American Sup.*," 1991.

Wash'-ba-sin Valve. A valve for wash basins, by means of which the sewer pipe is claimed to be as effectually closed as the water pipe ordinarily is, and that consequently no sewer gas can escape into the room. The valve being air tight, a partial vacuum is produced above the water trap, which prevents the rush of water through waste pipes below, siphoning the water out of the trap. The construction is also such that the valve cannot be left open when the water is turned off or left shut when the latter is turned on.

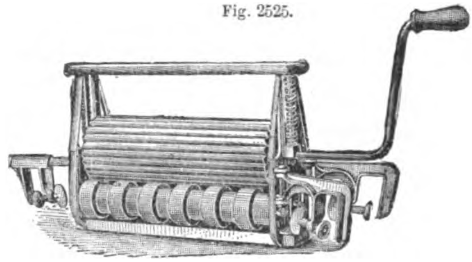
The valve is hinged to the rim of the basin, is made hollow, and of such a weight that as the water rises in the basin it is raised, and the holes covered are so opened that the overflow water may freely escape. The lower surface of the valve is covered with leather, rubber, or similar material, to cause it to cover the overflow holes tightly.

Wash'burn Wheel. A cast-iron car-wheel, designed and patented by Nathan Washburn in 1850. It consists of two plates, which extend from the hub to about half the distance between it and the rim. There they unite into one plate which extends to the rim. The plates are all curved so as to contract when the wheels are cooled without danger of fracturing the wheel. The single plate and the rim are united together and strengthened by curved ribs cast on the inside of the wheel.

Wash'er. The "*Pharmaceut. Centralhalle*" says that, for the purpose of packing joints which are to be hermetically sealed, such as retort connections, couplings, etc., where vulcanized rubber has usually been employed, cellulose appears to be even a better material. It has the advantage of cheapness, it readily absorbs water at first, thereby becoming pliable, and adapts itself more accurately to the surfaces which it is intended to render tight. If a joint is exposed to steam, and is to be frequently opened, the cellulose should be soaked in oil.

Wash'er, Clothes. The Keystone washer, Fig. 2525, has its frame and rollers so arranged that the machine can be attached to the ordinary tub. The washing is done by the united pressure

Fig. 2525.



Keystone Washer.

and friction of the corrugated and ribbed rollers between which the clothes have to pass. A lively pressure is insured by the spiral springs above.

Wash'er, Smoke. Two of the latest contributions to the abatement of the smoke nuisance employ water to wash the smoke as it passes through the flue of the chimney.

The more simple of the two consists of a spray or shower of water driven upward in the chimney flue. The water cleans the smoke of much of its impurities, and falling back escapes below. The blackened water is afterward collected, and under proper treatment yields a coloring material for a fine black paint. The other apparatus is more complicated. It consists of an upright cylinder of boiler plates 14′ high and 5′ in diameter. Inside are a number of sheet iron diaphragms placed one over another, and partly filling the interior. Each diaphragm overlaps the other, and all are perforated with a great number of holes 0.2 of an inch in diameter. The smoke enters below, and a stream of water flows in at the top. The water drips in a shower through the holes, and by the aid of a powerful exhaust, the smoke is forced upward through the apparatus. On its passage, owing to the obstructions caused by the diaphragms, the smoke travels 51′ and is perfectly cleared of soot. The experiments made with this apparatus go to show that the value of such devices depends chiefly on the power of the exhaust or draft, the distance traveled by the smoke through the shower of water, and the perfect subdivision of the water. The amount of water employed seems to be of less consequence.

Wash'er Scrub'ber. The "Standard," washer scrubber consists of a series of cast-iron sections, varying in number with the capacity of the machine. A shaft passes horizontally through the center of these chambers, and is connected at one end with a small engine, or suitable gearing, which furnishes motive power. Each section, with the exception of the two at the ends, contains a number of circular sheet-iron disks which are bolted together and securely keyed to the shaft; indentations in the disks serving to preserve ¼″ distance between them. Water at the rate of about twelve (U. S. standard) gallons per ton of coal carbonized, is admitted at one end of the machine, and after passing through the intermediate chambers, and constantly increasing in strength, is drawn off at the other end of the washer. The central shaft is revolved from four to five turns per minute, and the circular sheet-iron disks rotate with it, the lower halves being constantly immersed in the water while the upper portions always present a thoroughly wetted surface for the absorption of the ammonia as the gas passes through.

Wash'ing Fur'nace. The "Pernot" is a regenerative gas furnace, and has a revolving hearth of 12′ × 3′. The four regenerator chambers have 780 cubic feet capacity. The lining is 13″ thick on the sides and 9″ on the bottom, thus giving a hearth 9′ 10″ × 2′ 3″ deep. The lining is composed of lumps of highly refractory ores, roughly fitted together, the interstices being filled with fine ores, and the whole being glazed at a melting temperature. As the ore melts the lining is refilled until the mass becomes monolithic. The hearth is then fettled.

Wash'ing Rol'lers. For squeezing goods or yarn after being scoured.

Two cast-iron rollers turned perfectly true and smooth, are carried on two cast-iron standards; the pressure is obtained by compound levers with movable weights.

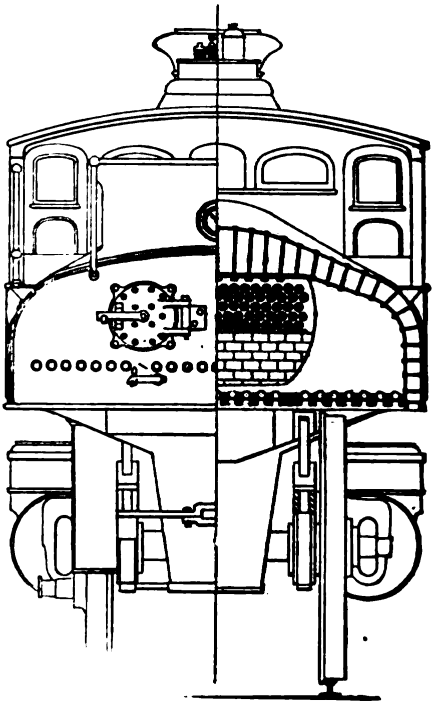
The bearings are of gun metal.

Wash Tub Waste. A stop valve that on removal allows the waste of the wash tub to escape.

Waste Card. A machine for working up and carding the waste, fluff, and broken fiber, that gathers on the floor of the factory.

Waste Coal Burn'ing Lo'co-mo'tive. The Wootten locomotive, Plates LIV. and LV., and Fig. 2526, is especially adapted to the consumption of waste coal, being unique in the large surface area of its grates. It is especially adapted to fast passenger service, by its free steaming qualities, its capacity being equal to the evaporation of 55 gallons of water per minute, enabling it to steadily maintain its speed.

Fig. 2526.



Waste Coal Burning Locomotive.

This result is secured by the peculiar form of furnace employed, by which although waste anthracite can be used as fuel with good results as far as steaming is concerned, yet the rapidity of the exhaust emissions is such as to lead to the discharge from the stack of the finer particles of impurities, contained in the waste coal. But notwithstanding its capacity, in consequence of the passenger service in which it is employed, the smaller sizes of prepared coal are used, so it would be a misnomer to class it as a dirt burner.

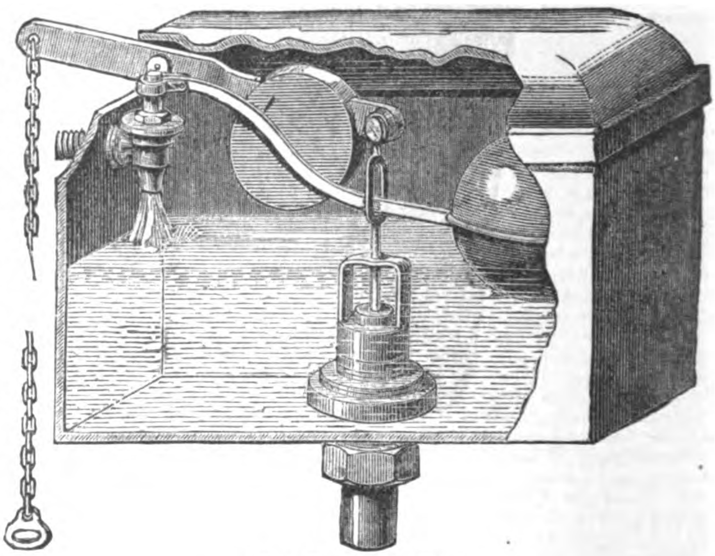
By reason of the moderate draft of these furnaces, and the consequent economy of combustion of fuel, they are enabled to attain an evaporative effect equal to 60 per cent. of the theoretical evaporative power of the fuel used, whether it be anthracite, bituminous, or lignite.

Waste Pick'er. See RAG PICKER.

Waste Pre-vent'er. Stone's positive waste preventer for cisterns, Fig. 2527, is so constructed that, although only possessing one inlet valve and one discharge valve, it yet answers the purpose of a double-chambered cistern. When the water is required to be drawn off from the cistern the inlet valve leading from the source of supply is closed before the discharge valve can be opened.

The valve is attached to the lower end of a socket in which the valve stem, which is connected at its upper end to the ball stem, is allowed to slide up and down a certain distance freely, so as not in any way to affect the valve; but as soon as the required distance is traversed, the valve stem acts upon the socket, and so causes the valve to be governed by

Fig. 2527.



Waste Preventer for Cisterns.

the rising and falling of the ball. When the water from the source of supply flows into the cistern, it raises the ball, and gradually closes the valve until it reaches a certain point, when the pressure on the back of the valve forces it on to its seat, and holds it there, while by means of the

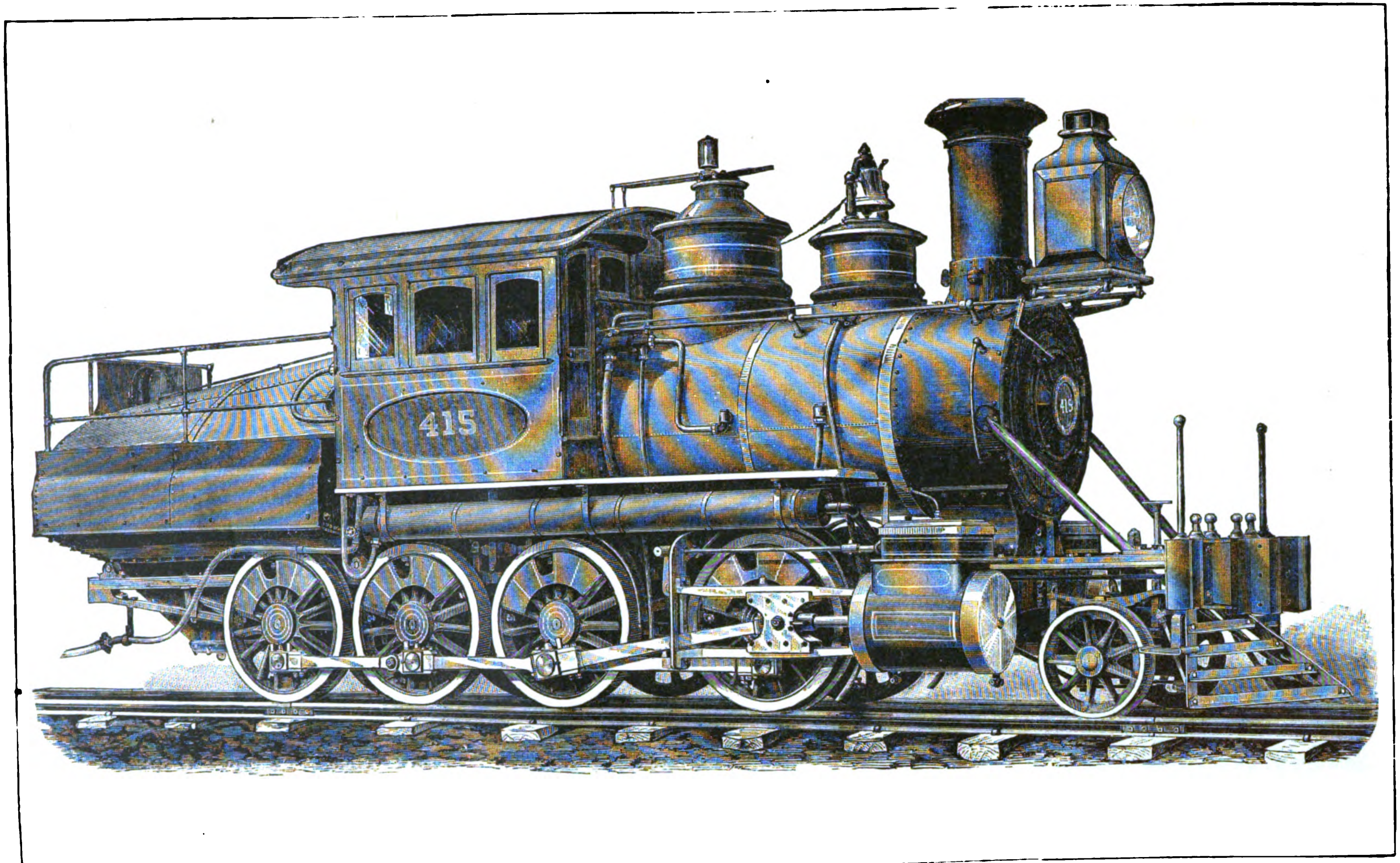


PLATE LIV. WASTE COAL BURNING LOCOMOTIVE. See page 936.

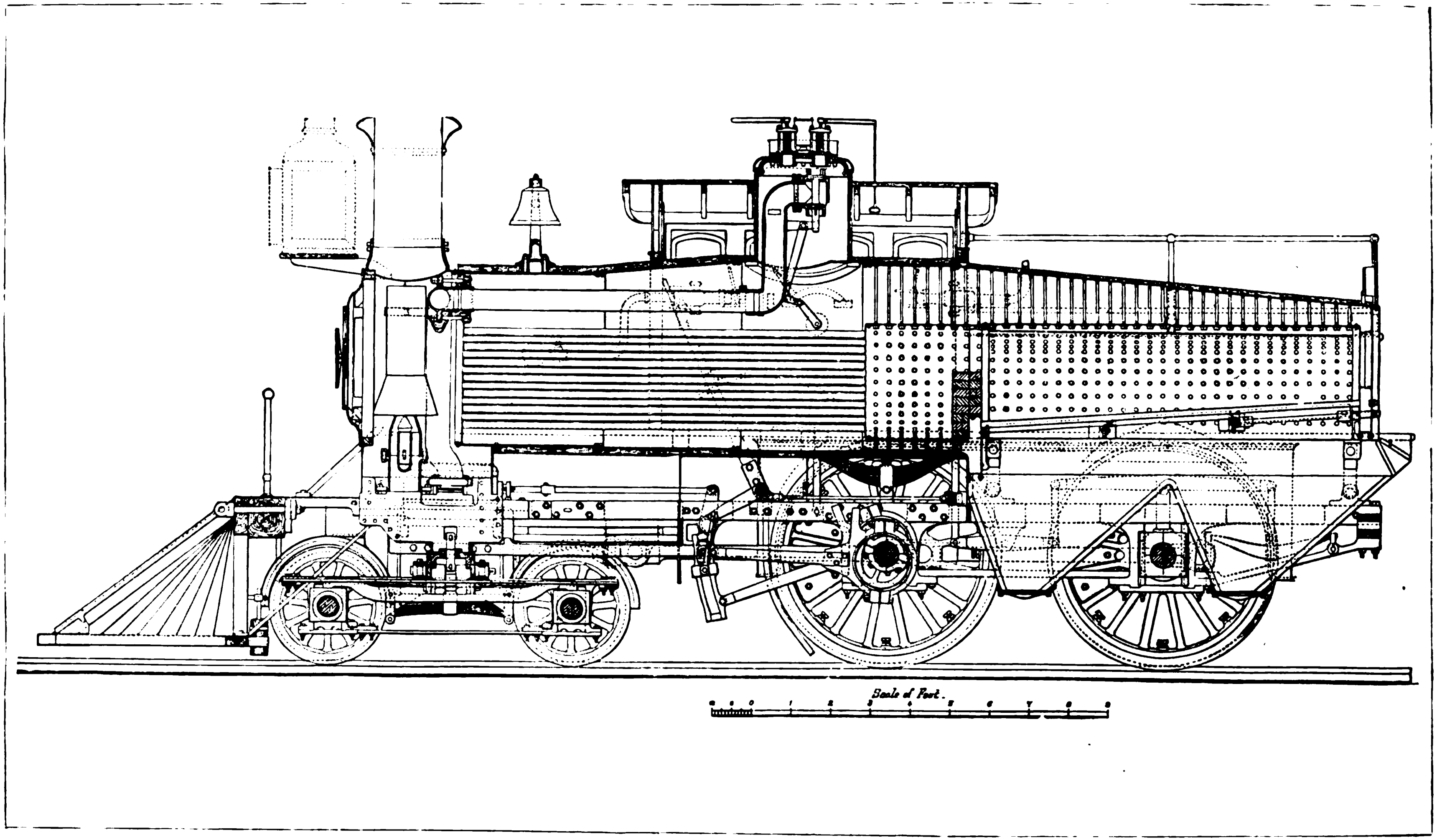


PLATE LV.

WASTE COAL BURNING LOCOMOTIVE. (SECTIONAL VIEW.)

See page 936.

sliding socket, the ball stem can be raised sufficiently high to allow the discharge valve to be opened, so that the water can run out only after the ball valve is perfectly closed.

Or when the lever is pulled and the discharge valve opened, the ball stem and ball are raised at the same time, which can readily be done by means of the sliding socket without affecting the inlet valve, which is held fast on its seat by the pressure of water from the source of supply, as already described. As soon as the water has run out of the cistern, and the lever or pull is let go, the discharge valve is closed, and the ball stem and ball drop, thus opening the inlet valve, and allowing the water to refill the cistern ready for use again.

Watch. Sir Edmund Beckett, a scientific horologist, who is, perhaps, the highest English authority upon the subject, in his work upon "*Watches, Clocks, and Bells*," says: —

"The liability of a watch, like any other piece of mechanism, to require repair, is in the ratio of the number of separate parts which make up its unity. The English watch, with its fusee and chain, is composed of 638 more pieces than the American watch. Dispense with these 638 additional chances of breakage, and it is easy to infer the superiority of American watches, in this one respect at least. The fusee and chain are rejected in the Waltham watch, and the direct action of the mainspring adopted, because the fusee and chain add greatly to the cost and liability to injury of a watch, and are of no practical value for good time-keeping. This change is advocated on the ground that there is greater simplicity of action, less friction in the transmission of motive power, increased facility for using a lighter and more uniform spring, and more room for play in the other parts of the movements."

In support of this view, Sir Edmund Beckett speaks very favorably of the American principle of omitting the chain. After alluding to what he calls the mischievous and common accidents of chain-breaking, and noting the tendency of advanced watch-making to do without fusee and chain, he says: "Accordingly, both in Switzerland and America, which are gradually stealing away our common watch trade, the fusee and the chain are almost universally omitted."

Dr. Hooke raised horology from a mechanical art to a science by propounding its laws and enriching it with valuable discoveries and inventions.

The discovery and application of the laws of isochronism in the balance-spring by Dr. Hooke and Arnold in England, Leroy and Berthoud in France, imparted the most essential quality for keeping a regular rate of time to the chronometer.

"*Isochronism* is an inherent property of the balance-spring, depending entirely upon the ratio of the spring's tension, following the proportion of the arcs of inflexion. A balance-spring, therefore, of any force whatever, having the progression required by the law of isochronism, will preserve this quality, whether it be applied to a balance making rapid or slow vibrations.

"The great advantage of an isochronal spring is its innate power of resisting the influences which cause a change of rate, such as change of position, increased friction as the works become dirty, or the viscidity of the oil at low temperatures." — *Carpenter.*

See list under CLOCK for exhibits of all horological instruments, from *Prof. Watson's* report in "*Centennial Exhibition Reports*," Group XXV., vol. vii.

See also *Dr. Knight's* report, vol. iv., "*Paris Exposition* (1878) *Reports*," p. 403, *et seq.*

Dr. Knight's report on watch-making machine at Waltham, is in "*Centennial Exhibition Reports*," vol. vii., Group XXII., p. 46, *et seq.*

The "*Journal de Genève*," of August 26th, has the following: The watch-making population of the several Swiss cantons may be held as exactly represented by the subjoined table, compiled from the returns of the census for the year 1870: —

CANTONS.	Men.	Women.	Total.
Neufchâtel	11,081	5,383	16,464
Berne	6,392	4,743	14,135
Vaud	2,439	1,313	3,752
Geneva	5,330	1,288	3,618
Total	25,242	12,727	37,969

Berne is the canton in which there has been the greatest rise in the manufacture of watches of late years. It is computed to produce 500,000 watches a year; and, as they are almost exclusively of ordinary quality, their average value may be set down at 40 francs, which would bring up the total of Bernese annual production to 20,000,000 francs ($5,000,000).

Geneva does not supply much over 150,000 watches yearly, but, as eleven twelfths of these are gold, and in part richly ornamented, their value does not probably fall short of 20,000,000 francs.

The canton of Vaud also turns out 150,000 watches per annum, the works of which are generally highly finished; but then they are in great measure exported without cases, as mere works, the average price being about 35 francs, and the total value being 8,000,000 francs.

Besides these, the canton of Vaud furnishes 80,000 musical boxes, which amount to 8,000,000 francs.

In respect to value, Neufchâtel produces nearly half of the entire Swiss watch-making (35 per cent.); the cantons of Geneva and Berne come in for 23 per cent. each, and the canton of Vaud for 9 per cent.

Break-circuit. *Davidson* *	"*Min. & Sc. Press*," xxxiv. 361.
Watches, American, *Watson*	"*Van Nostrand's Mag.*," xvii. 161.
Watch-making, American, on, *Grosjean*, Switz.	"*Min. & Sc. Press*," xxxiv. 154.
Watch, demagnetizing *	"*Scientific American*," xli. 227.
Watches, demagnetizing	"*Scientific American*," xxxiv. 28.
Invention and history	"*Sc. Amer.*," xxxvii. 88, 101, 121.
Watchmaker's lathe, *Williams*	"*Scientific Amer.*," xxxiv. 194.

Watch'ma-ker's Slide Rest. A slide-rest to a watchmaker's lathe, adjustable by its set screws, to any angle or position that the work requires.

Watch Tel'e-phone. (*Electricity.*) An instrument which takes its name from its resemblance in form to an old-fashioned watch. Invented by Alfred Niaudet-Begnet, of Paris. It is a Bell telephone in which the magnet is bent into a circular form, and the coil is seated upon one of its poles, the planer of the magnet, coil, and diaphragm being all parallel to each other.

Wa'ter A'er-a-ting Ap'pa-ra'tus. A device for aërating the water supplied to an aquarium. The apparatus is an application of the principle of the "Catalan trumpet" that is used to operate the bellows in the iron furnaces of Spain. It consists of a number of glass tubes, into which the water is forced by hydraulic pressure, carrying with it bubbles of air, the presence and movement of which in the tubes may be plainly seen.

Wa'ter A-nal'y-sis Ap'pa-ra'tus. McLeod's water analysis apparatus, used to determine the purity of drinking water, is an improvement of the one described by Dr. Frankland and Mr. Ward, by which temperature and tensions of fixed volumes of water and gas are tested. This instrument is very much in use. It consists of a measuring tube 900 mm. in length and about 20 mm. in diameter, which is marked with ten divisions, the first at 25 mm. from the top, the second at 50 mm., the third at 100 mm., and the remaining ones at the intervals of 100 mm.

In the upper part of the tube, platinum wires are sealed, and it is terminated by a capillary tube and fine glass stop-cock, the capillary tube being bent at right angles at 50 mm. above the junction. At the bottom of the tube a wide glass stop-cock is sealed, which communicates, by means of a caoutchouc joint surrounded with tape and well wired to the tubes, with a branch from the barometer-tube. At the upper extremity a glass stop-cock is joined, the lower end being curved and connected by caoutchouc with a stop-cock and tube descending through the table to a distance of 900 mm. below the joint. The two tubes are firmly held by a clamp, on which rests a wide cylinder, about 55 mm. in diameter, surrounding the tubes, and adapted to them by a water-tight caoutchouc cork. The cylinder is maintained in an upright position by a support at its upper end, sliding on the sam rod as the clamp. Around the upper part of the barometer-tube a syphon is fixed by means of a perforated cork, through which the stop-cock passes. A small bulb-tube, containing some mercury, is also fitted in this cork, so as to allow of the air being entirely removed from the syphon. The syphon descends about 100 mm. within the cylinder, and has a branch at the top communicating by caoutchouc with a bent tube contained in a wider one affixed to the support. A constant current of water is supplied to the cylinder through a glass tube, which passes to the bottom, and escapes through the syphon and tubes to the drain. To the end of the narrow tube is fastened a long piece of caoutchouc tube, covered with tape, by which a communication is established with the mercurial reservoir, suspended by a cord, so that by means of the winch it may be raised above the level of the top of the barometer-tube.

Wa'ter Bal'last. A mode of ballasting vessels with water, in tight compartments in the bottom of the hull.

Wa'ter Bar'rel Truck. A pivoted water-barrel mounted on wheels, and drawn by hand. The barrel, being pivoted by its spindles, is easily emptied.

Water ballast, on,
Martel (20 Figs.) . . * "*Engineer*," xliv. 174.
Construction . . . * "*Engineering*," xxiv. 186.

Wa'ter Bear'ing. Shaw's water bearing is designed to relieve the pressure on the step of a vertical shaft.

It consists of a disk secured to the shaft, and provided with a circular piston. The water entering from a pipe under a sufficient head, passes into the chamber of the piston and between it and the lower face of the disk, lifting the latter. If the upward pressure of the water be in excess of that necessary to sustain the shaft and the weight it may have to bear, a portion escapes beneath the lower edge of the piston and the shaft settles to its normal position.

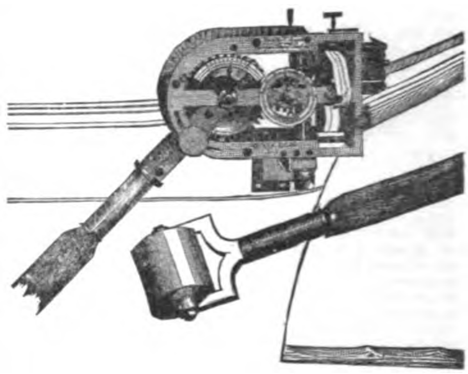
Wa'ter Box. (*Metallurgy.*) An iron box to contain water forming a bottom or side of a furnace in order to prevent it from burning out. Tuyere plates are so protected.

Wa'ter Breast. An improved tuyere for water breasts is described as follows: —

A bronze tuyere is inserted into the end of a water breast, which is bored out conically to receive it, and does not, therefore, call for any packing. The butt end of the tuyere is turned so that it presents a part of a sphere, and the end of the belly pipe is correspondingly shaped to produce a perfect joint. By a simple arrangement, which allows rapid and easy replacement of the tuyere, the movable parts are firmly held together. This is effected by a knee lever under the elbow, at the longer end of which a detachable weight is hung. The pressure exerted by this weight firmly connects water breast and tuyere on the one hand and belly pipe and tuyere on the other. By this means all bolts are done away with, and the weight need only to be removed to allow the different parts to drop apart. When it becomes necessary to replace a tuyere a hook is inserted, and it is readily pulled out. By arranging proper openings at the butt of the tuyere any air entering in the water is trapped and carried off direct by the waste pipe. The discharge pipe is taken off at the top of the tuyere and air prevented from collecting in it. For a short distance outside of it the discharge pipe is elevated, which carries off at once any air or steam bubbles to a higher point outside of the tuyere, thus avoiding danger to it. In order to prevent any water from entering the furnace the water is drawn through the tuyere by suction at the same velocity as if it were forced through. It is claimed that, as by this means the water pressure is brought down below the atmospheric pressure, which is generally smaller than that of the blast in the interior of the furnace, no leakage in consequence of cracks can take place. It was found also by experiment that drawing the water through the tuyere prevents any accumulation of air or steam bubbles, the steady growth of which will ultimately lead to cracking. Great though the advantages of suction may be, however, its use is not a necessary element in the application of the tuyere, which, it will be readily understood, works well with pressure also. The nozzle in the tuyere, as it fits into it well, is cooled by the circulation of the water in the latter, and can therefore be carried very near the end of the tuyere, a circumstance which aids the penetrating power of the blast. The nozzle may be easily drawn out through the belly pipe, if the cap on the tuyere pipe elbow is removed. When fire-brick stoves are used the tuyere pipes are made double, in order to prevent the serious loss of heat which otherwise takes place.

Wa'ter Chan'nel In'di-ca'tor. Echebarn's indicator, Fig. 2528, for water channels was designed to indicate and register the depths of water in the Rio da Prala, which, from the continual shifting of its waters, presents great difficulties to navigation. There is a long rod turning on an axle that is provided with a toothed wheel, and bears an index pointer, indicating on a graduated arc the inclination of the rod from the horizontal.

Fig. 2528.



Water Channel Indicator.

The lower end of the rod bears a roller that travels on the bottom of the river, or the body to be indicated. A toothed wheel drives a wheel train bearing a paper drum, and on a paper band a pencil describes in miniature the condition of the bottom in the line traversed by the vessel.

Wa'ter Charg'er. A device for retaining a body of water always close to the pump, so that if the lower valve of the pump leaks, and the water all runs out of the suction pipe, or if it has been let back to avoid freezing, this charger will still retain a full supply to be readily sucked into the pump, wetting the valves and packing, so as to at once bring the water, and cause the pump to work freely. The charger should be connected into the suction pipe as near the pump as it can be conveniently, and still be out of the way of frost. This charger also greatly facilitates the working of a pump, particularly where the suction pipe has to be of great length, serving as an air chamber in same.

Wa'ter Col'umn Air Com-pres'sor. One operating by the force of a descending body of water, as in some mines and mountain regions. See AIR COMPRESSOR.

Wa'ter El'e-va-tor. See PUMP.

Water elevator, *Coates* . * "*Scientific American*," xl. 278.
Steam, *Wright* . . . * "*Scientific Amer.*," xxxvi. 274.
By ammoniacal gas . * "*Scientific American Sup.*," 805.
For locomotives.
Haggas, Can.. . . * "*Engineering*," xxviii. 296.

Wa'ter En'gine. Wells' water engine is intended to be used as a motor, and also if desired as a pump. The cylinder is mounted on bearings of the case on trunnions. It has a circular valve formed on the lower end, with one port, and fitted to the correspondingly shaped valve seat in which is the inlet and the exhausts for the waste from the interior of the case. Passages are cored out in the cylinder, from the upper end down to the interior of the waste water case, to conduct the leakage to the discharge through the exhaust.

A cap screws to the top of the cylinder for a guide to the piston rod, and these passages enter the cylinder above the piston, under the cover. The oscillation of the cylinder, in the case, alternately opens the supply and exhaust passages.

Water engine, *Hastie* . * "*Scientific Amer.*," xxxix. 227.
Three-cylinder.
Hastie, Br. . . . * "*Engineer*," xlvi. 146.
Water ejector.
Vaughn, Br . . . * "*Engineer*," xlix. 342.

Wa'ter Gas. Any illuminating gas in whose manufacture the decomposition of water plays a prominent part, as distinguished from the illuminating gas produced solely by the decomposition of bituminous coal, wood, resin, tar, oil, or other like material.

Briefly, the Lowe process is the following: A generator of the ordinary type is filled with fuel brought to a high temperature by the aid of blast. The combustible gases thus formed are carried to a chamber filled with loose fire-brick, called a superheater by the inventor, although it should more properly be termed a regenerator. As soon as by the burning of the generator gases the regenerator has attained a high temperature, the blast is cut off and superheated steam is admitted a little above the grate, and simultaneously small streams of crude petroleum or naphtha are allowed to drop through the current of ascending gases upon the incandescent fuel. The steam is decomposed and hydrogen and carbonic oxide are formed. The products of the decomposition of petroleum, hydrocarbons, pass to the regenerators together with the water gas, where the hydrocarbons are gasified. As soon as the temperature of the generator falls below a certain limit the flow of steam and of petroleum is stopped, fresh coal is charged, and the blast of air turned on again.

Dr. W. H. Wahl gives the following answer to the query, "What is water gas?" "Water gas may be defined to be the gaseous product resulting from the interaction of steam and carbon at a high temperature. Generally speaking, the mode of its manufacture is to pass steam through a thick layer of glowing coal. The result of this procedure will be very easily understood by reference to the following explanation: The glowing coal (carbon) seizes upon the oxygen of the steam, uniting with it to form carbonic acid and liberating hydrogen. The carbonic acid thus formed is, however, obliged to pass through a considerable layer of glowing coal (carbon) before it can escape, and this carbon has so strong an affinity for oxygen that it deprives the carbonic acid of one equivalent of its oxygen, reducing it to the state of a lower oxide of carbon. The product which results from these several reactions is 2 equivalents of hydrogen and 2 equivalents of carbon oxide; or, expressed in chemical terms, $2\,H + 2\,CO$. This product is what is known as water gas. It is incorrect to assert that any positive gain in heating effect is obtained by this process, for the energy expended in the process of decomposing the water is precisely equal to the additional heat given out by the combustion of the water gas over what would have resulted from the combustion of the carbon alone. On theoretical grounds, therefore, there can be no economy in the process; but there is a gain in practice, and this is due to the fact that the combustion of a gaseous fuel can always be effected with greater economy in our furnaces, stoves, etc., than that of a solid fuel. The gain, therefore, is to be ascribed to the physical condition of the fuel, and not to any advantage resulting from the chemical reaction that has taken place. This is a very common error and is entertained even by otherwise well-informed persons. We look upon the future of water gas as highly promising. With its aid it is made possible to produce illuminating gas more cheaply than by any other process, by simply enriching it with the vapors of petroleum or of other substances rich in illuminating elements But the grand field of water gas for the future will lie in filling the place of a fuel for industrial and domestic uses to take the place of coal. We think the time is not very remote when water-gas will be distributed to our houses just as coal gas is now distributed, — when coal and wood fires, with their dirt and ashes, will only be known as things of the past."

Water Gas, *Strong* . .	"*Van Nostr. Mag.*," xxiii. 376.
On, Prof. Henry Morton	"*Plumber & San. Eng.*," ii. 347.
Dwight	"*Scientific American Sup.*," 948.
Appa., *Lowe & Strong* *	"*Engineering*," xxviii. 385.
Lowe . . . . . . *	"*Iron Age*," xxi., April 11, p. 1.
As a fuel, *Dwight* . .	"*Scientific American Sup.*," 836.

Wa'ter Lens. The first microscope in existence consisted of a drop of water. Water lenses as formerly used were unstable and tremulous, and almost if not quite worthless. This difficulty may be overcome, and the drop of water rendered available as a microscope lens by confining it in a cell consisting of a short tube having a glass bottom.

The simplest and cheapest of all microscopes consists of a thin piece of glass, having attached to it one or two short paper tubes, which are coated with black sealing-wax, and cemented to the glass with the same material.

By aid of a small stick water is placed, drop by drop, in the cells until the lenses acquire the desired convexity. Objects held below the glass will be more or less magnified, according to the diameter and convexity of the drop.

An easily made and convenient stand for the water lens is made of wood. The sleeve that supports the table slides freely upon the vertical standard. A wire having a milled head, by which it may be turned, passes through the upper end of the standard, and has wound upon it a strong silk thread, one end of which is tied to a pin projecting from the table supporting sleeve. An elastic rubber band is attached to the lower end of the sleeve, and to a pin projecting from the standard near the base, to draw the table downward. By this device the focus may be nicely adjusted.

Two standards project from the bed-piece for receiving the corners of a rectangular piece of silvered glass which forms the reflector.

The best form of water-cell consists of a brass tube about $\frac{3}{8}''$ long and $\frac{1}{8}''$ to 3-16'' internal diameter, having in one side a screw for displacing the water to render the lens more or less convex. A thin piece of glass is cemented to the lower end of the tube, and the inside of the tube is blackened.

Several bushings may be fitted to the upper end of the tube to reduce the diameter of the drop, and thus increase the magnifying power of the lens.

Water containing animalcules may be placed on the under surface of the glass, and the lens may be focused by turning the adjusting screw. The lens may also be adjusted to magnify objects placed on the movable table.

If air-bubbles form on the upper surface of the glass they may be readily displaced by means of a cambric needle.

Water lens microscope * "*Scientific Amer.*," xxxviii. 258.

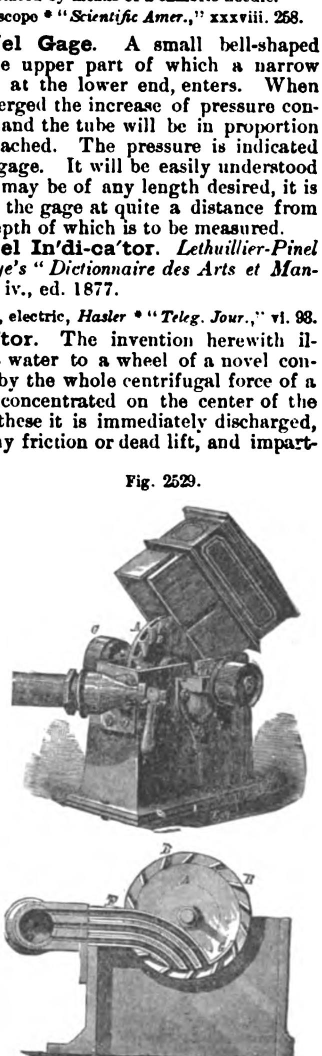
Wa'ter-lev'el Gage. A small bell-shaped casting, into the upper part of which a narrow brass tube, open at the lower end, enters. When the ball is submerged the increase of pressure confined in the bell and the tube will be in proportion to the depth reached. The pressure is indicated on a graduated gage. It will be easily understood that as the pipe may be of any length desired, it is possible to place the gage at quite a distance from the water the depth of which is to be measured.

Wa'ter-lev'el In'di-ca'tor. *Lethuillier-Pinel* (Fr.), * *Laboulaye's "Dictionnaire des Arts et Manufactures,"* tome iv., ed. 1877.

Water level indica., electric, *Hasler* * "*Teleg. Jour.*," vi. 93.

Wa'ter Mo'tor. The invention herewith illustrated applies water to a wheel of a novel construction, whereby the whole centrifugal force of a jet of water is concentrated on the center of the buckets. From these it is immediately discharged, thus avoiding any friction or dead lift, and imparting to the wheel not only a greater impetus, but, it is claimed, a very high degree of power, considering the pressure and the size of the stream used. Although adapted to all purposes where water is used as a motive power, this invention is more particularly designed for use where the supply of water is limited or variable; and this is believed to be a desideratum, as streams of water are liable to much fluctuation at different seasons of the year. More especially is it designed for use

Fig. 2529.



Water Motor.

in propelling light machinery, such as printing presses, sewing machines, lathes, etc., wherever water can be taken from a hydrant. It is also claimed to be well adapted for heavy work.

The disk of the wheel *A* is made of brass of various sizes, and together with the buckets *B B*, is of a peculiar construction and of a capacity to correspond with the size of the stream and the power required. *C C* are the belt pulleys; *D* the supply pipe; *E* a self-packing faucet or stop-cock, which is the subject of another patent obtained by the same inventor. This faucet is capable of supplying one, two, three, or more streams of water of different dimensions through the pipes *F*, which are firmly held in position at the point of delivery of the water on the buckets by a shoe, *G*. The pipes are provided with bushings at their extremity, which can be removed at pleasure, and others of a different capacity inserted. The waste pipe, of course, can be arranged as required, either from the sides or bottom of the casing. The communication between supply pipe and buckets is shown in section in Fig. 2529.

One of the smallest motors capable of being put to practical use is the Hayworth's miniature turbine water motor. It consists of a tube 3″ long and ⅞″ outside diameter, with an oblique inlet by which it can be screwed to the hydrant or faucet. A small stem with a double pulley at the end projects from the upper end of the tube, and is rapidly revolved when the water is turned on. A rubber hose drawn over the lower end of the tube conveys the water off after performing its duty. By an endless cord the motion can be transmitted from the pulleys to a sewing machine or any other machine requiring only light power for driving. The motor is constructed on the principle of turbine wheels, and can be run with water pressure of 10 to 15 lbs. to the square inch. After entering the tube by the inlet, the water first passes a stationary wheel having a series of radial vanes of such a shape as to give the water a spiral motion. Issuing from these vanes, the water strikes against similar vanes of a wheel that is fastened to the above mentioned spindle, and which, by the impact of the water, is made to rotate.

Different sizes of this motor are manufactured. The smallest size, of the dimensions above stated, furnishes sufficient power to drive sewing machines, etc.

Messrs. W. H. Bailey & Co., of Salford, England, have recently designed a new water motor which works under the ordinary pressure of the water sent through the street mains. In appearance it is somewhat similar to an ordinary horizontal steam engine. It has an oscillating cylinder, with parts so arranged that the motion of the cylinder cuts off the supply of water at the end of the stroke, a reciprocating action being thereby obtained and imparted to the fly-wheel by the ordinary crank arrangements. There are no loose valves or tappets in connection with the motor, and all the fixing it requires may be done by a plumber, as there is nothing more to do than to connect the machine with a pipe from the street main. One of the motors is said to be working very successfully at the bottom of a colliery shaft near Bolton, the power being supplied by the water pumped up from the pit by the steam engine. A large number of laden wagons are drawn up an incline with great ease by this means. The motion has also been utilized for sawing timber, printing newspapers, etc. — *Iron Age.*

See also Patents: —

Tate, Oct. 31, 1871	No. 120,548.
Backus, Jan. 6, 1874	No. 146,120.
Dobson, Jan. 7, 1873	No. 134,651.
Schmid, Feb. 27, 1872	No. 124,162.
Welch, Dec. 17, 1872	No. 134,115.

See Hydraulic Pressure Engine; Water Pressure Engine.

Water motor . . . * "*Scientific American*," xxxv. 150.

Wa'ter Pres'sure En'gine. See Hydraulic Engine.

Wa'ter-proof Ce-ment'.

Glue	4.
Resin	4.
Red ocher	3, with a little water.

Wa'ter-proof-ing. The Neptunite water-repellent process, owned by the International Chemical Company of New York is founded upon the several patents of Mr. D. M. Lamb. It is applicable to all sorts of textile fabrics: paper, leather, etc., in fact to all goods which it is desirable to protect from the action of water and dampness, and which are liable to mildew and decay.

The effect of the treatment by this process is to render the goods non-absorbent, or water-repellent. The property of capillary attraction possessed by all fibrous goods is destroyed. The pores of each fiber are filled with the Neptunite material and the fiber receives a coating of the same. By the action of heat this is thoroughly incorporated into the fibers, giving them the remarkable properties mentioned.

The action of water upon the fabrics treated is very peculiar. When poured upon the goods the water runs about like quicksilver, without showing any disposition to be absorbed or to penetrate. In the case of open goods like grenadine or even musquito-netting, the water can be made to run about like quicksilver without passing through the open spaces.

The advantages given to the goods are by no means confined to the water-repellent quality. The fibers are made tougher and stronger, and do not crack and disintegrate as before treatment. Goods may be rendered proof against moth and vermin; the colors are imprisoned and fastened: the threads are slightly swelled, giving the goods a firmer and more compact texture. This is peculiarly valuable in the case of silks, giving them a hand and body which cannot be secured except by a large increase of the stock used.

It is well known that rubber waterproof garments are pronounced injurious to health from the fact that they confine the perspiration of the body. In the case of the Neptunite garments, however, the interstices between the fibers are not closed, and a free circulation of air is permitted, but at the same time a perfect protection from the rain is insured. Ladies' waterproofs are now made from thin mohair goods and these light garments will afford the same protection in ordinary showers as the unsightly rubber goods.

The process is of almost universal application and is of great economic importance. It is at the present time extensively used, and must soon come to a general application throughout the country.

The solution used is a colorless fluid produced by the action of certain gases upon hydrocarbons, and is inexpensive. It is better to treat the goods in the piece before being made up, but ready-made garments can be treated, though they are more expensive to handle in quantities.

Waterproof soles, which are either inserted into ordinary leather soles or laid into the boot, are made as follows: A mixture is prepared, consisting of 60 parts of resin, 80 parts of tallow, 5 parts of wax, and 5 parts of turpentine. In this mixture linen is soaked, and is thereby rendered water-tight. The sheet of linen is then united to a sheet of wool by being passed between rollers. On the linen side the sole is now covered with a solution of glue to prevent the resinous surface from sticking to the stockings and shoes in walking.

To waterproof leather: Melt one liter of boiled linseed oil, 125 grams of suet, 46 grams wax, and 32 grams resin together over a slow fire, and apply it to the leather with a brush while warm. This composition keeps the leather very soft. The English fishermen have long been using it. They can remain in the water for hours ere it penetrates through the leather.

For making canvas waterproof: It is very easy to make canvas waterproof, without altering its appearance or pliability, by saturating it with a boiling and strong solution of soap, pressing out the excess of this, and then submitting it for a short time to the action of a hot bath of alum, sulphate of aluminum, or acetate of lead, which operation causes the formation of an insoluble alumina or lead soap, which will permeate all the pores of the texture and make it waterproof.

To render fabrics waterproof, M. Dujardin proposes the following procedure: 335 grams each of potash, alum, and sugar of lead, are to be triturated in a mortar until the mass becomes syrupy, to which is then to be added 400 grams of a mixture of equal parts of finely pulverized bicarbonate of potassa and sulphate of soda. To this mixture there should now be given about 50 liters (about 11 gallons) of rain water, and when complete solution is effected, the same is poured into a vessel containing an oleine soap in solution in an equal quantity of water. This mixture is to be stirred for about 20 minutes, or until complete mixture has occurred. To waterproof a fabric it is necessary only to immerse it, with the hand or by mechanical means, into the aforesaid mixture, and to retain it there until by pressure or otherwise the fluid has penetrated to every portion of it. The fabric is then removed, and after allowing the surplus fluid it retains to drop off, hung up to dry. Afterwards it is thoroughly washed in cold water, and again dried. Goods treated in this way, it is affirmed, are waterproof, but still permit free transmission of air. The colors of the goods are in no wise affected. — "*Journal des Fabricants de Papier.*"

Wa'ter-proof Pa'per. Waterproof paper of superior quality, transparent and impervious to fat, may be prepared by saturating good paper with a liquid prepared by dissolving shellac at a moderate heat in a saturated solution of borax. Paper thus prepared resembles parchment, and may be given any color by the use of aniline dyes.

When a sheet of paper is immersed in an ammoniacal solution of copper and then dried, it is said to become quite impermeable to water, and does not lose this quality even although the water be boiling. Two sheets of paper thus prepared and passed between cylinders adhere to each other so completely as to be quite inseparable. If a large number of sheets so prepared be thus cylindered together, boards of great thickness are obtained, the cohesion and resistance of which may be increased by interposing fibrous matters or cloths. The substance so prepared is quite as hard as the closest-grained wood of the same thickness. The ammoniacal solution of copper is prepared by treating plates of copper with ammonia of the density of 0.880 in contact with the atmosphere.

Wa'ter Sup-ply' for Lo'co-mo'tives. The water tanks of locomotive tenders are usually replenished from elevated tanks at the side of the track, either filled by the natural flow of water from a more elevated source or by means of a pumping engine. In some cases the locomotive itself is caused by suitable connections to operate a pump and draw its own water from a reservoir or well.

Either of these methods involves a stoppage of the train, and to obviate this efforts have been made to render the engine capable of supplying itself with water while in motion.

In 1854 Mr. Angus W. McDonald, of New Creek Depot, Va., patented an invention embracing two different methods of effecting this object.

By one the tank of the tender was to be air-tight, so that after being filled and partially exhausted there would be a partial vacuum within. From the side or bottom of the tank a valved pipe or hose was to be dropped into a cistern of water on or under the road, as the engine passed by, when, the valve being opened, atmospheric pressure would force the water into the tank. The other method was to employ an inclined trough or plane at a suitable angle to dip into the pool of water; the velocity of the train causing the water to ascend into the tank.

The latter plan has since been adopted on some railways. A water-trough of cast-iron sections, 18″ wide at top by 6″ deep, is laid upon the sleepers between the lines of rails at such a level that when full the water surface is 2″ above the level of the rails. A scoop of brass, having a mouth 10″ wide by 2″ high, and turning on a hinge, is, when in normal position, kept elevated by means of a balance weight, but is, when used, depressed, and is kept in this position while the tank is being filled.

The upper end of the scoop and the lower end of the delivery pipe are of corresponding circular arcs, so that the scoop forms a prolongation of the pipe when in position for raising water. The limit to which the scoop may be depressed is adjusted by set screws, and is varied as the brasses and tires of the tender become worn, lowering the level of its body. The trough is cast in lengths of about 6′, so as to rest on each alternate sleeper, and is fixed to the sleepers, its height being adjusted by means of wooden packing. The ends of each length are formed with a shallow groove, made water-tight by round strips of vulcanized rubber, the metal not being in contact. The road at each end is laid with an incline of 1 in 100 for a distance of 16 yards, the trough tapering down to a mere plate to allow the scoop to pass clear in entering and leaving it. At each extremity is an overflow pipe to limit the depth of water to 5″.

The orifice of the scoop is just covered by the water, and its edges are beveled off sharp to diminish splashing. The top edge is carried forward 2″ or 3″, and turned up with the same object. The water rushes into the scoop and up the delivery pipe, which is caused to discharge downwardly in order to prevent splashing.

Wa'ter Thief. A tube for drawing water from a cask, barrel, etc., by the bung-hole. A *bung-bucket*.

Wa'ter Tow'er. A portable stand-pipe for use at fires. This invention of Mr. Logan, a practical machinist of Baltimore, having been brought to the attention of the New York Commissioners they invited an exhibition in that city, and Chief Bates was instructed to furnish every convenience for a thorough test of the apparatus. The test was in every way satisfactory, and all who witnessed the operation of the machine, says the "*Fireman's Journal*," expressed the opinion that it was a practical and desirable adjunct to fire departments.

The water tower consists of three sections of iron pipe mounted on a truck; these sections being fitted together horizontally are raised to a perpendicular position by turning a wheel, an operation easily performed by one man; at the upper end of the tower is a flexible play-pipe, to which was affixed a 1½″ nozzle: at the base of the tower are connections for two lines of hose. Engine No. 20 was at a hydrant at Washington Square, and connected to the tower by two lines of hose. When water was first put through the hose, a coupling flew off and had to be sent to the repair shop to be readjusted. Meantime the steamer played through one line of hose, a splendid fire stream being projected through the tower, the nozzle of which was 51′ above the ground. One man on the truck had perfect control of the stream, and by means of a simple gearing was able to depress or elevate the stream, or turn it in any direction, sweeping the horizon at all points and freely sprinkling the promiscuous crowd that had assembled. At a height of 28′ a branch-pipe is placed and two streams were thrown at the same time, being handled with equal ease and facility by one man. Subsequently the tower was lowered and a short section substituted, having a 1¼″ nozzle and a height of 37′. Two lines of hose were connected, and two streams thrown from the tower to a great height and a great distance horizontally.

The ease with which the machine was handled and its effectiveness excited the admiration of all beholders. Firemen, especially, were enthusiastic regarding it, but wanted to see one 70′ instead of 50′ high, and a 2″ nozzle substituted for the smaller. The advantages offered by this machine are the getting of a solid stream high in the air before it leaves the nozzle without the aid of ladders, and the ease with which it is controlled by one man. Of course no greater power is exerted than is furnished by the engines, but half a dozen streams could be siamesed into it if necessary. At the test the highest water-pressure obtained was 170 lbs., while the owner claims that the tower will sustain a pressure of 300 lbs. at the nozzle. As Commissioner King remarked, a 2¼″ stream delivered at that height under such pressure would be bound to make a black mark on any fire against which it was projected. It would also be of great value in "wetting down" buildings contiguous to a fire, as its range would enable it to sweep both sides of the street and keep the buildings wet from curb to cornice.

Wa'ter Wheel. A wheel turned by the action of water.

Laffineur's "*Treatise on the Construction of Water-wheels.*"
Lowell's "*Hydraulics.*"
Glynn's "*Treatise on the Power of Water as applied to drive Flour Mills, and to give motion to Turbines and other Hydrostatic Engines.*" 12mo. New York, 1869.

Wa'ter Works. For a description of various works for furnishing water supply, see "*Mech. Dict.*," p. 2746.

See also *Colburn & Maw's* "*The Water-works of* "*London.*"
Jacob's "*On the Designing and Construction of Storage Reservoirs.*" 16mo.
Prof Corfield's "*Water and Water Supply.*" New York, 1875.
McMaster's "*High Masonry Dams.*"
Kirkwood "*On Filtration of River Waters.*"
Fanning's "*Water Supply Engineering.*"
McElroy's "*Papers on Hydraulic Engineering.*"
Hughes' "*Water-works for Cities and Towns.*" (Weale's Series.) New edition.
Humber's "*Comprehensive Treatise on the Water Supply of Cities and Towns.*" Illustrated.
Haskoll's "*Water-works, Sewage, and Irrigation.*" Being vol. ii. of "*Engineering Field Work.*" London, 1871.

Wave Mold'ing Ma-chine'. The Ransome wave molder has carriage, feed, and reciprocating scraping cutters. The chisel bar or its connections are elongated to give the stroke, the bar and chisel having a reciprocating motion, but capable of being extended to the depth of the mortise, and yet resisting in its joints the force of the blow.

Wax. The following are some useful recipes for sealing wax: —

Red Sealing Wax, Fine. — Melt cautiously 4 oz. pale shellac in a copper vessel, at the lowest possible temperature; add 1½ oz. of Venice turpentine, previously warmed, and stir in 3 oz. vermilion; pour into metallic molds and allow it to cool.

Red Sealing Wax, Common. — Resin, 4 lbs.; shellac, 2 lbs.; melt; mix in 1¼ lbs. Venice turpentine and red lead.

Black Sealing Wax, Fine. Shellac, 60 parts; Venice turpentine, 20 parts; melt shellac carefully; add Venice turpentine; stir in 30 parts of finely-powdered ivory black.

Black Sealing Wax, Common. — Resin, 6 lbs.; shellac, 2 lbs.; melt. Add 2 lbs. Venice turpentine, and lamp black to color.

Gold Sealing Wax. — Melt cautiously 4 oz. pale shellac in a copper vessel, at the lowest possible temperature; add 1¼ oz. of Venice turpentine, previously warmed; and stir in 3 oz. mica spangles; pour into metallic molds, and allow it to cool.

Colored Sealing Wax. — 4 oz. pale shellac, 1¼ oz. white resin, 2 oz. Venice turpentine; add a finely powdered pigment of the required color.

Bottle Wax. — (1.) Resin, 6¼ parts; beeswax, ½ part; Venetian red or red lead, 1¼ lbs. (2.) Shellac, 3 parts; Venice turpentine, 1½ parts; vermilion, 2¾ parts, or Venetian or red lead, q. s. (3.) Resin, 6 parts; shellac and Venice turpentine, each, 2 parts; coloring matter to suit.

Wax, Graft'ing. This is an article which should be kept on hand ready for use whenever needed, for it is valuable for various other purposes besides that of grafting. All wounds made in pruning trees will heal over much sooner if coated with this wax; and, if a piece of bark is accidentally stripped from a tree, the place should be covered over with it, and the wood will remain sound underneath. A good wax may be made as follows:

Melt in a basin 1 lb. of tallow, 2 lbs. of beeswax, and 4 lbs. of resin; stir well together, and keep in a cool place in the dish in which it is melted. If beeswax is a very costly item, one-third less quantity can be used.

Wax'-thread Sew'ing Ma-chine'. A sewing machine for sewing leather with waxed thread. Such machines are made to work with two threads or with one.

In the single thread machine the needle carries down the thread, which is caught by a looper working in the pillar beneath, and thereby held till the leather is fed forward so that the next descent of the needle will be through the former loop. Provision is made for keeping the waxed thread warm so that it may be flexible. The warming is usually by a lamp which heats a current of air in the duct through which the thread passes. In other cases the thread passage is heated by hot water. The wax is heated by a lamp beneath and the thread is conducted from the spool, through the wax and along a heated passage to the needle.

Way. (*Railway.*) With one exception, the Paris Exposition did not furnish any valuable suggestions of new uses for iron. This exception relates to the introduction of various systems of iron permanent way for railroads, in place of the wooden cross-ties and stringers which are now generally in use.

One of these systems, Hilf's, has been adopted on nearly 1,000 miles of railway in Germany, Austria, Belgium, and other countries. Both the stringers and the cross-ties are of wrought-iron. Other systems, at least one of which substitutes steel for iron, are modifications of the Hilf system. It seems not improbable that one or two of these systems will become popular and even necessary in countries which do not possess an abundance of timber, but at present many objections are made to their adoption. It is alleged that the first cost of an iron permanent way, cheap as iron has become, is much greater than one of wood, and that it is liable to corrode, and is more rigid than wood.

Iron, however, has found new friends in those inventors who have suggested its use in the construction of the so-called permanent way of railroads, and various systems of this new permanent way are now in daily use on the Continent. In Great Britain one or two of them have been used experimentally, and a commencement has been made in shipping iron for the construction of the permanent way of an Indian railroad.

Wear I'ron. The projecting piece of iron fastened to the bottom of a buggy or wagon to protect the wheel from wearing away the body in turning.

Weath'er-board'ing Saw. A combination saw, composed of saw, square, level, plumb, and rule, allowing the carpenter to plumb, space, true, saw, and fit on weather-boarding without other tools.

Weav'ing. The manufacture of fine blankets by the Navajo women is thus described: —

The wool is all spun with the fingers and without the aid of a wheel, the process being very slow and requiring great skill. The colors are all vegetable. As two women spin the warp two others stretch the yarn upon pegs driven into the ground, each thread being as long as the blanket is to be. When the warp is made and arranged, the woof or filling is spun in the same way, and each thread woven in by hand and with the greatest care. In this manner four women make four fine blankets in about three months. The Navajos have not lost the art of weaving blankets. While the men hunt and herd cattle and sheep, the women spin and weave blankets for their own use and for sale. Some are coarse and can be purchased for from $3 to $6, but others are so fine and tightly woven that they will hold water like a rubber poncho, and sell for from $25 to $75 each.

Diagrams showing the principles of various *armures* or dispositions of the harness for twills, satins, etc., may be found in *Laboulaye's* "*Dictionnaire des Arts et Manufactures,*" article "*Tissage,*" vol. iii., ed. 1877.

We'ber. (*Electricity.*) The practical unit of quantity (1 weber — $\frac{1}{10}$ (C. G. S.)). — *Ampère.*

The practical unit of resistance is called the ohm or B. A. unit (1 ohm — one billion absolute electromagnetic units). (1 ohm — 10^9 (C. G. S.).) — *Gordon.*

We'ber-me'ter. Edison has lately patented a "webermeter." This is an instrument for measuring the amount of electric current flowing through a circuit, or in other words a meter for electric currents to tell the number of webers that have been supplied.

Wedge. (*Nautical.*) One of the supporting blocks of a ship on the ways.

Wedge Cut'ter. A dentist's cutting pliers to excise the ends of separating wedges, inside and outside of the jaw.

(*Carpentry.*) A combined relisher and wedge cutter for relishing the rail of a door and cutting the wedges at one operation. The first arbor is perpendicular, the second upright arbor is thrown forward on the right angle to give the bevel to the wedge, and can be adjusted to give different bevels to accommodate different widths of tenons, or can be moved to a perpendicular. The two horizontal arbors are adjusted by screws, and can be moved up and down to cut any width of relish. The two small saws are fastened on end of arbors with screws, the heads being flush with face of saws. The sliding bed moves the length of machine on tracks. The rail to be relished is placed on its worked edge, on the bed, with shoulder against the stop (which can be adjusted to any depth of cut), and run through machine, thus cutting the relish and wedge in one movement. One man can relish the rails and make the wedges for 1,000 to 1,200 doors in ten hours.

Wedge Valve. A wedge-shaped valve driven to its seat by a screw. Used in closing mains, etc.

Weed'ing Hoe. One style is made with three small triangular blades or shares which cut the weeds off at the surface of the ground, or lower, and are adjustable laterally to cut all in one broad row, or spaced apart as desired.

Weed Scythe. See BRAMBLE SCYTHE.

Weigh Can. A can containing a liquid, resting on scales. The indicator is fixed at the present weight less the amount wanted; the faucet is opened, and when the beam rises the flow is cut off.

Fig. 2530.

Weighing Scoop.

Weigh'ing Ma-chine'. Figs. 1423–1425, p. 486, *supra*, show a convenient form of hydrostatic scale for weighing in transitu.

See also STEELYARD, TRACK SCALE, PLATFORM SCALE, SUSPENDED SCALE, etc.

Weigh'ing Scoop. Mery's scoop has a spring balance located in the scoop handle, scale and pointers on the handle, and a stop so arranged as to save the spiral balance spring from damage when the scoop is thrust into any hard, unyielding material.

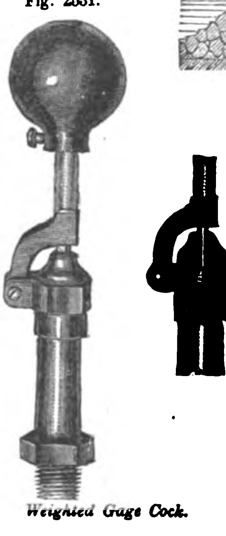
When the scoop is in use the handle is naturally grasped so that the thumb is directly over the stop *L*, and a slight pressure on it when the scoop is thrust into any material prevents the stem from being pushed down upon the spring, and causing any damage to it. The combination of handle and stem is made stiff and unyielding by reason of the stop, thus facilitating the scooping up of any hard unyielding material.

When the material to be weighed is raised up in the scoop, the stop is released and the balance, being free to act, the weight of the material will show on the scale. This arrangement of scoop and scale gives two useful articles in one, and is very serviceable where a large amount of material has to be divided by weight into small quantities.

Weight'ed Car'riage Lathe. One in which the carriage rest is held down by a weight.

Weight'ed Gage Cock. One in which the piston or valve is held to its seat by a weight. See Fig. 2531.

Fig. 2531.



Weighted Gage Cock.

Weight'ing. Loading silks, cotton, and other goods with foreign substances in dyeing, to give them body and weight. This fraudulent practice is resorted to in many cases, the principal weighting material used being chloride of magnesium. Sulphate of magnesium (Epsom salts), oxymuriate of tin, sumac, galls, gums, sugars, salts of lead, oxides of iron, and other articles of a similar kind are used by unscrupulous dyers to give to silk an artificial weight, regardless of the fact that the goods are seriously damaged thereby, for use.

Weir. A dam across a stream to raise the water to a higher level, either for milling, fishing, or navigating purposes.

The rivers Seine and Yonne have been made navigable for small vessels, between Paris and Auxerre, by a system of weirs which give a minimum depth of about 5′.

This has been accomplished by building 34 movable dams, with side locks, and also making three cut-offs; every cut-off has a guard-gate at its head to keep out the flood water, and a movable dam, without a lock, is built across the river just below each gate. See BARRAGE, p. 76, supra, and Plate IV.

The above operations have served to convert the two rivers into a series of navigable pools. Rivers so converted are said to be canalized.

Each weir, 150′ wide, is composed of a fixed and movable portion, the fixed part consisting of a mass of béton, faced with masonry, poured between two lines of sheet piles with an interval of 25′ between the lines. This mass rises to within 3½′ of the upper bay level. This fixed part is surmounted by 33 movable gates 5′ wide, with their tops, when they are up, at 3½′ above the permanent portion. These gates were designed by M. Desfontaine, and called by him *hausses à tambour*, or drum gates.

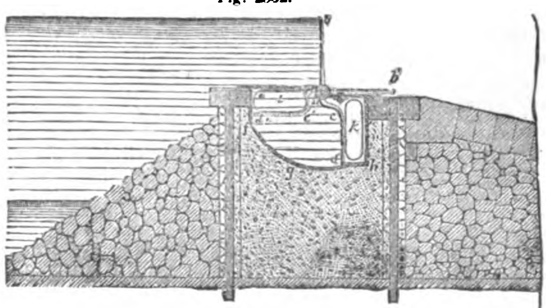
The object was to operate the dam by utilizing the power produced by the fall itself.

The moving apparatus, Fig. 2532, consists of a series of gates, independent of each other, and turning around a horizontal hinge, *a*, placed in the middle. The upper half, *a b*, is the *hausse* or gate, properly so-called; it is this which forms the upper bay. The lower half *a c d*, called the counter *hausse*, has no other function than to carry along the *hausse* in the movement impressed upon itself. It is inclosed in a quarter of a horizontal masonry cylinder of the same length, whose axis coincides with the hinge, and in which it can consequently make a quarter of a revolution. The horizontal one is slightly raised parallel to itself, and the vertical one has been similarly moved back, so as to leave the empty spaces *l* and *k* between the drum and the extreme positions of the counter *hausse*.

By admitting water from the upper bay into the chamber *l*, when the bay is full, the gates are revolved on their axes, and the bay emptied as far as desired. The admission of the water into *k* raises the gate again.

The simplest form of a *fish weir* consists of a fence of brush

Fig. 2532.



Weir.

driven into the sand or mud and forming a curve concave to the ebb of the tide. As the water runs off, becoming more shallow, the fish in the inclosure are detained and are captured when stranded.

A *dry* weir is one on a flat left dry by the ebb of the tide.

Weirs are called *slat* weirs or *brush* weirs when made of boards or brush respectively.

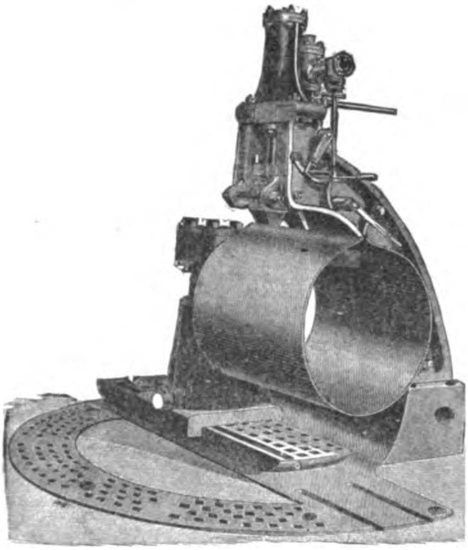
Weirs may have leaders of brush or slats and pounds of net, or the heart and net may be of brush below and netting above.

Weir and *pound* are almost synonymous terms.

Weld'ing. A welding block mounted on the long slide, carries a welding bar, upon which saddles may be fitted for different diameters. The block and bar carrying the flue are traversed along the bottom slide, and as much length as can be heated may be welded at once. See Fig. 2533.

Weld'ing Tubes. Herr Krupp, of Essen, Germany, has recently patented in Germany a method of welding tubes and tires. He draws the tube over one of a pair of ordinary rolls, and then heats

Fig. 2533.



Welding Hammer.

the whole length of the portions to be welded by a special contrivance, which is a portable fire-box, into which air is so blown that the heat is directed against the weld. After the necessary heat is attained the rolls are set in motion and the place to be welded is repeatedly drawn through them. His heating apparatus could, we believe, be replaced to advantage by some gas apparatus similar to that used for heating wagon tires in this country and in France.

Well-bor′ing Tools. The tools used in well-boring may be classed under five heads.

1. Drills, acting by percussion.
2. Augers, for boring by rotation.
3. Reamers, for enlarging the hole.
4. Sand pumps, for extracting detritus or soft material.
5. Grabs, for recovering fallen or broken tools, rods, or tubing, and for raising or lowering rods or tubing.

The simplest plan for operating boring tools is the Chinese; the tools are suspended from a rope which is worked vertically and imparts by its torsion a circular motion to the tool. The well is tubed as the work progresses. This plan, while it has the merit of simplicity, is liable to the objection that the tool is apt to follow fissures, to avoid nodules and hard seams, and thus become deflected from the true course.

The usual mode of boring is to attach the boring tool to the end of a section of rod, which, as the work progresses, is lengthened by the attachment of other rods, which are in lengths of from 10′ to 20′. A vertical reciprocation is given to the drill stock by attachment to a walking beam, by a lever or by other means, and a certain amount of rotation being imparted to the tool at each stroke causes it to fall in a fresh place at each impact.

The tool acting upon the rock, or the scoop upon the sand, gravel, etc., accumulates a quantity of *débris* which requires to be withdrawn from time to time, the rod being lifted and unscrewed, section by section, and the *débris* removed by sand pump if the tool itself has no provision for withdrawing it. The sections are then again attached and the tool lowered to its work.

The loss of time entailed by this plan, in the raising and unscrewing, emptying, reattaching, and letting down has given rise to a number of inventions designed to withdraw the *débris* as it is made. For this purpose was suggested a downcast and upcast current of water circulating through two tubes or on each side of a partition in a single tube. Another device, patented in England in 1844, by Beart, was to make the rods hollow, with water-tight joints, and then introduce a downcast current of water which carried the *débris* up the space between the rod and the wall of the well.

Pumps of various kinds have been contrived, designed to accomplish the same purpose, and other inventors have made hollow drill-rods with a succession of valves, the water and *débris* being supposed to work their way from section to section upwardly by means of the forcible contact of the tool with the yielding strata.

When danger is apprehended from the weight of the drill-rod, a slide-joint may be made which will limit the percussive action to one or two sections at the lower end of the rod while the portion above the joint is counterbalanced so as not to be involved in the blow.

This slide-joint is the invention of Œuyenhausen.

See full-page plate of well-boring tools, p. 2758, "*Mech. Dict.*"

Well Smack. A perforated submerged cage attached to the bottom of fishing smacks for transporting the fish to market alive.

Welt Ma-chine′. A machine to cut leather, cloth, etc., into a series of parallel strips to be used as welts in side seaming. The material is passed into the machine irrespective of its width, the end knife separating the portion not cut into strips before it can be carried against the standard.

Well′-wheel Block. A grooved pulley for the cord of the well-bucket to run over. It has a hook for suspension and anti-friction rollers for the axis.

Wet and Dry Plates. The wet plates used in photography and prepared by the photographer at time of taking a picture, are being largely superseded by the dry or gelatine plate, which can be prepared or bought in advance, and carried around for taking views, or other pictures. These dry plates are practically instantaneous. See work by J. Traill Taylor, published by the Scovill Manufacturing Co., New York.

Wet Broke. (*Paper.*) The moist and imperfectly felted stock or pulp as it leaves the wire cylinder and before being smoothed out on the forwarding blanket.

Wha′ling Ap′pa-ra′tus. For list of U. S. patents on whaling apparatus, harpoons, bomb-lances, rockets, and explosives used in fishing and whaling, 1838–1879, see HARPOON.

Wha′ling Gun. Off the Norway coast, near Wadso, whales are killed by the use of a gun invented for the purpose.

The gun has a chamber about four feet long, is mounted on the forecastle of the vessel, and, being balanced, can be easily moved to allow aim to be taken. The projectile in use consists of a long iron bolt, having at its extreme end four harpoons bound round with a line so as to be flat, and close to the harpoons a five or six pounder shell. As soon as the steamer has approached sufficiently near to the fish, the bolt is fired off, and, if well directed, penetrates deeply into the flesh and blubber of the animal. The whale rushes off at a furious pace, and the effect of his rapid movement is to make the bolt slip back a little, thus setting free the four harpoons from the lines, and, by means of a mechanical arrangement, causing the shell to explode. This generally proves the *coup de grace*.

A fire arm or small cannon hurling a bomb, harpoon, or lance. Patents: —

Brand	June 22, 1859.
Pierce	1865.

See also HARPOON GUN.

Wha′ling Rock′et. A projectile carrying harpoon, line, and explosive, used in whaling.

The Roys rocket has a strong brass cylinder containing the projectile charge. In the front of this is secured a bomb containing an explosive charge, and inside of it is a harpoon attached to the shell. To the rear end of the rocket, is attached the whale line. The bomb has a bearded or barbed point, and when projected into the whale by the rocket explodes, inflicting a fatal wound, the harpoon takes its hold, and the boat is fastened to the whale by the line. These shots are good for killing and fastening to a whale at 30 fathoms distance. The whole apparatus weighs 32 pounds, and is 6′ 6″ in length.

A peculiar rest is used in firing, having on it a shield to protect the operator from the fire which issues from the rear end of the rocket. The rocket is set in the rest, the rear end of which is placed on the shoulder, and by discharging a pistol charge into a hole provided for the purpose, the projectile is discharged and the rocket powder carries the rocket, bomb, and line in the direction required.

Whale'men's Tools, Knives, etc. *Blubber Fork.* Used for tossing blubber into the try kettle.

Blubber Hook. Used in hauling small pieces of blubber on deck.

Blubber Knife. For cutting up blubber for trying out.

Boarding Knife. For cutting the blanket-piece of blubber or long piece which is flensed or peeled from the sides of the whale.

Boat Spade. Used from the boat to disable the whale by cutting its flukes.

Boat Hatchet. Same use as *boat knife.*

Boat Knife. To cut the harpoon line when it becomes tangled in paying out. Kept in its sheath on the bulkhead of the whale-boat, ready for use.

Cutting Spade. Used in peeling the blubber from the carcass of the dead whale. Known as "cutting in the blubber."

Half-round Spade. For cutting the "blanket" piece, to allow blubber hook to enter.

Head Knife. For cutting off the head of the whale; opening the skull to obtain the spermaceti; removing the baleen, etc.

Head Spade. For cutting off the head of the whale.

Junk Hook. Used for hauling heavy pieces of blubber on deck.

Lance. To give the whale its death thrust.

Line Hook. A hook for catching the line.

Lip Hook. A grapnel for catching in the whale's lip, to tow it to the vessel.

Mincing Knife. For cutting the blubber into small pieces.

Mincing Spade. For cutting the blubber into small pieces before trying out.

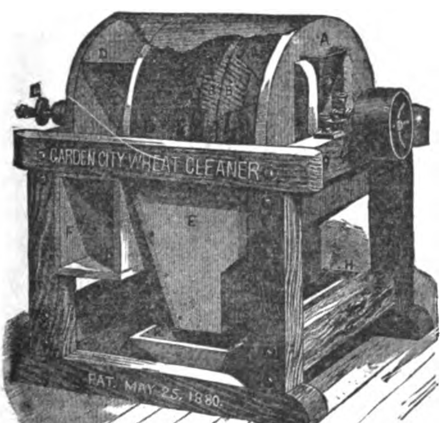
Throat Spade. Flat with a round shank. Used in cutting off the head of the whale.

Whaling Gun. A fire arm or small cannon hurling a bomb, harpoon, or lance.

Wide Spade. Used in the blubber room for cutting blubber in the rough, before mincing.

Wheat Brush. A device for scouring grain. The illustration, Fig. 2534, shows two bristle brushes, with the bristles inclined. One of the brushes revolves while the other is stationary. The wheat enters the hopper *A* and passes to the center between brushes B^1 and B^2, whence it is carried by centrifugal force to the periphery of the brushes, when it falls into the air-chamber *E*, whence the dust is removed by the suction created by fan *D*.

Fig. 2534.



Wheat Cleaner.

Wheat Crack'er. (*Milling.*) A mill for making grits. See Grits Mill.

Wheat Damp'en-ing and Dry'ing Machine'. Apparatus for washing and cleansing smut and dirt from grain, and drying the wheat when washed. See Grain Washer.

Wheat Drill. See Grain Drill.

Wheat Gra'der. A machine for separating the perfect from the imperfect grains, and for sorting out long from round grains, or removing dirt, stones, etc., from grain. See Grain Separator, Stone Cleaner, Wheat Separator.

Wheat Heat'er. (*Milling.*) An apparatus for heating grain before grinding in order to facilitate the loosening of the bran coat. It is usually some form of steam heated chamber, and in Welch's wheat heater, it has a perforated steam ring for damping the grain also, if desired.

It has an interior iron cone, heated by one steam-pipe, and a frusto-conical steam coil a short distance outside of the cone. The live steam pipes of each are above and the waste below. The wheat enters the machine and passes down the channel between the conical coil of pipe and the central iron cone, which is notched on the outside, spreading out and passing through a series of openings in the bottom, where it is collected by the hopper at the bottom of the machine, and spouted to the burrs. The ring just below the wheat induction opening is for steaming the grain, when required: the pipe having its own valve. The space outside the steam is packed with asbestos to prevent radiation of heat. The length of the apparatus is 26.5″. Capacity, 15 bushels per hour.

Several forms of apparatus may be found under the following references:—

Provost, "Victor"	* "*American Miller*," vi. 148.
Gratiot	* "*American Miller*," v. 83.
Price "IXL."	* "*American Miller*," v. 83.
Fulton	* "*American Miller*," vi. 277.
Osborne	* "*American Miller*," vi. 148.
Deal	* "*American Miller*," viii. 237.
Welch	* "*American Miller*," viii. 287.
Palmer	* "*American Miller*," viii. 461.
Hunt	* "*Leffel's Milling & Mech. News*," vii. 4.
(Steamer)	"*Leffel's Milling & Mech. News*," ix. 89.
	"*Scientific American*," xlii. 152.

Wheat Mag'nets. Fig. 2535 shows forms of magnets for inserting in the mill spouts to gather the pieces of wire that may have gotten in from the use of wire binders or other sources.

Fig. 2535.

Wheat Magnets.

Wheat Rid'dle. See Separators, full page of plates, p. 417, *supra.*

Wheat Scour'er. (*Milling.*) A machine which follows the smutter.

It consists of a stiff brush, against which and below, a grooved burr-stone is made to revolve, the wheat passing between the brush and burr-stone. It serves to remove still adhering hairs and loosened portions of the outer bran, and presents, after passing through a blower, a berry of remarkable smoothness and look of purity. By this process, some varieties of wheat lose, beside the hair, portions of the outer layer of true bran, traces of the cigar-coat, and scales from the surface of the embryo.

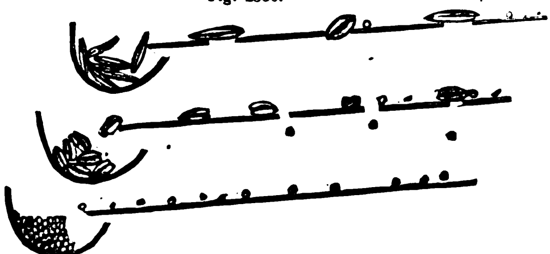
To effect the same end in other mills, the wheat is passed between a grooved steel cylinder and a segment of a stone shell in which the abrasion of the surface of the wheat and the partial removal of the outer bran coat are effected.

Another form has a cylindrical grater operating against a surface of stone. The wheat enters the machine at a spout and comes in contact with a system of cast-iron spiders. Passing through in a spiral form, it is discharged. The screenings are delivered from one spout and the dust from another. The separation can be adjusted by a movable valve.

Wheat Sep'a-ra-tor. The separation of mustard, cockle, and grass seed from the wheat is effected by passing the mixed grains over inclined plates perforated with holes large enough for the smaller seeds to pass through but not large enough for the wheat.

The oat-grain is separated by taking advantage of its elon-

Fig. 2536.



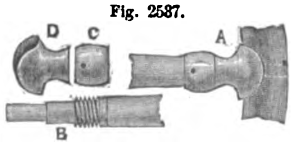
Wheat Separator.

gated form. The mixed oat and wheat grains are discharged in a thin sheet upon an inclined, jogging, thin, iron plate, perforated with round holes, at intervals nicely determined by experiment, abundantly large for the ready passage of both the wheat and oat grains if presented end foremost perpendicularly to the surface of the plate. But as the plate is inclined, each berry must be tipped forward in order to enter a hole. An individual hole is of such diameter that when the wheat-grain sliding forward carries its center of gravity beyond the support of the upper edge of the hole, there will be room for the prow, that is, the forward end of the grain, to sweep downward through the hole without striking its lower margin, and thus the wheat-grain be separated. The oat-grain, however, in sliding down the inclined plane, before the center of gravity has passed beyond the support of the upper margin of the hole, will, by reason of its prolonged hull, extend over the lower margin of the hole, and thus fail to fall through. As the oat-grain advances, the center of gravity will pass beyond the lower edge of the hole and gain the support of the continuous surface before the tail of the berry will have lost the support of the upper edge.

Wheel. (*Vehicle.*) A circular frame supported on an axis, distinguished from a roller by the axle bearing the stress.

Fig. 2537 shows the Raddin elastic adjustable iron and wooden spoke for carriage wheels.

Fig. 2537.



Adjustable Spoke.

The cut shows the manner the felloe is expanded to set the tire. *A* represents a spoke and felloe, with clasp and nut ready to be expanded to set the tire. *B* shows a spoke with screw-thimble to receive the nut *C* and hasp *D*. By turning the nut on each spoke the felloe is expanded, the tire is set, and the wheel made round, which cannot be done by the ordinary method.

Smith's wheel has a metallic hub with the spokes clamped between collars. The outer collar is held on by a jam nut and a loose spoke can be replaced without removing the tire.

The spokes in the Watson wheel pass through a metallic collar encircling the hub, the two parts of which are joined by connecting pieces which form wedges to spread and tighten the spokes as they are driven in.

Wheel Cut'ting Ma-chine'. A device for dividing a circle into any number of equal divisions.

Wheel cutting machine.
Scott . . . . . . * "*Engineering*," xxiii. 381.
Wheel cutter bevel.
Grube . . . . . * "*Scientific American Sup.*," 450.

Wheel En-gra'ving. (*Glass.*) As distinguished from sand-blast engraving or acid etching. See GLASS ENGRAVING.

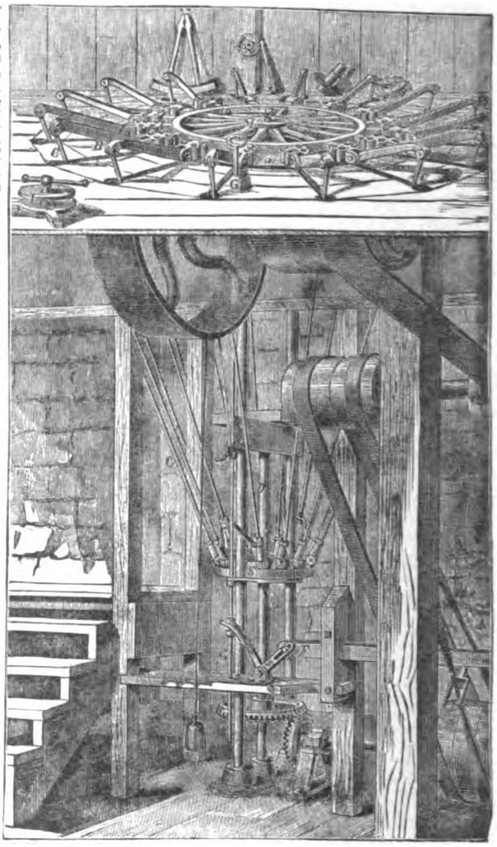
Wheel Hoe. One, or a series of hoes, mounted on a wheeled frame, and adapted to be pushed by hand. Revolving disks are sometimes interposed between the plants and the hoes to prevent the plants being smothered with earth.

Wheel Joint'er. For trimming the joints of staves, heading, etc. See HEAD JOINTER, *supra*.

Wheel-ma'king Ma-chin'e-ry. Apparatus for pressing hub, spokes, and felloes into a solid wheel at one operation.

Fig. 2538 shows Archibald's wheel machine, which occupies space upon two consecutive floors. A strong circular plate of cast-iron, about 7' diameter, having its upper surface faced off true, is placed horizontally level with the second floor. Arranged at equal distances around its outer edge are a number of levers, *B*, equal to the number of spokes to be set in the wheel, having their fulcrums securely bolted to the plate. The long arms of the levers radiate from the plate, about 8' all around; the short arms are formed into cams, or rolling inclines, or curved wedges, acting upon sliding pieces of cast-iron, which move freely in a radial direction, in guides formed in the fulcrum blocks. When the long arms of the levers are raised, the sliding pieces are pressed outwards by springs until they bear upon the cam-shaped short arms of the levers at the point nearest the fulcrum or center of motion of the lever. When the long arms of the levers are lowered, their sliding pieces are forced inwards by the cams, and unite in pressing inward the wheel. The levers are actuated by means of wrought-iron rods, *C*, extending downwards from the ends of the levers, converging to a vertical column, *D*, under the center of the plate, much as the braces of an umbrella extend downwards from the ribs to the stick. A screw is cut upon the central column, and a nut, *E*, answering to the slide upon an um-

Fig. 2538.



Wheel Machine.

brella stick, raises or lowers all the levers at once, with great facility, and with any required power. Motion is given to the nut by means of beveled gears, and a belt with fast and loose pulleys, so arranged that at the upward and downward limits the belt is thrown automatically upon the loose pulley, and the motion of the nut and levers stopped. Any required motion, either up or down, within the range of the screw, can be obtained with great delicacy and convenience by a shipper, *F*, actuated by a shipping-rod, *G*.

Wheel Plow. One having a wheel in adjustable standards depending from the front end of the plow-beam to regulate the depth of the furrow.

Wheel plows.
Ransome, Br. . . . . . * "*Engineering*," xxvii. 486.
Wheel plow, *Howard*, Br. . . * "*Engineering*," xxx. 49.

Wheel Press. A hydraulic press for forcing car-wheels upon their axles.

Wheel Ribs. Projections on the inner side of plate car-wheels to strengthen them.

Wheeled Scra'per. One mounted on trucks to scrape and level newly-dumped dirt on railroad tracks.

Wheel Seat. The part of an axle inclosed by the hub of a wheel.

Wheel'wright Ma-chine'. A machine for doing the different varieties of work necessary in the forming of a wagon wheel.

Some forms will plane wagon or buggy rims when on the wheel, and plane the periphery of a rim made of sections (*i. e.*, sawed felloes), so that each section shall have a true circle of its own, greater than the circle of the wheel, forming what is known in the trade as swelled joints, without which such wheel would be deficient, as the rim is always inclined to dent in at the joints of the felloes. The amount of irregularity can be varied, and is quickly changed so as to plane a bent rim to a true circle.

The rim planer will also plane stuff straight, out of wind, square, and to thickness (and 8″ wide with an extra cutter-head of this width). The upper table may be taken off its hinges without removing a bolt, and a saw board substituted, making an adjustable saw table for rip-sawing or cutting-off, the cutter-head being exchanged for a saw.

The machine thus fitted, and furnished with back-top, adjustable fence and bevel rest, patent gaining and saw frame, is a complete universal wood-worker, without interfering with the rim planer.

On the opposite side, when desired, is attached a spoke saw and wheel tenoner, with or without a boring table. It can be changed to a boring machine without the use of a wrench.

Two men may operate on the machine at the same time, one on the front side and the other on the opposite side.

A horizontal shaper may be made of the rim planer, which will shape, round, and corner all ordinary work.

Whelps. 1. (*Nautical.*) The projecting ribs of a capstan, around which the rope is wound, generally of the form of a frustum, to keep the rope from becoming jammed against the pawl.

2. The teeth or projections of a sprocket wheel.

Whet'stone. A report on this subject by *J. M. Safford* is given in that of Group I., "*Centennial Exhibition Reports*," vol. iii., p. 172, *et seq.*

Whin. (*Mining.*) A machine for raising ores and refuse.

Whip Crane. That form of crane in which the winding rope passes over the periphery of a larger wheel, on whose barrel axis the lifting rope coils itself. Such cranes are independent on rooted posts or are supported above according to the exigencies or facilities of the case; the latter swings completely round, is fitted with three purchases or speeds of lifting, and with break apparatus for lowering. Weights up to 600 lbs. are lifted quickly by pulling directly upon the rope; for weights up to one ton the handle is put on the rope-barrel shaft; for heavier loads the handle is put on the pinion shaft.

The upright and jib are of pitch pine timber, with cast-iron shoes, top and bottom, wrought-iron pivots, and square cast-iron plates for fixing to floor and beam. The jib is fitted with cast-iron bracket and jib-head and wrought-iron tie-rods to the top pivot casting.

Whip Gin. A simple tackle-block, over which a hoisting-rope runs. Also called *gin block* and *monkey wheel.*

Whip on Run'ner. (*Nautical.*) A tackle with two single blocks, one a standing and the other a running block. The fall of the standing-block is spliced round the block of the lower whip. A *whip-on-whip*. *b* Fig. 6159, p. 2480, "*Mech. Dict.*"

Whip'ping. (*Nautical.*) Tying or binding with twine the end of a rope to prevent its untwisting. For list of *whipping*, *lashing*, *seizing*, etc., see SEIZING.

A Spanish whipping occupies an intermediate position between a knot and a splice, and gives a very neat finish to a rope's end. Unlay the rope for 12″ or 15″ and make a crown with three strands. Then carry the strands severally through the body of the rope, downward, as in a short splice, gradually tapering the strands away. In making a Spanish whipping, as in splicing of all sorts, — the long splice excepted, — a marlinespike must be used to open the body of the rope to receive the ends of the strands.

Whip Ma'king. For method of covering whips, see BRAIDING MACHINE, p. 355, "*Mech. Dict.*," and for history, etc., see WHIP, p. 2769, *Ibid.*

The main items of expense in whip making material are rattan and whalebone. The rattan is imported from Batavia and China. The qualities which are too soft, or otherwise unfit for use in whips, are sorted out and sold to the basket-makers. The fine strips which make up the stock of a whip are split out first by hand, and afterwards worked down by drawing them through a shave, which can be gaged. The whalebone is already split when imported.

The main part of most whips is composed of nine pieces. The whalebone is in the center, surrounded by the thin strips of rattan, and secured in place by glue. This compound stock is dipped in glue so that every part is permeated by it, and then run through a machine, which winds it with a strong thread from end to end. It is again wound with rope, so that it cannot warp out of shape, and left to dry. A peculiar turning lathe gives a smooth finish and even taper from butt to tip.

The thread covers are plaited on to the stocks by machines, which are wonders of ingenuity; some carrying as many as 24 spools. Some of the better grades of whips have this cover made of fine gut, prepared from sheep entrails. Sometimes a portion is worked on by hand, and fancy designs in colors, or the owner's name is introduced. A great variety of sticks is used for the stiff portion of the stock, many of them being very handsome, and include the holly and other ornamental woods. The Malacca cane, which grows in the Dutch East Indies, and is imported, is also used largely.

Fine lashes for stage drivers, teamsters, or tandem whips are plaited out of the best California deer skin. They contain from 4 to 24 strands, and are from 4′ to 16′ long. Horse-hide answers for the cheaper grades used by cartmen and others.

Plaiting lashes well can be done only by careful and experienced hands and is all piece-work. Much of it is given out to be done at the homes of the operatives.

Whis'ker Gaff. (*Nautical.*) One of the spars rigged out from the bow to spread the guys of the jib-boom. Also called a *sprit-sail gaff.*

White Brick. A process for the manufacture of white pressed brick from common red clays, consists in mixing or grinding into the common clay a cheap material, chiefly magnesian limestone, which has been reduced to an impalpable and harmless powder by being burned and slaked.

This compound is passed through a series of mixing and grinding mills, and so completely ground that it leaves the last mill reduced to a fine powder; in this state it falls through the feeder into the molds of a powerful steam-pressing machine, is subjected to a heavy pressure, and is delivered at the delivery table a complete and almost dry pressed brick, which, when burnt in the kiln, produces a white brick of good quality. The ingredients added to the clay at once absorb about 40 per cent. of the moisture found in the natural clay, and the grinding is so close and complete that the mixture is thoroughly and evenly amalgamated. The change effected in the color of the red clay on being burnt is due to the presence of the mixture.

White Bronze. A name given to either of several light-colored bronzes. See NICKEL BRONZE; MANGANESE BRONZE. See list under BRONZE.

White Cloud Il-lu'min-a-tor. A round piece of plaster of Paris fitted on the microscope, reflecting a white beam of light, often used instead of the ordinary mirror.

White Glass. (*Glass.*) A term used in England to distinguish certain brilliant uncolored glass from *flint* glass, which has lead in its composition. See FLINT GLASS, CRYSTAL.

Whi'ten-ing. (*Leather.*) The leather is laid over the beam, and with an extremely fine-edged knife a thin shaving is taken from the flesh side.

Whi'ten-ing Ma-chine'. A buffing machine, operated by power, to buff, whiten, or flesh leather in finishing.

Whit'worth Steel.

One of the most interesting of the British steel exhibits at the Paris Exhibition, 1878, was that which embraced various samples of the "Whitworth metal," to which much importance has been attached in Great Britain in connection with the manufacture of ordnance and other articles by the Siemens and Siemens-Martin processes. The exhibit was large, and of a character to favorably impress the visitor. The metal is made of more than ordinary solidity and tenacity by being cast under hydraulic pressure. Cannon and shells of this metal are said to withstand the severest tests, a claim that received confirmation from some of the samples submitted. A propeller shaft was exhibited, forged hollow, which it was claimed was much stronger than a solid wrought-iron shaft of the same size and weighing one-half more. This shaft, forged from a hoop of compressed steel, was 33′ 7″ long, the outside diameter 17½″, and the diameter of the bore 11⅝″. A hydraulic cylinder of this metal was shown which was represented to stand a pressure of four tons to the square inch. For machine tools, in which strength combined with lightness is desirable, the compressed steel is claimed to have no equal. Sir Joseph Whitworth's aim has been to produce a steel that would be free from blow-holes, and this result he has accomplished by mechanical means. A similar result has been claimed by the Terre Noire Company, in France, through chemical combinations.

White'wash. A good durable whitewash is made as follows: —

Take half a bushel of freshly burnt lime, slake it with boiling water; cover it during the process to keep in the steam. Strain the liquid through a fine sieve, and add to it 7 lbs. of salt previously well dissolved in warm water; 3 lbs. of ground rice boiled to a thin paste and stirred in boiling hot; ½ lb. of powdered Spanish whiting; 1 lb. of clean glue, which has been previously dissolved by soaking it well, and then hanging it over a slow fire in a small kettle, within a large one filled with water. Add 5 gallons of hot water to the mixture, stir it well, and let it stand a few days covered from dirt. It must be put on quite hot. For this purpose it can be kept in a kettle on a portable furnace. About a pint of this mixture will cover a square yard.

A recipe almost identical is recommended by the Treasury Department to all lighthouse keepers. It answers for wood, brick, or stone.

Wide Spade. (*Whaling.*) Used to cut the blubber in the rough, before mincing.

Wil'low Cur'tain. (*Hydraulic Engineering.*) A device to curb the rapidity of streams and induce deposit of sediment. Its action is similar to the FLOATING BRUSH DIKE, which see. See also FLOATING WIRE DIKE.

The willow curtain is made of willows 1″ to 2″ diameter, and fastened parallel to each other and 6″ to 8″ apart, by means of wire. It is made of any desired width and length and anchored in position in the stream by weights attached at intervals along the lower edge, and sustained by buoys made fast to the upper edge. — "*Report of U. S. Engineers,*" 1880, pp. 1452, 1459.

The tools and methods are well shown in the "*Chief of Engineer's Report,*" 1879, *ii. 1074, *et seq.*, Plate IV.

Winch. A hoisting machine operated by hand, crank with gearing, and tackle, which should always have a follower or dog, as a safety-brake.

Wind Fur'nace. (*Metallurgy.*) One depending upon the draft of a chimney, as distinguished from a blast furnace.

Wind Gage. A gage attached to a gun to indicate the strength of the wind and enable the person using the gun to make allowance for the deflection of the ball in its flight to the target.

Wind'lass. A drum revolving on a horizontal axis for raising heavy bodies. A capstan has a vertical axis.

Win'dow Bar. A bar intended as a security against children falling through an open window or door. It is so constructed by reversible screws at each end that it can be extended or contracted to fit the doorway or window.

Window Glass. Common window glass is made by the blowing and whirling process. Plate glass is run into molds, ground, and polished.

The irregular thickness of the Pompelian window glass shows that it could not have been blown, and M. Bontemps is of the opinion that it was cast in bronze frames.

The analysis shows the following composition: —

Silica	69.48
Lime	7.24
Soda	17.31
Alumina	5.55
Oxide of iron	1.15
Oxide of manganese	0.89
Oxide of copper	trace

Window glass in wooden frames in France under Louis XIV.

Window glass in use in England, XIIth century.

Window glass in royal palace in Edinburgh, 1661.

Painting on glass in Abbey St. Denis, XIIth century (Le Vieil).

Painting on glass in Abbey Leroux, Anjou, 1121.

Painting on glass in Abbey Tergernsere, Bavaria, Xth Century.

See CROWN GLASS, CYLINDER GLASS.

Win'dow Mir'ror. A mirror mounted outside the window, and capable of being adapted at any angle to reflect the passing objects in the street, to the view of persons inside the house.

Win'dow Op'en-er. A lever or rod by which a window, ventilator, sash, or panel in a clear-story is held in any desired position.

Win'dow Sec'tor. A bar or plate of metal of the form of part of a circle, and which is used as a guide or stop to control the movement of a clear-story window.

Win'dow Tube. A glass or hard rubber tube forming a passage-way for an electric wire into a building.

Wine Heat'er. A machine to preserve wine after it has acquired its best condition from its natural fermentation, against secondary fermentation, and all diseases which arise from the development within the wine of animo-vegetal parasites, such as bacteria, vibria, mycodermi aceti, etc. It is simply the mechanical application of the well-known and well-established theory of M. Pasteur, the eminent French chemist, that subjection of any fermented liquor to an instantaneous heat of 45° to 55° centigrade (112° to 131° Fahr.), or to a slowly acquired temperature of 65° to 75° centigrade (149°

to 167° Fahr.) will destroy or render inert all germs of fermentation or of animo-vegetal life existing therein.

Wine Press. In the common form used in France the main characteristics are the exact arrangement of the gearing on the nut. The inventions of Mabille frères, Marmonier, Primal, and others differ.

The crate is made of a cylindrical series of slats, hooped and latched. Rising from the bed of the machine is the screw, upon which is the follower, which is forced down by the nut. The latter is rotated by the lever, the laborer at the first merely walking round the press. When he can no longer operate thus, he commences a reciprocating movement, drawing the lever back and forth, which he is enabled to do by a species of gravitating ratchet movement in the apparatus upon the nut.

The cotter-keys are gravitating; each motion of the lever turns the mortise-wheel in a constant direction, the action of the cotters being alternate. While one cotter is effective the other slips up out of its seat, slides over the intervening space, and drops into the next mortise. The stroke of the lever is 0.8 meter.

Wine making, Hammondsport . . . . . . * "*Scientific American*," xliii. 79.

Wing. (*Fishing.*) The portion of a hand-seine on each side of that central part which is known as the *bag*.

Wing Net. (*Fishing.*) A net running down stream from one of the stakes of the stake net, to the stake at the mouth of the *hook* net, to guide fish intercepted by the main or *bar* net. See STAKE NET, p. 850, *supra*.

Wing Stop'per. (*Nautical.*) A rope clenched to a ship's beam and at the other end to a cable.

Winze. (*Mining.*) A shaft sunk from one level to another.

Wiped Joint. (*Plumbing.*) One made by placing the parts in the required juxtaposition and covering the joint with a mass of solder.

The wiping action of the woolen pad used originated the name.

Wire. The following table, showing breaking strain of ropes of 133 wires, is from a pamphlet by Messrs. J. A. Roebling's Sons: —

	Diameter. Inches.	Strength. Tons.
No. 1	2¼	74.00
No. 2	2	65.00
No. 3	1¾	54.00
No. 4	1⅝	43.60
No. 5	1½	35.00
No. 6	1⅜	27.20
No. 7	1¼	20.20
No. 8	1	16.00
No. 9	⅞	11.40
No. 10	¾	8.64
No. 10¼	⅝	5.13
No. 10½	9-16	4.27

The following shows the weight and resistance per mile of galvanized iron wires: —

Number.	Resistance.	Weight.	Number.	Resistance.	Weight.
6	10 ohms	550 lbs.	11	25 ohms	220 lbs.
7	12.1 ohms	455 lbs.	12	32.7 ohms	168 lbs.
8	14.1 ohms	385 lbs.	14	52.8 ohms	104 lbs.
9	16.4 ohms	330 lbs.	16	91.6 ohms	60 lbs.
10	20 ohms	275 lbs.			

Wire for Brooklyn bridge, bids . . . . "*Iron Age*," xix., Jan. 25, p. 14.
Wire for East River bridge, making . . . * "*Scientific Amer.*," xxxvi. 127.
Wire manufacture . . * "*Scientific American*," xl. 319.

TABLE OF WIRE RESISTANCE AND WEIGHT.

The following electric resistances are calculated for pure copper wire. The number of feet to the pound is only approximate for insulated wire.

Number.	Diameter.	Feet per Pound.			Resistance, Naked Copper.			
		Cotton Covered.	Silk Covered.	Naked.	Ohms per 1,000 Feet.	Ohms per Mile.	Feet per Ohm.	Ohms per Pound.
8	.12849	-	-	20	.6259	3.3	1,600.	.0125
9	.11443	-	-	25	.7892	4.1	1,272.	.0197
10	.10189	-	-	32	.8441	4.4	1,185.	.0270
11	.09074	-	-	40	1.254	6.4	798.	.0601
12	.08081	42	46	50	1.580	8.3	633.	.079
13	.07196	55	60	64	1.995	10.4	504.	.127
14	.06408	68	75	80	2.504	13.2	400.	.200
15	.05707	87	95	101	3.172	16.7	316.	.320
16	.05082	110	120	128	4.001	23.	230.	.512
17	.04525	140	150	161	5.04	26.	198.	.811
18	.0403	175	190	203	6.36	33.	157.	1.29
19	.03539	220	240	256	8.25	43.	121.	2.11
20	.03196	280	305	324	10.12	53.	99.	3.27
21	.02846	360	390	408	12.76	68.	76.5	5.20
22	.02535	450	490	514	16.25	85.	61.8	8.35
23	.02257	560	615	649	20.30	108.	48.9	13.3
24	.0201	715	775	818	25.60	135.	39.0	20.9
25	.0179	910	990	1,030	32.2	170.	31.0	33.2
26	.01594	1,165	1,265	1,300	40.7	214.	24.6	52.9
27	.01419	1,445	1,570	1,640	51.3	270.	19.5	74.2
28	.01264	1,810	1,970	2,070	64.8	343.	15.4	134.
29	.01126	2,280	2,480	2,617	81.6	432.	12.2	218.
30	.01002	2,805	3,050	3,287	103.	538.	9.8	338.
31	.00893	3,605	3,920	4,144	130.	685.	7.7	539.
32	.00795	4,535	4,930	5,227	164.	865.	6.1	856.
33	.00708	-	6,200	6,590	206.	1,033.	4.9	1,357.
34	.0063	-	7,830	8,330	260.	1,389.	3.8	2,166.
35	.00561	-	9,830	10,460	328.	1,820.	2.9	3,521.
36	.005	-	12,420	13,210	414.	2,200.	2.4	5,469.

Wire Belt. Machine straps of wire, as a substitute for leather, are being made.

The belts are made of the best crucible steel wire, in transverse network of 1 to 10 wires, in any desirable length or width. The two ends of the strap are joined like the middle, so that there is no beginning and no ending, the belt forming an endless band. All the wires run parallel only across the width, in such a manner that one wire catches into the other like a spiral, a continuous, densely woven chain being thus produced, the movability of which is so great as to enable it to go round the smallest pulley. The straps are also made with leather or elastic lining, or bordered with leather, elastic, hemp, hair-tape, or any other material, also its interstices filled with gutta-percha, to supply elastic bands with cotton web, and to prevent their stretching. The tightening of the strap — shortening of the chain — which is only necessary once, namely, when put on by means of a strap key, may be effected very easily and very quickly by taking out any desirable number of wires, and again joining the two ends in the same manner by twisting in the required number of wires.

Wire Book'-sew-ing. In this system of book sewing the book is "sewed flexible" upon tapes or wide bands (sawing the signatures being entirely dispensed with), and the work is equally well done upon all classes of books.

Every signature is sewed "all along" by independent tinned-wire staples, uniting them firmly to the tapes or webbing, thus securing the utmost strength and durability in addition to the valuable feature of thorough flexibility.

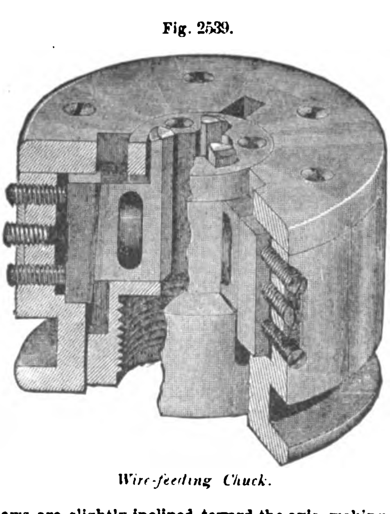
This system is equally adapted to all grades of edition and school book binding, from the cheapest to the most costly full bound books. Also for all classes of blank books, music books, and pamphlets of one or more signatures.

Wire Cut'ting Scis'sors. A double pivoted projecting slide shears for use where there is not play for the common single pivot shears.

Wire-feed'ing Chuck. A screw machine, Fig. 2539. It has an adjustable chuck and wire-feeding apparatus. It is used for making the smallest screws of sewing machines, guns, etc., making from 1,000 to 3,000 screws per day. The chuck is operated while in motion, and the wire is fed through it automatically when loosened, without stopping for each screw. It is adjustable to any sized wire from $\frac{1}{8}''$ to 7-16″ diameter.

It has a hollow cylinder with an outer sleeve sliding upon it. The cylinder contains three jaws fitted to slide in slots which converge to the center; the inner sides of the jaws are parallel with the axis of the chuck, the outer sides of

Fig. 2539.



Wire-feeding Chuck.

the jaws are slightly inclined toward the axis, making each jaw a wedge. The chuck is attached to the machine by screwing the cylinder upon the tubular spindle. The sleeve contains three shoes, fitted into deep cavities which correspond in position to the slots in the cylinder. In the circumference of the sleeve are adjusting screws, so placed that when screwed in their points bear against the outer sides of the shoes until they conform, each to the inclination of its respective jaw in the cylinder. Each shoe has a pair of these adjusting screws, which may be fastened, after being adjusted to the wire, by a pair of set nuts which are tightened by a cone-shaped screw. When the sleeve is moved upon the cylinder toward the spindle, the shoes, acting on the inclined sides of their respective jaws, force them straight toward the center until they grasp the wire. The sleeve is operated by a fork-lever by pins projecting into a suitable groove in its circumference.

Wire Fence. Wires or strips of metal armed with barbs and stretched on posts.

It is nearly fifty years since experiments with wire fencing began to be made, and twenty-five years since it began to be much used. The method promised great economy, both in first cost and in the saving of ground space. Besides, the wire fence was less liable to be blown down, and it would not occasion snow drifts. On the other hand, it was soon found that it was rapidly corroded by the weather, and being inconspicuous was liable to be run down by cattle and horses. When "galvanized," the wire was more durable and more easily seen; and in spite of its inability to stop unruly cattle, wire fencing became widely adopted, particularly in the West, where it is estimated, as many as 150,000 miles of plain wire fencing have been set up since 1850. To make wire fencing stock-proof several devices have been invented and patented during the past ten years, to provide for arming the fence with cattle-repelling spines or barbs of metal.

The "*Holyoke Manufacturer*" states that during the four years the first barbed wire was put upon the market the sales amounted to between fourteen and fifteen thousand tons, and the demand has rapidly increased both at home and abroad. There are several manufactories, and in one instance the works cover three acres and give employment to 1,200 men. The wire is made from Bessemer steel, and is drawn in the usual way. The "galvanizing," or zinc coating, is done by heating the wire in suitable furnaces and drawing it from them, first through tanks of acid, and then through tanks of boiling zinc. A thin and even coating of zinc adheres to the wire, giving it both a handsome finish and a perfect protection from the chemical action of the atmosphere. The barbing is done by automatic machinery. These machines, as described by the "*Manufacturer*," are good specimens of American mechanism, and do their work with lightning-like rapidity, yet with mathematical accuracy. One of the main wires passes through the machine longitudinally. A second wire is fed into the machine at right angles to the first. At each revolution of a certain disk or wheel, the sharp end of wire number 2 is twisted firmly around number 1, and cut off so as to leave a sharp point on the incoming wire as before, while the bit of pointed wire cut off remains as a steel thorn attached firmly to wire number 1. This wire, thus armed with barbs at regular intervals, passes on to a revolving reel, where it is met by wire number 3, — a plain wire without barbs, — and by means of the reel motion is loosely twisted with it. The completed fence wire is thus really a two-strand steel rope, armed with barbs projecting in every direction. The great advantage, besides additional strength, that is secured by the second strand and twist, is an automatic adjustment to changes of temperature. When heat expands the metal the twist simply loosens, and when cold contracts it the twist tightens — all without altering the relative length of the combined wires. The reels upon which the finished product is woven are light, strong, wooden ones, suitable for shipping, and provided with cross-pieces at the ends, on which they can stand, and the barbed wire be protected from injury. Each of these barbing machines turns off 1,200 lbs. of barbed wire a day.

At present wooden posts are usually used as supports for the wire in putting up the fence. But it is believed that iron posts will sooner or later supplant the wood. For study, with a view to new and useful improvements the subject of metallic fences is a promising one for inventors. The demand increases not only with the decay of the old wooden fences, but also with every acre of new land that is opened up to cultivation.

Wire Find'er. (*Electricity.*) An instrument for testing insulation of wires. It has a short ear tube, with ferrotype diaphragm, which is placed in proximity to a magnet which holds the wire between its poles. — *Gott.*

"*Journal Soc. Teleg. Engineers*" . . * vi. 522; * vii. 77.

Wire Gage. An adjustable gage for measuring the diameter of wire, iron, etc.

Wire gage, on a standard * "*Scientific American*," xlii. 233.

Wire-han'dle Ma-chine'. (*Sheet Metal Working.*) A machine for straightening wire, forming it into oval or oblong handles, from 2″ to 3″ long, such as are used on petroleum cans, dripping pans, etc. No. 148 of "*Bliss's Catalogue,*" 1881.

Wire In'stru-ments. (*Surgical.*) Instruments for manipulating wire in surgical practice. The list includes —

Wire adjuster.	Suture wires.
Needles.	Wire twister.
Shot compressor.	

Wire Lath. A wire screen or netting that is applied in the place of wooden lath for holding plaster. It is claimed to be more secure against fire.

Wire Meas'ur-ing, Form'ing, and Cut'-ting. (*Sheet Metal Working.*) A machine for preparing wire for use in making up sheet-metal ware.

Bliss's automatic machine is adapted to straighten wire from the coil, cut it off in lengths not exceeding 72″, or form it into rings of from 4″ to 20″ diameter, suitable for pans, kettles, pails, brackets, etc., or into half-circles for pail-handles, etc.

It is driven by power, quite automatic, and works wire up to ¼″ diameter.

Wire Nail. A round nail made of wire, and used for attaching molding, metallic roofing, etc.

Wire nails, American . "*Iron Age,*" xix., March 15, p. 24.

Wire Pan. A cake-pan with wire screen bottom.

Wire Pla'ting. Immerse in sulphuric acid in which a piece of zinc is suspended. Then place in contact with a plate of zinc in a solution of water (100), tartaric acid (2), chloride of tin (3), soda (3). Let it remain 2 hours, and polish by passing through a draw-plate. — *Dr. Heeren.*

Wire Rope. Commodore Shufeldt has recently ordered the proper authorities of the Boston navy yard to make several 7″ steel wire hawsers. These will probably be the largest wire ropes ever made. The navy department has use for immense hawsers to tow monitors and vessels in distress. They are put on board the men-of war for use when required. The usual appliance is a 12″ hemp rope, but it swells when wet, and gets very heavy by absorption of water. The steel wire hawsers will be 5″ less in diameter, much lighter, non-absorbent, more pliable and durable, and in every respect better. This is a curious, and, in fact, wonderful advance in the application of steel and iron to commercial uses. A hemp hawser 12″ thick is a wonderful thing in itself, but a steel wire hawser 7″ in thickness, better answering the same purpose, is something fruitful of thought to the student in ship building and rigging.

Stahl's "*Transmission of Power by Wire Ropes.*"
Hildenbrand's "*Cable-making of Suspension Bridges, as exemplified in the East River Bridge.*"

Wire Ropes, paper on, by G. L. Abegg	"*Scientific American Sup.,*" 2094.
Wire rope, wear of . .	"*Scientific American Sup.,*" 86.
Steel, tests, Engl. . .	"*Scientific Amer.,*" xxxvii. 88.
Transmission . . .	* "*Van Nostrand's Mag.,*" xvi. 68, 166, 225.
Transportation, Reading Iron Works . .	"*Scientific American,*" xli. 40.
System, stationary .	* "*Manufact. and Builder,*" xii. 59.
Wire ropes *vs.* chain cables	"*Iron Age,*" xxi., June 6, p. 18.
Wire rope *vs.* chain cable	"*Iron Age,*" xxii., Oct. 24, p. 11.
Ships cable apparatus. *Bullivant,* Br. . .	* "*Engineering,*" xxix. 264.

Wire Rope Con-vey'ance. A system of aërial transit on suspended wire ropes has been established to connect the gasworks at Hanover with the neighboring coal station on the Hanover Altenbeck Railway, for the supply of coal to the works. The line crosses the Limmerstrasse and the river Ihme, and is about 625 yards in length.

There are 2 iron wire ropes placed 5′ 10″ apart, and employed respectively for the carriage of loaded and of empty wagons. They cross the Limmerstrasse at a height of 23½′, and the river at about 30′. The cables are respectively 1.12″ and 1″ in diameter, and are constructed of wire of 4 millimeters, about 1-6″, in diameter. They are supported on pulleys at intervals of 24 yards, except in crossing the river, on a span of 57 yards. Resting on pulleys, they are free to expand or contract. They are kept taut by weights of 5 tons and 4 tons respectively.

The wagons are drawn by means of a 9-16″ endless wire rope, supported on rollers at intervals of 60 yards, and driven by a 6-horse steam engine at a speed of 3 miles per hour. The wagons are constructed of sheet-iron, and are capable of holding 3 hectoliters, or 106 cubic feet of coal; they are suspended from the carrying ropes on 2 grooved wheels, one in advance of the other, between which the attachment of the wagon is made. The bodies of the wagons are swiveled, so that they may be easily emptied. They follow each other at intervals of about 60 yards. Allowing for delays, the quantity of coal carried at no time exceeds 180 tons per day of ten hours, and is frequently less, the average delivery being only 135 tons.

Wire Rope Thim'bles. A curved metallic eyelet for protection of the rope from wear.

Wire Rope Tow'age.

The ferry-boat, Waag, is a vessel of 120′ in length, 23′ beam, and 6½′ depth of hold, and draught is of 2½′, is propelled by "overhauling" a chain which lies along the bed of the river between Vienna and Pressburg. The same method is adopted on the Elbe and on other rivers of Europe for towage. The chain is laid on the river-bed, from end to end of the route. The steamer is provided with a winding-drum instead of paddle-wheels, and is thus fitted to haul in the chain at one end of the vessel and to pass it off at the other end.

This method of propulsion, where practicable, is claimed to be more economical of power than the ordinary methods, especially where, as in towing, the losses by slip and by oblique action of the paddle-floats become very serious.

Wire Rope Trans-mis'sion. The use of a round, endless wire rope running at a great velocity in a grooved sheave, in place of a flat belt running on a flat-faced pulley, constitutes the "transmission of power by wire-ropes."

Remarks on same by

Roebling	* *Cooper's* "*Belting,*" 258.
Achard	* *Cooper's* "*Belting,*" 260.
Telodynamic system, *Hirn*	"*Prac. Mech. Jour.,*" March, 1867, 358.
Professor Barnard . .	"*Report Paris Exposition,*" 1867.
Wire rope driving . .	"*Manuf. & Builder,*" Feb., 1869, 38.
Rope gearing	"*Newton's Journal,*" xxi. 46.
Durie	"*Iron,*" London, Oct. 28, 1876.
Wire ropes as connecting rods	* *Cooper's* "*Belting,*" 285.

Wire Spring Ma-chine'. A machine for making spiral wire springs.

The wire is first seized by a pair of rollers, one of which has a groove and the other a corresponding milled projection. It is passed under a guide roll, the position of which may be adjusted according to circumstances, and is then carried between a second roller and a guiding sheet which throws it forward. The position of the guide roll determines the diameter of the spiral spring, while the deviation of the second roller and guiding sheet from a position parallel to the first pair causes the spring to become spiral. This deviation is automatically regulated, and the machine is so constructed that when a double spiral has been finished the wire is cut at the proper time.

Wire Test'ing Ma-chine'.

The wire to be tested is held by two clamps, which are drawn apart by a screw and hand wheel attached to one. The other acts upon a long lever, to the longer arm of which a fine chain is attached, which is so connected with a weight that its tension increases in proportion to the movement of the lever. A rod which carries a pencil is attached to the lever, and by a spring the pencil is made to travel along a straight guide-piece. The paper upon which the line is drawn is moved perpendicularly to the direction of the wire through the agency of cog-wheels and a toothed rod. The ratio of the two movements is so chosen that a curve is he result, the abcissas of which, if multiplied by ten, yield the elongation of the wire, while the ordinates register the tensile strain.

See also "*Scientific American*," . . xxxix. 211.
"*Iron Age*" . . . . xxii., Nov. 21, p. 1.
Wire testing machine, *Riehle*, . * "*Iron Age*," xx., July 19, p. 9.

Wir'ing Press. A press for wiring pieced tinware. — No. 33 of "*Bliss's Catalogue*," 1881.

Withe. The metal rings that embrace the mast, boom, or gaff, and which have eyelets through which to reeve the ropes.

Wol'las-ton Bat'te-ry. (*Electricity.*) A trough battery; an improvement on Cruikshank's in which the cells are of glass and the plates are attached above to a wooden bar. The first plunging battery.

Niaudet, American translation . . . . p. 15.

Wood Bend'ing. The bending of hard wood, especially beech, is effected at present by means of hot water or steam, a process somewhat costly as regards fuel, and taking a long time. For overcoming these difficulties the following method has been proposed, chiefly for sieve hoops: —

Two rollers are used, one above the other, the upper one having less velocity, so that it acts by holding back, while the lower extends the wood fibers. When the board, thus bent, leaves the rollers, it is fastened in the mouth of the sieve. The upper roller is fluted, the under one smooth. If two smooth rollers were used a very much greater pressure would be necessary.

Wood Bend'ing Ma-chine'.

Fig. 2541 represents one modification of the machinery for bending timber, which has been brought by a number of years' practice to a high state of utility. It consists of a jointed mold made up of cast-iron sections which have two horizontal projecting arms on the flush side, the one above the other, forming a groove between them for the timbers. The end of each of these sections is circular, and is secured like hinges, interlocking in its adjoining section, and held together by a vertical wrought-iron pin. The sections thus united form a series of joints adjustable to any form, and may be extended to any length. This mold rests upon a

Fig. 2541.

Wood Bending Machine.

circular table with a circular frame beneath, 22' in diameter. This table, being 3½'' thick and pierced with slotted holes systematically arranged to receive the fastening of the mold, etc., is mounted upon a hollow shaft of cast-iron, 8'' in diameter, and has a screw-thread cut in its outer surface at the lower end, by means of which the table may be raised or lowered and made to bear a part or the whole of its weight on the shaft-bearing. On the lower edge of the table are circular cogs into which a pinion-wheel meshes, and the power applied to the pinion revolves the table. The table has an attachment fastened on the top at its edge, called the head-block, which receives the small end of timbers and plate-strap covering the outside of timbers. The larger end of timbers is confined in a massive cast-iron clamp, which also receives one end of plate-iron strap. This clamp is mounted upon casters, and having a vertical roller on its back at the larger end, is drawn along by means of the plate-strap as the table revolves, the roller in end of clamp bearing against a vertical bulkhead raised from the floor of the building while the timber is being bent into the groove of joint-mold. The clamp, and also the head-block, have screws passing through their ends, by the use of which pressure on the two ends of the timber is communicated. This end-pressure applied to the timber draws the strap straight and to its full tensile dimensions, and when thus brought up against the outside of the timber, the process of bending commences by revolving the table. A mold for bending knees is arranged upon the same table, and is complete in all its parts, details of which it seems unnecessary to describe. The whole machinery is massive and ingenious, although easily operated.

Wood'bu-ry-type.

Where the subject is in line a positive photograph of it (*i. e.*, positive by transmitted light) is made, and from this is obtained a relief in gelatine by the ordinary method, the result being that the hollows of the relief will all be of one uniform depth, this characteristic producing a level or uniform surface in the resulting mold, which is made by impressing this relief into metal by hydraulic or other pressure, or by the method stated in the second part of this invention. Where the subject is in half-tone, as in a photograph from nature, the process is as follows: In printing on the gelatine film there is interposed between it and the negative a photograph on mica or transparent collodion of what is known as mosquito netting, or Brussels net, which breaks up the resulting relief into a multitude of fine square or hexagonal lines. To obtain from this a printing block the means already described are employed, the resulting block in soft metal being capable of giving from 100 to 200 impressions; but where large numbers are wanted this block is electrotyped in the ordinary way. Diffused light is used to produce the block from half-tone negatives, as in that case the light in the parts that represent the whites creeps around the lines, thus obliterating them in that part, and leaving them strongest only in the parts printing dark. Another method is sometimes adopted: A negative of the network is taken by transmitted light, and copied together with the negative, thus producing a positive with the lines already thereon, from which a relief is made as stated.

The second part of this invention may be accomplished as follows: In place of using a thin film of collodion (as is generally used in the process called "Woodburytype") to hold the gelatine of the relief, a sheet of plate glass is first rubbed over with French chalk or ox-gall, and then coated with the bichromatized gelatine solution as now used. When this is dried and ready for use the side that was next to the glass is exposed for a few seconds to daylight before exposing it under the negative. This has the effect of causing a thin film of gelatine to become insoluble, which after subsequent exposure under the negative will not wash away, but form a support for the photographic image afterwards impressed, thus doing away with the expense and trouble of the double coatings as now practiced. When the gelatine relief is dried in the ordinary way, a thin sheet of tinfoil (same size as the gelatine relief) is attached by gum or other adhesive substance around the edges to the gelatine relief. A stout sheet of plate paper is laid on the back of this and the whole passed through an ordinary rolling press. The tinfoil is by this means impressed into all the details of the relief; but in this state it would be useless to print from. Therefore a shallow metal box is filled with a composition of shellac and asphalt, which on warming becomes soft, but hardens on cooling. This box is placed on a hot plate until the composition softens; it is then placed on the lower plate of the ordinary Woodbury printing press, the foil and relief laid on it, the press closed, and the pressure applied by the under screw. When the composition has hardened the tinfoil adheres to it. The gelatine relief is removed from the foil, and the foil-backed mold used to print from. In place of fixing the proofs by alum or other substance of a like nature, they are varnished with an ordinary varnish composed of shellac and alcohol, giving the print an effect of a photograph on albuminized paper, at the same time protecting the surface from moisture. Sometimes the composition is melted in boxes and used without the foil as a printing mold direct;

when sufficient numbers have been printed the box holding the composition is again heated and can be used over and over again.

The third part of this invention consists in an improved method of printing "Woodburytype" by machinery. This is accomplished as follows: Out of a solid block of iron a cylindrical hole is turned, in which is made to fit very loosely a cylinder of soft metal having a taper or conical hole through it lengthwise. Between the interior of the steel block and the soft metal cylinder the gelatine reliefs are inserted: then, by means of a taper or wedge-shaped spindle (roughened), by hammering or by pressure the soft metal is driven against the iron cylinder, thus impressing the relief on the outside of the metal cylinder, the taper spindle at the same time forming a shaft for the cylinder to be used in the process of printing. This roller, bearing the relief, is then mounted in vertical slots in a frame having a bed of plate glass on which the paper rests, the roller resting on the glass its own weight and being dragged round by the paper itself; or in place of the glass plate the soft metal cylinder is allowed to lie on another fixed or movable roller of metal or glass. The latter may be hollow so as to reduce its temperature in hot weather by a stream of cold water running through it.

Wood'chop-pers' Maul. A large wooden sledge with heavy iron-bound head for driving wedges used in splitting wood.

Wood'en Floor Mat. A sort of grating made of strips of wood, used as a door-mat.

Wood'en Pave'ments.

A rigid foundation of bituminous or cement concrete is universal. This costs more than sand, but it is permanent, and will prevent the blocks from sinking under the wheels. English engineers, in discussing pavements, call the foundation the true pavement, the blocks being the wearing surface only. The "Henson" pavement, with some modifications, is the best for this country. Instead of a layer of tarred paper on the concrete, use a thin layer of pitch, with oil enough in it to make it permanently slightly plastic, setting the blocks upon it while hot and soft, using the strips of tarred felt between the rows, and driving the blocks together. The tarred felt would make a very close joint. Then pour melted pitch over the whole surface, taking care to fill every crevice, and upon this spread fine sharp gravel, which will work into the ends of the blocks and form a surface resembling macadam, and afford a far better footing than wide spaces between the rows, which serve as receptacles for mud and dust. It is easy to keep this pavement clean. No water can penetrate it, so that it will not be injured by frost. The blocks themselves, if creosoted, will not absorb water, and if laid without spaces between the blocks, the drainage will be surface drainage solely, which is of the first importance.

But the pavement would be short-lived if *green* and wet blocks are used. It is not practicable to use, as Mr. North says is the case in London, "wood better seasoned than the pine generally used by house carpenters in this country." Seasoned wood cannot be obtained in sufficient quantities here. But, what is far better, it can be preserved from decay.

No faith can be placed in any method of wood preservation for paving blocks which does not exclude water. The blocks are so short that any soluble preparation is quickly washed out of them, and, if not made waterproof, they are certain to absorb the seeds of destruction from the filth in the streets. The blocks should be well saturated with creosote oil, whose chemical constituents act preservatively upon the fibers of the wood by coagulating the albumen of the sap, while the fatty matters act mechanically in obstructing the pores of the wood and keep the water out. At the same time, as oil cannot be injected into wood full of moisture, the thorough artificial seasoning which forms a part of the process of creosoting as carried on in this country, is as useful to the timber as any of the metallic salt processes.

By thoroughly creosoting the blocks, expansion and consequent throwing out of the blocks is prevented. They will not shrink or expand. The wood is also rendered homogeneous; the sap wood becoming as durable as heart wood. Looking to sanitary considerations, the creosoted wooden pavement is perfect. The carbolic acid contained in the oil is a powerful disinfectant, and as the pavement described will not absorb any deleterious substance from the surface, it has only to be kept clean to maintain the best sanitary condition.

Wooden pavement, Lond. "*Scientific American*," xxxv. 115.
On, (many figures) . * "*Engineer*," xlv. 171, 314.

Wood'en Rail. For wooden rails the best wood is maple, laid with the heart up; hard pine is used in the South.

The simplest form of wooden rail is a stringer cut in 16′ to 20′ lengths, and of such cross-section as the kind of wood or weight of engine requires. 6″ square is usually the best size for stringer, although 5″ face by 7″ depth, is sometimes as good. 4″ face by 6″ depth, or 5″ square, will answer for small engines, if the wood is good; still smaller sizes may be used by placing the cross-ties close together, say 2′ or 2½′ between centers; for large stringers, 4′ between centers will answer. When worn out on top the stringer may be reversed, and when again worn out may be used for ties.

The ties are more easily fitted and laid if made uniform, and of about the same size lumber as the rails; 6″ square is heavy enough. Any cheap lumber not specially liable to decay will do. Ordinary hewn ties may be used, but not being uniform are less convenient for cutting out recesses for rails. They should be at least 3′ longer than the width of the track between rails. The ties must be cut out accurately and uniformly to receive the rails. The recesses should be about 3″ deep, and be at the top face of the tie 1″, and at the bottom of the recess 1½″ wider than the rail. The inner faces of the recesses are perpendicular, and the distance between them is the gage of the track. The bottom of the recess should be level, and ties laid well to afford proper bearing for the stringer.

Wedges made of any cheap wood, or better, of ends of stuff left from rails, are driven on the outsides of rails. They are made of right shape to fit the space left; the reason for making this space wider at the bottom than at the top, is to keep the wedges from working up, so that the rail may be held securely in place.

The stringers must be arranged to break joint on the ties. Both stringers should not break joint on the same tie. The stringers are sometimes sawed off diagonally instead of perpendicularly, so as to lap and be spiked altogether. The cost of lumber for a hard pine wooden road will be about $450 per mile.

With another style of wooden road the stringer is made of hemlock or any cheap lumber, and a maple strip 4″ to 5″ wide and 2½″ to 3″ thick is spiked on to the stringer. By this plan, such a part of the rail as is worn out may be removed without taking up the stringer. The maple strip may be replaced by a T-iron rail considerably lighter than would be required if laid directly on cross-ties; this is preferable to strap iron.

A wooden rail is very slippery when wet, and hard to keep clear of snow and ice in freezing weather. On very bad curves and steep grades a wooden rail is impracticable, and iron must be used.

A locomotive has but one half or two thirds the power on wood that it has on iron; the friction useful for traction is less, and the flange friction is greater. Locomotives for wooden rails should be built very strongly and evenly balanced; the weight should be less, and the drivers larger than for the same size of cylinders on iron rail. A locomotive with six wheels connected, or with four drivers and a two wheel truck, is preferable to a four-wheel engine for wooden rail.

Wood'en Wall Cov'er-ing. A veneer surface for wall paper.

The wood is cut to the thickness of paper, and by a peculiar process stuck on the paper, which serves as a protection against the influence of the walls on the graining and color of the wood. The delicacy of the machinery employed in cutting so thin a veneer may be gathered from the fact that 200 leaves are cut out of an inch of white maple wood, and 125 out of wood with very open grain, such as oak and walnut.

Wood Fa'cing Ma-chine'. A machine used in the manufacture of furniture, sash, doors, patterns, agricultural implements, etc.

It is adapted for planing out of wind, making bevel or square glue joints, facing and edging, surfacing straight, squaring, beveling, etc. The work, as it passes over the tables, needs no dogging or exertion to hold it.

The tables are drawn back or pushed forward, to regulate the cut, by a screw, while the machine is running. The motion of the tables on the wedges, while regulating the cut, secures at the same time a uniform distance from the knives.

Wood Oil.

The curious product of India, called by the English *wood oil* or *Gurjun balsam*, forms the subject of two papers published in the "*Pharmaceutical Journal*," by Messrs. Charles Lowe and Daniel Hanbury. Mr. C. Lowe, who only knew that this resinous liquid is extracted in India, by incisions made in the tree, considers it as a *Copaiva balsam* rendered turbid by a greenish resin held in suspension. The filtered balsam forms a brown and transparent liquid, from which we withdraw by distillation —

Volatile oil	65
Hard resin	34
Water and acetic acid	1

According to Mr. Lowe the volatile oil possesses all the characters of that of copaiva, and the *hard* resin, which he regards as pure *copaivic acid*, free from the *soft* resin, which, according to him, exists in the most part of commercial copaivas, seemed to him to indicate a superior quality as a medicine.

Wood Pre-serv'ing.

The various processes for preserving wood have for their object the prevention or arrest of fungoid growth. This is sought to be accomplished by two main systems; one of which consists in impregnating the wood with a solution of a metallic salt, such as corrosive sublimate, chloride of zinc, or sulphate of copper, and the other includes the several creosote processes. The action of the salts named is purely chemical, and as they are introduced in watery solution, it is evident that subsequent exposure to moisture tends to redissolve them and leave the wood unprotected. Creosoting, while producing the same result chemically, also secures dryness, which alone is sufficient to prevent decay, provided that it can be maintained.

In creosoting, it is essential that the wood should be thoroughly dried, in order to secure complete impregnation, and hence timber is usually seasoned for months before treatment. This is a serious objection, which inventors have attempted to remedy by adding a preliminary dessicating operation. At extensive works at South Boston, Mass., a process known as the Hayford is in use, which consists in drying the timber *in vacuo*, and then impregnating it with creosote oil under pressure. Green timber is fed by a rail track into an air-tight cylinder of boiler iron, 100′ long and 6′ in diameter. This cylinder has been tested by hydrostatic pressure of 200 lbs. to the square inch, and is capable of being hermetically closed. When the charge is in, steam is introduced, raising the temperature gradually, so as not to harden the outside of the wood and prevent the escape of moisture from the interior. Atmospheric air is also forced in at a pressure of from 80 to 40 lbs., to restrain the tendency of the wood to crack. A temperature of 250° to 270° is found sufficient to evaporate the sap, and the whole steaming process occupies from 4 hours for boards to 10 or 12 hours for heavy timber. When it is certain that the sap and vapor have been turned into steam, the direct steam is shut off, and air pumps set to work to free the cylinder from the steam, vaporized sap, and result of condensation. This stage is reached in about an hour. The cylinder being made tight again, and still heated by the coil, a vacuum pump is put in action. Then the creosote oil, previously heated to near the boiling point to render it limpid and penetrating, is introduced under a pressure of 60 lbs., which, added to the drawing power of the vacuum, makes a total pressure of over 70 lbs. to the square inch. The hot oil soon impregnates the wood. If the timber is of very close fiber, the pressure is raised to a higher point. The process completed, the charge is withdrawn and another takes its place.

The process known as "Beerizing timber," takes its name from Sigismund Beer, a chemist of New York City, who discovered that by the use of borax as a solvent the coagulation of sap is prevented, and this without injury to the wood tissues. The obnoxious ingredients being thus removed, the wood is rendered closer in grain and thereby improved in appearance, becomes impervious to decay, and remains unaffected by atmospheric changes.

A recent number of the "*Annales des Ponts et Chaussées*" gives the following information, furnished by the officers of the railway from Hanover and Cologne to Minden. The proportion of pine ties, injected with zinc, renewed after 21 years, was 21 per cent.; beech ties, injected with creosote, renewed after 22 years, 46 per cent.; oak ties, not injected after 17 years, 49 per cent.; oak ties injected with chloride of zinc, after 17 years, 20.7 per cent. The ties which were not renewed appeared perfectly sound. Since 1870 the Emperor-Ferdinand Northern Railway has used only oak ties, injected with either creosote or with chloride of lime.

Hatzfeld recommends, in "*Eisenbahn*," for this purpose the injection of tannin in form of decoctions of substances containing it, as for instance, chestnut and oak bark. The wood is treated with these decoctions in closed vessels at high pressure, and afterwards treated with a solution of the pyroacetate of the sesquioxide of iron. The latter is transformed into a tannate and finally converted into a salt of the oxide by oxidation. This process has now been generally introduced by the larger railroad and telegraph companies in France.

Mr. Lostal, a French railroad engineer, recommends lime as a preservative for wood. He puts the wood to be prepared in large excavations in the ground, and covers them with freshly calcined lime, which is gradually slaked by the addition of water. Wood to be used for mining structures must remain in the lime about 8 days before becoming fully impregnated. The wood becomes exceedingly hard and never rots. Beechwood prepared in this way has been used as material for hammers and other tools in several factories, and is said to have become as hard as iron, without losing its peculiar elasticity. At Strasbourg, lime slacked in a solution of chloride of calcium is used as a fire and weather proof pigment for woodwork.

Wood, preservation of.	"*Scientific American Sup.*," 1880.
Paper by *Jefferson*	"*Man. & Builder*," xii. 181, 190.
	* "*Scientific American*," xxxv. 360.
Wood preserving process *Palmer*	* "*Scientific Amer.*," xxiv. 259.
Wood preserving and fireproofing, *Folbacci*.	"*Scientific American*," xl. 67.

Wood Pulp Pa'per.

In wood paper manufacture the split 4′ timber is fed into a circular fan-like hopper provided with swiftly revolving steel knives, which cut the timber into small chips in very short order, when a fan drives them up into the loft, where they are shoveled into two steel digesters holding from four to six tons each. Soda ash, and other chemicals, are introduced, a heavy head of steam is turned on, varying in different mills from 100 lbs. to 200 lbs. pressure to the square inch, and the chips are thoroughly separated. Then the pulpy mass is washed out into vats to drain off the chemicals, and after it has become solid it is again washed out and pumped up into the engines and beaten, and the usual process of paper-making is then gone through with.

Some makers think evergreen woods far preferable, as having a larger and more hardy fiber.

The year 1846 — when the German engineer, H. Völter, began his experiments of using, instead of vegetable fiber from flax and cotton, wood fiber, which he prepared by quite a simple expedient — was the beginning of a branch of industry which is already of great importance to Sweden, since that country possesses just what is chiefly required for it: abundant supplies of fir-forests and large waterfalls. The first factory established on this Völter's system was at Trollhättan, in 1857, and for ten years was the only one of its kind, until here and there in the country they began to establish others, so that in 1870 there were six; but from this time their erection was very rapid till 1873, when there were twenty-seven wood-pulp factories already completed or nearly so: but since that time none have been erected.

The observations and inventions made in this branch of industry have not been unnoticed, and therefore the manufactories are calculated to be worked, partly on the chemical and partly on the mechanical method. The chemical method is as yet so new, that it is difficult to say what development it will enjoy. It is certainly true that in this way a better and more fibrous pulp is obtained, but in proportion to the ground pulp, it is also dearer, especially since caustic soda, which is needed for the manufacture, has considerably risen in price. The grindstones that have hitherto been employed in the mechanical method have as yet been generally obtained from Germany, the cause of which cannot be that the material required for it is wanting in Sweden, but rather at the new-established works they have wished to avoid experiments at first, and hence the stones have been brought from such places, where they have already been practically tried. All the machinery, on the other hand, is now made in the country.

The Swedish wood-pulp manufactories extant at the beginning of 1873, may be divided as follows: —

I. *Mechanical*, new works where 100 horse-power is calculated for each grindstone:

a. Eleven Völter's manufactories with vertical grindstones, and the supplying of the pieces of wood by a screw-mechanism. Of these the oldest (Trollhättan) has twenty stones, of which the greater number are small; but besides, there are several large establishments with from five to six grindstones of from 5 to 5½′ in diameter.

b. Two Hartmann's, with small vertical grindstones, and supplied by weights.

c. Four Siebrecht's, with large horizontal grindstones, and supplied by hydraulic pressure.

II. *Chemical*, generally provided with two boilers:

Ten manufactories constructed on different methods (Sinclair's, Lee's, Fry's, etc.). The boiling is generally done with caustic soda, in weight about 25 per cent. of the wood, besides, the so-called half-chemical method is applied, consisting in boiling or steaming blocks of wood, and then grinding them in the usual manner. Some of the more recent paper manufactories in the country manufacture from such pulp a kind of paper very good for wrappers and sheathings.

Wood Screw. A square-headed screw with a coarse thread for fastening together wooden frames.

Wood screws.	"*Scientific Amer.*," xl. 24.

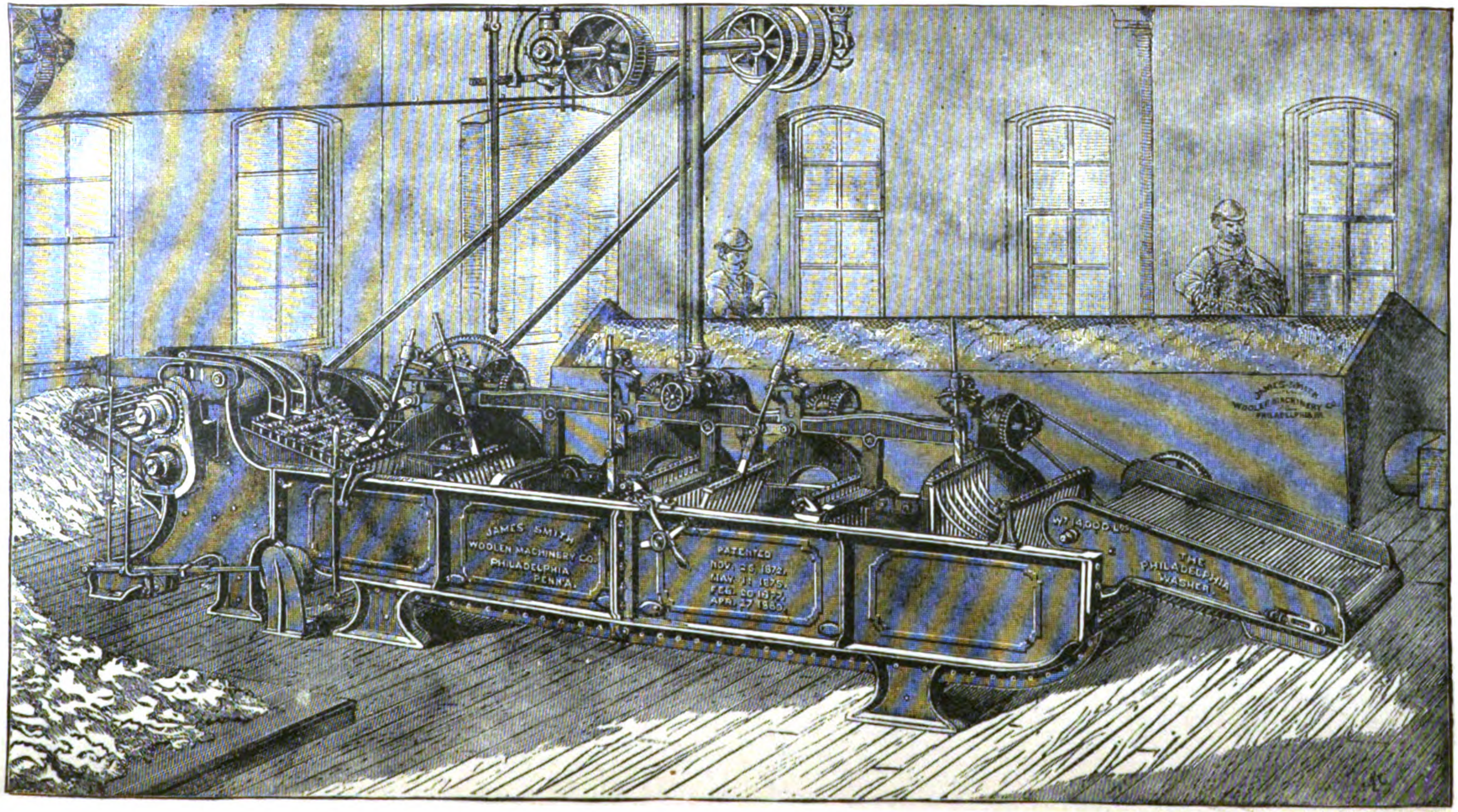


PLATE LVI. WOOL WASHING MACHINE. See page 965.

Wood Stain'ing.

In most cases the staining of wood may be effected so as to produce very bright colors without any previous preparation, as, generally speaking, the mordants employed have a bleaching action on the wood. But in many cases, in consequence of the quality of the wood under treatment, it must be freed from its natural colors by a preliminary bleaching. To this end it is saturated as completely as possible with a clear solution of 17¼ oz. chloride of lime and 2 oz. soda crystals, in 10½ pints of water. In this liquid the wood is steeped for half an hour, if it does not appear to injure its texture. After this bleaching it is immersed in a solution of sulphurous acid, and then washed in pure water. The sulphurous acid which may cling to the wood in spite of washing does not appear to injure it or alter the colors which are applied.

Red. — The wood is plunged first in a solution of 1 oz. of curd soap in 35 fluid oz. of water, or else is rubbed with the solution; then magenta is applied in a state of sufficient dilution to bring out the tone required. All the aniline colors behave very well on wood.

Violet. — The wood is treated in a bath made up with 4¼ oz. olive oil, the same weight of soda ash, and 2½ pints of boiling water, and it is then dyed with magenta, to which a corresponding quantity of tin crystals have been added.

Blue. — Prepare as for violet and dye with aniline blue.

Green. — Mordant the wood with red liquor at 1° B. This is prepared by dissolving separately in water 1 part sugar of lead and 4 parts of alum free from iron; mix the solutions and then add one thirty-second of a part of soda crystals, and let settle over night. The clear liquor is decanted off from the sediment of sulphate of lead and is then diluted with water till it marks 1° B. The wood when mordanted is dyed green with berry liquor and extract of indigo, the relative proportions of which determine the tone of the green.

The wood, mordanted, as above directed, can also be dyed a fine blue with extract of indigo.

Yellow. — Mordant with red liquor and dye with bark liquor and with turmeric.

Besides the aniline colors cochineal gives a very good scarlet red upon wood. Boil 2 oz. of cochineal, previously reduced to a fine powder, in 35 oz. of water for three hours, and apply it to the wood. When dry, give a coating of dilute chloride of tin, to which is added a little tartaric acid, 1 oz. of chloride of tin, and ½ oz. of tartaric acid in 35 fluid oz. of water. If instead of water the cochineal is boiled in a decoction of bark (2 oz. bark to 35 oz. of water), and the chloride of tin is used as above, an intense scarlet, and all shades of orange, may be produced according to the proportions.

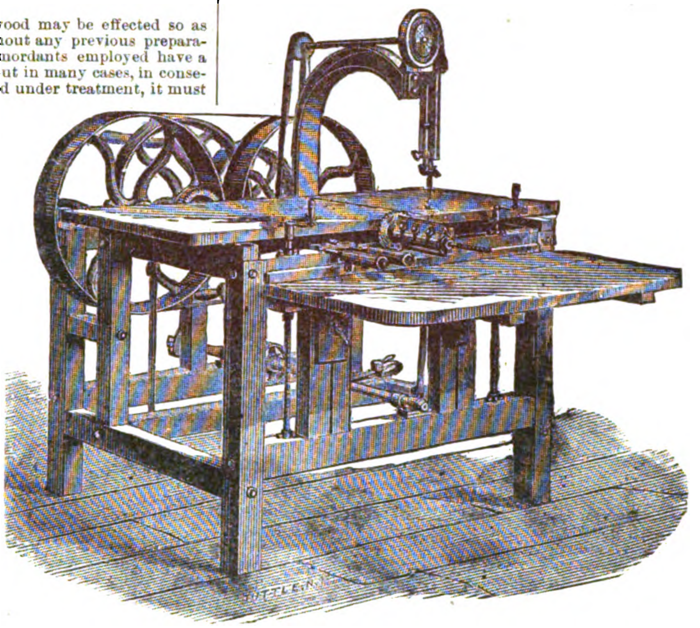
Brown. — Various tones may be produced by mordanting with chromate of potash, and applying then a decoction of fustic, of logwood, or of peachwood.

Gray. — Grays may be produced by boiling 17 oz. orchil paste for half an hour in 7 pints of water. The wood is first treated with this solution, and then, before it is dry, steeped in a beck of nitrate of iron at 1° B. An excess of iron gives a yellowish tone; otherwise a blue-gray is produced which may be completely converted into blue by means of a little potash.

Black. — Boil 8¾ oz. of logwood in 70 oz. of water, add 1 oz. blue stone, and steep the wood for twenty-four hours. Take out, expose to the air for a long time, and then steep for twelve hours in a beck of nitrate of iron at 4° B. If the black is not fine, steep again in logwood liquor.

Wood'work-ing Ma-chine.' The Greenwich Combined Woodworking Machine, Fig. 2542, is a machine for circular and scroll sawing, surface molding, planing, mitering, and boring.

Fig. 2542.



Woodworking Machine.

The scroll saw has a positive motion, and there is a steel bearing at the back of the saw that steadies and keeps it firmly in its place when running, so as to enable those inexperienced in the use of the scroll saw to do true work. Any desired rake can be given to the saw, by turning the hand-screw behind it.

The cutting edges on planing and molding machines should move at a velocity of 6,000′ per minute. Where hard wood exclusively is worked the feed should be one fourth less.

Teeth of circular saws should travel about 9,000′ per minute.

Teeth of band-saws should travel about 4,000 per minute, to obtain the best results.

See English patents of *Sir Samuel Bentham*, 1791 and 1793.

Joseph Bramale, 1802.

Hatton, 1776.

Samuel Miller, 1777.

Molesworth's pamphlet on "*The Conversion of Wood by Machinery*," Proceedings Inst. of C. E., London, 1857.

Prof. Rankin on machine tools.

Prof. Willis's lecture before the Society of Arts, 1852.

Woodworker, variety.	
Fay & Co.	* "*Engineer*," xli. 463.
Fay	* "*Scientific Amer.*," xxxiv. 114.
Woodworker, Universal.	
Fay	* "*Scientific American*," xxxv. 118.
Bentel, Mayedant & Co.	* "*Engineer*," xxi. 409.
Fay	* "*Scientific American*," xxxv. 147.
	* "*Engineer*," xlv. 439.
Fay & Co.	* "*Man. & Builder*," viii. 270.
Wood working machines, Power, *Barnes*, Fr.	* "*Manufact. & Builder*," x. 55.
Wood working machinery, *Woods*	* "*Manufact. & Builder*," ix. 136.
Works, *Rogers*	* "*Scientific American*," xlii. 31.
Wood working machines. French	* "*Scientific Amer.*," xxxvi. 210.

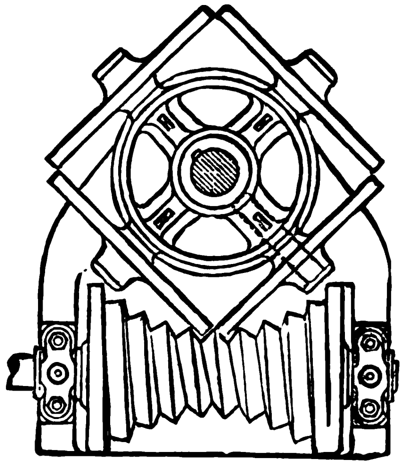
Wool "Ex'tract." Wool recovered from worn mixed fabrics where the cotton has been destroyed by a chemical process. In the year 1865 the amount of *extract* used was 5,000,000 lbs.

Wool Hat Ma-chin'e-ry. See HAT MACHINERY; also the various special machines under the caption HAT, as HAT FULLING MILL; HAT BLOCKING MACHINE, etc., etc.

Wool Wash'er.

Plate LVI. represents "Smith's" wool washer. The ducker is attached to the rake, next to the feed apron, and serves to duck or push down the stock into the liquor. The stock is forced under by the curved lines, as it drops from

Fig. 2543.



Worm Gearing.

the feed apron, and it is carried at once to the bottom of the bowl. A valve outlet is so arranged that the stock cannot wind about the valve levers.

Steam has access to the water through numerous small holes pierced through a pipe extending lengthwise of the machine, under the false bottom, thus distributing the heat. The water is supplied through a chamber in the side of the bowl, obviating any splash in filling it. A double-acting carrier takes the stock up and delivers it to the press rolls. The carrier has teeth, the rear rank of which are nearly as long as those of the stirrer fork. On its forward movement the carrier engages with the stock and takes it up over the face of the chute.

The cone pulley on the main driving mechanism is driven from a like cone pulley on the counter shaft.

Wootz. The genuine Wootz steel comes from India in three forms, namely, in bullet-shaped pieces of a certain weight as they cool in the pots, and which comes from Calcutta; in cakes of 2½ lbs. from Bombay; and in cylindrical rods of about the same weight from Golconda. See "*Mech. Dict.*," pp. 2364, 2818.

Work'er. (*Leather.*) A two-handled blunt knife curved to suit the inclined face of the beam, and used to scrape the hides.

Work'ing Glove.

Ordinary gloves used in husking corn and doing other similar kinds of work, wear out first upon the tips of the fingers and thumb, and upon the ball of the thumb. To obviate the unequal wear, and to render the glove more serviceable, a glove has been devised the body of which is of the ordinary form and materials, and to its inner or palm side are attached pieces of cloth upon which, in places subjected to the greatest wear, there are surfaces that are covered with a protecting coating of sand and rubber. Instead of applying the protective coating to the cloth in this manner, it may be applied directly to the face of the glove.

The rubber coating protects the glove and renders it waterproof at the points to which it is applied, and the sand assists materially in removing the husks from corn; it also renders the glove more effective in grasping objects of any description.

Worm Gear'ing. Hawkin's gearing, Fig. 2543, is a new modification of worm gearing.

It has an arrangement for transmitting circular motion in either direction. It is a plan in which the spiral worm is made of such a length that the edge of one roller does not cease contact until the edge of the next comes into contact; a wheel carries four rollers which turn on studs, the latter being secured by cottars; the axis of the worm is at right angles with that of the wheel. The edges of the rollers come near together, leaving sufficient space for the thread of the worm to fit between any two contiguous rollers. The pitch line of the screw thread forms an arc of a circle, whose center coincides with that of the wheel, therefore the thread will always bear fairly against the rollers and maintain rolling contact therewith during the whole of the time each roller is in gear, and by turning the screw in either direction the wheel will rotate.

Worm'ing. (*Nautical.*) Laying of yarn in the cant of a rope to bring it to a rounder surface before *parceling* or *serving*, which see.

Worm'-thread Tool'-gage. A gage that furnishes a correct guide of form for tools used in turning the threads of worms, when the worm wheels have been cut to correspond. The figures on the gage represent the number of threads per inch of the worm. The slots in the gage are also of the proper depth for their respective threads.

Wor'sted. (*Fabric.*) From Worsted, in Norfolk, England. The wool-workers of that place adopted a comb in carding and a harder twist in spinning, which gave the name to its products.

Wound Ex-plor'er. (*Surgical.*) An electric sound used in searching for bullets.

The electric wound explorer of M. Trouvé, of Paris, was presented to the Academy of France in 1867.

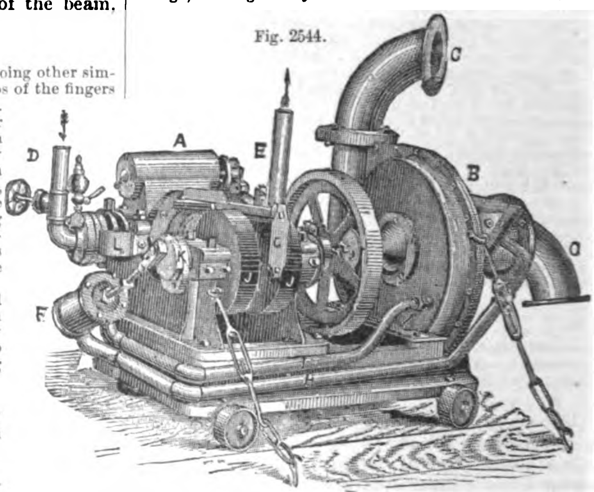
Wo'ven Wire Belt'ing. Woven steel wire belting is claimed to transmit power well, to operate without lengthening, and to run smoothly because there is no overlapping at any place. The spirals of wire are woven across the belting, so that three, four, or more spirals form one link. The space between two links is, besides, filled up with a cross-piece, so that the closely woven netting of spiral wire forms a band of great strength and flexibility. It is faced and lined with rubber or leather.

Wreck'ing Pump.

The "Heald" steam pump, Fig. 2544, is for use in pumping out wrecked vessels. It is actuated by an oscillating engine of short stroke. The rolling valve within the valve-chamber on the cylinder is worked by an eccentric from the engine-shaft. The guides for relieving the strain on the piston-rod project from the head of the cylinder, and are partially concealed by the counter balance-wheels. There is a force-pump used for priming the main pump through the pipes.

It is operated by friction-wheels, connected or disconnected by a lever. There are swiveled elbows for suction and discharge, turning in any direction and detachable. There is a

Fig. 2544.



Wrecking Pump.

device in the cross-head of the guides for taking up the slack occasioned by wear of the parts. There is also a bale, with tubular trunnions, in conjunction therewith for securing a better connection of the steam-pipes with the engine.

Wrench. A lever having jaws at one end adapted to catch around the head of a bolt, or around a nut to loosen or tighten the nut on the bolt.

One jaw is often made adjustable. The "Alligator" has ratchet teeth cut diagonally across one jaw, thus enabling it to bite with three teeth at once. A single wrench will hold many sizes of nuts or bolts.

Robinson's crank-wrench and bit-brace is a combination of the wrench, crank, and brace. It is intended in its crank movement to provide a wrench that will not require to be readjusted at each half-turn; a rotary wrench that turns without removal till the nut is advanced to its place.

As a brace it is clamped to the bit by the set-screw that drives the movable jaw and holds the same. As a vise it is inverted and secured to the bench by a clamp.

The "Baxter" wrench has adjustable sliding jaws that are connected by a set screw that contracts them to their embrace.

The "Rogers" wrench is an elongated ring bar device, diverging to a larger capacity at one end so as to hold nuts of all sizes. A bevel rigidifying sleeve that clamps to the square of the nut, holds it while being operated on.

Wrench, *Squire*	* "*Scientific American*," xxxv. 51.
Port	* "*Scientific Amer.*," xxxiv. 131.
Bedell	* "*Scientific Amer.*," xxxiv. 182*
Bemis & Call	* "*Iron Age*," xxi., June 27, p. 11.
Rouse	* "*Iron Age*," xxiii., June 26, p. 9.
Phillips	* "*Scientific Amer.*," xxxix. 8.
Automatic, *Birch*	* "*Scientific American*," xli. 278.
Monkey, *Johnson & Co.*	* "*Iron Age*," xxi., March 28, p. 11.
Screw, *Coes*	* "*Iron Age*," xxi., May 2, p. 25.

Wrench Han'dle. A double-arm wrench for use with dies for cutting threads, and other purposes.

Wri'ting. For restoring faded writing. Brush it over with a solution of ammonium sulphide.

M. Von Bibra, in the "*Journal de Chimie*," describes a method of restoring the writing of old manuscripts and the colors of oil paintings which have faded or become discolored by age. For the manuscripts, the writing is treated with recently prepared ammonium sulphide, and in the course of a few moments the characters become distinctly visible. Any excess of the reagent must be removed by washing in cold water, and the manuscript is then dried, either by gentle heat or by means of blotting-paper. Should the characters fade again after this treatment, they should be submitted to the action of a solution of tannin. As it is only in far distant times that carbon writing fluids were used, and as nearly all the more recent manuscripts have been written in gallate ink, it may be said that M. Von Bibra's method can be employed with any writings. For the oil paintings, after having dusted them with a wash leather, they are washed with a sponge and fresh water; they are then covered with a solution of soap (the author recommends shaving-soap, probably that which is known in France as *crême de savon*), which is wiped off with a brush after the lapse of from eight to ten minutes, and when the soap has been completely removed the painting is allowed to dry. It is then rubbed with a soft linen cloth soaked in nitro-benzine, which restores the luster. Lastly, a little olive oil is passed over it, and it is varnished with a white varnish.

Wri'ting Tel'e-graph. Cowper's writing telegraph, unlike previous autographic systems, does not depend upon electro-chemical decomposition. A pencil is moved at the sending station, and at the receiving station a pen charged with ink describes the same movements.

The sending apparatus consists of a pencil under which a continuous band of paper is drawn by clockwork. Attached to the pencil are two light rods placed at right angles to one another. When the pencil is moved, the curves made in forming the various letters cause the ends of these rods to make a series of lateral and longitudinal movements. These ends of the rod pass over the ends of a bundle of brass plates, connected each with a resistance coil, so that their movements over them transmit to the distant station currents of varying intensity. These are utilized at the receiving station in the following manner: There are two strongly magnetized needles on delicate bearings, forming movable cores in coils, which are placed between the poles of four permanent magnets. These magnetized needles are also placed at right angles to one another. Fastened to the point of each is a thread, and these two threads cross one another and are knotted together at the point of intersection. At this central point they carry a tiny pen, consisting of a glass hair-like tube of syphon form, its upper end dipping into a little cistern of limpid analine ink. A traveling slip of paper passes slowly beneath this pen, and as it moves a straight line of ink is drawn upon it. But directly the operator at the sending station begins to write with his pencil, the varying currents thus caused, in the manner indicated, impart varying degrees of strength to the magnets surrounding the needles. The needles are consequently endowed with movements of greater or less amplitude. The crossed threads are pulled by the moving needles, and the curves of the written letters are reproduced by their combined action. By this machine the question of sending autographic messages, so important in many government and commercial affairs, has been solved in a simple and ingenious manner.

X.

Xan'the-ine. (*Chemical.*) A yellow substance soluble in water, which forms the coloring matter of some yellow flowers.

Xan'thi-an. A kind of marble found near Xanthus in Asia Minor.

Xan'thid. (*Chemical.*) A supposed compound of xanthogen with some basifiable or acidifiable element.

Xan'thite. A mineral occurring in rounded grains and foliated masses, of a yellow color, and translucent, consisting chiefly of silica, alumina, lime, oxide of iron, oxide of manganese, and magnesia.

Xan'tho-core. A mineral of a dull red or brownish color, consisting chiefly of sulphur, arsenic, and silver.

Xan'tho-rite. A variety of allanite, of a yellowish color, and containing much water.

Xe'bec. (*Nautical.*) A small three masted vessel used in the Mediteranean Sea. With a fair wind in good weather, it carries two large square sails; when close hauled it carries large lateen sails.

Xy-lan'thrax. Wood-coal, or charcoal. So called in contradistinction from mineral coal.

Xy'lite. (*Mineral.*) A mineral resembling xylotile, of a brown color and asbestiform structure, and consisting chiefly of silica, sesquioxide of iron, lime, magnesia, and water.

Xy'lo-phone. An instrument to determine the vibrative properties of woods and metals.

M. Decharme experimented a short time ago on the musical sounds given by metallic bars of different metals having the same dimensions. He has made similar experiments on different kinds of wood. Notwithstanding the diversity of the kinds of wood examined (38 species and 14 varieties) they were all found to give sounds comprised in the interval of an octave. The most grave sound is mi_4, given by box; the highest mi_5 given by Northern fir. M. Decharme gives a list of the sounds emitted by different woods between the two extremes. The range of sounds from the metals extended from 690 vibrations for lead to 2,762 vibrations for aluminum. Sounds from wood are comprised between those for brass, 1,303.62, and aluminum, 2,762. This is no doubt partly accounted for by the much less range of densities in woods than in metals. Still there are anomalies. Thus, the willow, which, after the poplar and certain firs, was the lightest of the woods experimented on, gives the same note (sol_4) as ebony, which is the heaviest after the tea and the palisander. It was difficult to appreciate the intensity and the duration of the sounds, but palisander, logwood, walnut, and acacia were in the front rank in this respect. (The durations of the sounds did not exceed the fraction of a second 0.5 to 0.7, for the most sonorous palisander.) Northern fir and poplar had the clearest timber.

Y.

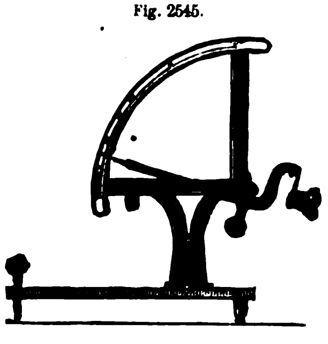
Y. Or fork, for holding boring bars by the square. See also CLAMP.

A branching pipe having a bifurcation like the letter Y. See BRANCH.

One of the forked pieces that support the pivots of a transit instrument, of the telescope, or the theodolite, etc.

Yarn As-sort'er. Fig. 2545 represents an apparatus for the assortment and graduation of yarns.

Fig. 2545.



Yarn Assorter.

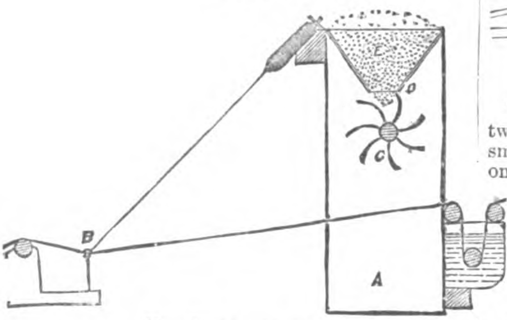
A skein is placed in the cup suspended from the rear arm of the pointer, when the number is immediately indicated on the graduated scale.

Yarn Flock'ing Ma-chine'. *Le Jacquard* gives a description of an apparatus which, though crude, is intended to produce a new effect in the appearance of certain yarns for fancy goods.

The yarn to be manipulated, according to this plan, is passed through the apparatus before being doubled. One thread passes direct from a cop or bobbin, and the other through a trough containing water or a thin solution of size. The latter is then carried through a box, provided at its upper end with a hopper filled with particles of colored wool, broken fiber from rag-ends, feathers, or any desirable substances, which are allowed to fall through an opening at the bottom of the hopper, and upon a revolving fan-wheel which pulls it out and disperses it, throwing it upon the thread passing through the lower part of the box.

In a modification of this arrangement a traveling apron

Fig. 2546.



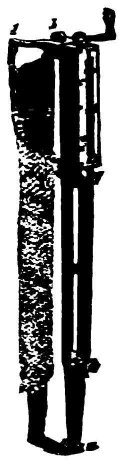
Yarn Flocking Machine.

runs under the threads, and carries any superfluous flocks or feathers back into the hopper. In this manner any foreign substance may be evenly or intermittently twisted into the yarn.

Yarn Print'ing Ma-chine'. A machine for printing warps for tapestry carpets. Short's patent, No. 168,932, Oct. 19, 1875. See TAPESTRY CARPET; CARPET LOOM.

Yarn Test'er. An instrument for testing the strength of yarn. See Fig. 2547.

Fig. 2547.



Yarn Tester.

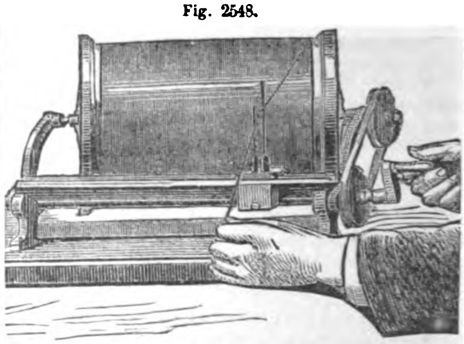
Fasten the foot *a* to the floor, and the legs *d b* to the wall, thus holding the machine firmly in a perpendicular position. Then with a yarn rest, wind from cop or bobbin one knot (or one seventh of a hank or skein) which equals 120 yards. Carefully remove the knot from the reel and place it upon the pins opposite, *g* and *h*: then turn the crank *i* to the right until the yarn breaks. The index point *d* will then show the amount of stretch in inches and eighths, and the upper index *c* will also give the exact breaking weight in pounds avoirdupois.

The machine, shown in Fig. 2548, has for its object the exposure of all unevenness in yarn.

It consists of a black board turned by a strap and pulley from a handle, which latter also revolves a screw, upon which slides a prong-shaped guide for directing the yarn as it comes from the cop, bobbin, or hank. By the revolution of this screw the yarn is wound properly spaced upon the black board, and any unevenness may thus be readily detected, as well as all impurities in the same.

The principle of testing the evenness of the yarn against black boards is not unknown to yarn agents and shippers, but this little apparatus seems to be very handy, and to have the advantage that these boards, with the yarn, may be put aside for ready reference when required.

Fig. 2548.



Yarn Tester.

Yarn Wash'ing Rol'lers. A machine with two cast-iron rollers turned perfectly true and smooth, working on wrought-iron spindles, carried on two cast-iron standards. The pressure is obtained by compound levers and with movable weights, so as to vary the pressure as desired. All the bearings are of gun metal and bored.

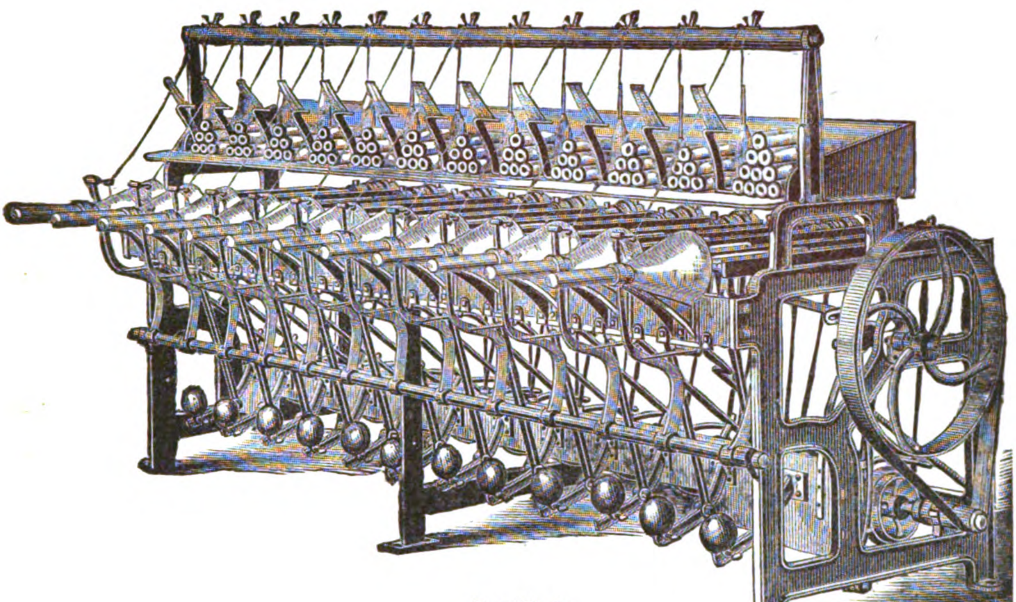
These machines are also fitted up for steam power, with stopping and starting gear.

Yarn Wind'er. Fig. 2549 is Campbell & Clutes' yarn winder for spinning machines.

The yarn is condensed as it is wound on the cone of each bobbin by a glass faced cop-former which leaves the yarn smooth and perfect.

Each sliding bobbin spindle is supported by a sliding journal-box which is at all times close or adjacent to the

Fig. 2549.



Yarn Winder.

base of a bobbin on the spindle so as to prevent the bobbin from shaking and beating upon the cop-former.

Each sliding journal box, with the bobbin spindle and bobbin thereon, is pressed toward the cop former with an adjustable yielding force, by means of a weighted lever having the weight adjustable, so that any desired degree of condensation and solidity can be given to the yarn wound on the bobbin by simply setting the weight to a given point on the lever.

Y Branch. A branch with a divergent stem.

Y Cross. A pipe with two divergent stems.

Yoke. Twin hot and cold water pipes that unite in their discharge, and which have stop cocks that regulate the temperature of the supply.

(*Wheelwright.*) The over-lap tire bolt washer, used at the joints of the felloes.

The arch on which the bell hangs and on whose pivots it swings.

Yt'tri-a. (*Chemical.*) A fine white powder or earth without taste or smell, insoluble in water, and having no effect on vegetable blues. It is supposed to consist of the protoxide of yttrium.

It was discovered by Professor Gadolin in 1794.

Yt'tri-um. A very rare metal discovered in 1828 by Woehler. Its texture is scaly, its color grayish black, and its luster perfectly metallic.

Yt'tro-ce'rite. (*Min.*) A mineral of a violet blue color inclined to gray and white, occurring very sparingly at Finbo and Brodbo, near Fahlun, embedded in quartz. It consists of lime, sexquioxide of cerium, yttria, and hydrofluoric acid.

Yt'tro-tan'ta-lite. (*Min.*) Columbium and yttrium, found in Sweden. It is found of yellow, brown, and black colors.

Z.

Zaf'fer. (*Glass.*) Fr. *zafre, zaffer, saffre;* Sp. *zafore;* It. *zaffera;* Ger. *zaffer.* Impure oxide of cobalt; residuum of treatment of cobalt after impurities are driven off by calcination. Used as blue color in glass-making.

Z Crank. A form of crank especially adapted to use where the minimum of space is one of the most important items of consideration.

The result is a very compact engine of long stroke, the height of the engine being little more than the diameter of the cylinders. In small launches the engine is placed under the smoke-box end of the boiler (locomotive), so that only the space necessary for the latter is required, the engine being in otherwise unused space, and its weight brought to the lowest position possible.

Zinc Dec'o-ra-ting. A chemical process for covering zinc with colored coatings has lately been described by Dr. L. Stille.

The articles of zinc are first brightened by scouring with quartz sand, moistened with dilute muriatic acid, putting them quickly in water and then carefully wiping them dry with white blotting paper. To insure success, however, it is necessary to employ zinc as free as possible from lead, and to have it as bright as a mirror. When these conditions are fulfilled the metal may be coated with a variety of beautiful colors by immersion in a solution of alkaline tartrate of copper for a shorter or longer interval of time, depending on the color that is desired.

Zin'cite. A brittle translucent mineral of a deep red color, sometimes inclining to yellowish, consisting chiefly of oxide of zinc, but containing also a small quantity of oxide of manganese.

Called also red zinc ore and red oxide of zinc.

Zinc Coat'ing. On brass or copper.

The following simple process is recommended by Bottger: Boil a large excess of so-called zinc dust some time, with a concentrated solution of caustic soda, or potash, and place the copper or brass articles to be coated in the boiling liquid. By continuing the heating, after a few minutes a beautiful, mirror-like film of zinc will form upon them by the decomposition of the alkaline solution, in consequence of their electro-negative character in combination with the zinc. It is suggested that the process is applicable to the preparation of disks for dry-piles, and also for forming a layer of tombac, by heating a copper article thus coated, carefully, to about 248° to 284° (best under olive oil), when the zinc will unite with the copper support to form a gold-tinted tombac, and the article need only be quickly cooled in water, or some other suitable liquid, as soon as the desired color is apparent.

Zinc Me'thyl. A volatile liquid consisting of two equivalents of carbon, three of hydrogen, and one of zinc. It takes fire spontaneously on exposure to the atmosphere. Its vapors are very poisonous.

Zin'co-graph'ic Cop'y-ing Pro'cess. In the Belgian "*Bulletin du Musée,*" M. Hannot describes the following new autographic process: —

The writing or drawing is made upon any kind of paper, which should, however, not be very thick. A special ink is used, composed of gum arabic or gelatine ¾ oz., water saturated with bichromate of potash, 1 quart, and sufficient India ink to color the whole. The gum is first dissolved in the solution and the ink afterwards added. The preparation must be kept sheltered from the light, and when used a portion should be poured out in an inkstand of black glass. When the drawing is finished it is exposed to light, whereby the lines are rendered insoluble.

A plate of zinc or a stone is then prepared and polished with emery, and the drawing is placed upon it face downward. Above the latter is laid a sheet of paper covered with gum arabic, and above this two or three sheets of dampened blotting paper. The whole is then pressed. The moisture in the blotting paper reaches the gummed paper, and the gum, dissolved, traverses the autographic paper and affects the zinc or stone everywhere except where the insoluble lines of the design have prevented its passage. A roller of greasy ink may then be passed over the plate, and the grease will adhere only to the lines which are not covered with moisture. Printing is then done in the usual way.

Zin-cog'ra-phy. Engraving on zinc in the style of wood-cuts, as also in the use of the lithographic stone, and taking impressions therefrom.

In a paper lately read before the London Society of Arts, by Mr. Thos. Bolas, F. C. S., the following simple process in zincography is described: Zincography, he said, is similar to lithography, except that a zinc plate is employed in the place of the lithographic stone. The so-called transfer paper is merely a moderately fine paper which has been brushed over, on one side, with a mucilaginous mixture, prepared by boiling together the following: Water, 1,0 0 parts; starch, 100 parts; gamboge, 6 parts; glue, 1 part. This part is written upon with the ordinary commercial lithographic writing ink, which has been rubbed up with water like an artist's water-color. The writing being dry, it is necessary to moisten somewhat the back of the transfer by means of a damp sponge; after which it is laid face downward on a sheet of ordinary roofing zinc, which has been previously cleaned by means of emery cloth. Both being now passed together under the roller of a small press, the transfer adheres to the metal plate; but on damping the back of the paper it becomes easily removable, leaving the writing on the zinc. The face of the zinc plate is now gently rubbed over with mucilage of gum arabic, which is all the better for being slightly sour, and the excess of gum having been sponged off, an india-rubber inking roller, charged with ordinary printer's ink, is passed over the still damp zinc plate a few times. The ink takes only on the lines of the transferred writing, and it is now merely necessary to lay a sheet of white paper on the plate and to pass both through the press to obtain an impression, — an exact reproduction of the original writing.

Any number of copies can be printed by repeating the operations of damping and inking. The zincographic process, thus simplified, is rapid, economical, and within the reach of every one.

Malepeyre. "*Technologiste,*" xxxviii. 26.

Zinc Col'or-ing.

The "*Technologiste*" gives the following process for permanently coloring zinc. The metal must be quite pure, as must also the materials of which the following bath is composed: Tartrate de cuivre, 30 grains; potasse caustique, 40 grains; eau distillée, 400 grains. After being submitted for two minutes to the action of this bath, the zinc takes a violet tint; after three minutes' immersion it becomes a deep blue; in four and a half minutes, green; in six and a half minutes, purple.

The "*Metallarbeiter*" gives the following recipe for giving bright colors to zinc: The objects to be colored are first thoroughly brightened by rubbing with sand and moistening with hydrochloric acid, which is rapidly washed off with water. In order to be successful it is necessary to use zinc free from lead. The colors are produced according to necessity by dipping the object for a certain varying length of time in a solution of tartrate of copper and alkali.

Zinc Pla'ting.

As nickelizing is replacing silvering in some cases, so there are some where nickelizing may be itself replaced for many articles of small value, such as pins, particularly if they contain copper. The manipulation is very simple. Coarse rasped or granulated zinc is boiled for some time in a mixture of three parts by weight of sal-ammoniac and ten of water; the objects are immersed and stirred with a zinc rod. The deposit is silvery bright, and resists mechanical action as well as a coating of nickel. The process can be recommended for goods which are meant for a second coating of some other metal, since any other is easily deposited upon zinc.

Zinc Pow'der.

A powder which is now considerably used in the arts, is said to be composed of zinc, 40 parts; lead, 2.5; cadmium, 4; zinc oxide, 50; zinc carbonate, 2.5, with some traces of non-metallic dust. As a part of the cargo of vessels it is extremely dangerous and ought never to be stowed where it cannot be readily removed. When it is slightly moistened with water it becomes spontaneously inflammable.

Zo'o-gy'ro-scope. A modification and amplification of the zoötrope, in which a series of succeeding instantaneous photographs of an animal (a horse, for instance) in motion are placed on a circular rotating glass, the photographs being alternately illuminated by an oxyhydrogen lantern as the glass turns, throwing a single continuous, yet ever changing, picture upon the screen.

While the separate photographs had shown the successive positions of a trotting or running horse, in making a single stride, the zoögyroscope apparently throws upon the screen the living, moving animal.